



Of apples and oranges

by Andrea Saltelli
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KEI Workshop on
Composite Indicators:
Theory, Methodology and Applications
Leuven, 5 - 6 September 2006



Outline:

- What qualifies as a composite indicator (CI)?
- CI's controversy
- Can good practices help ?
- CI's and narratives

From: Saltelli, A. Composite indicators between analysis and advocacy, To appear on *Social Indicators Research*, Accepted March 2006



- What qualifies as a composite indicator



From the OECD Glossary of statistical terms

- Definition:

- A composite indicator is formed when individual indicators are compiled into a single index, on the basis of an underlying model of the multi-dimensional concept that is being measured.

- Context:

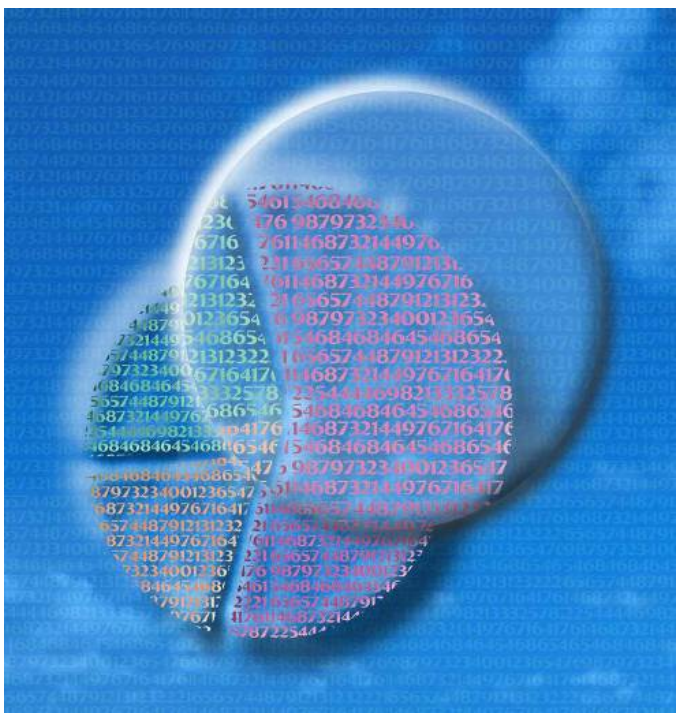
- A composite indicator measures multi-dimensional concepts (e.g. competitiveness, e-trade or environmental quality) which cannot be captured by a single indicator. Ideally, a composite indicator should be based on a theoretical framework / definition, which allows individual indicators / variables to be selected, combined and weighted in a manner which reflects the dimensions or structure of the phenomena being measured.

- Source Publication:

- OECD, 2004, "The OECD-JRC Handbook on Practices for Developing Composite Indicators", paper presented at the OECD Committee on Statistics, 7-8 June 2004, OECD, Paris.

A search for "Composite Indicators":

	Google	Scholar google
October 2005	35,500	992
June 2006	80,800	1,440
August 2006	96,800	1,540



Google's first hit is
<http://farmweb.jrc.cec.eu.int/CI/>



The EC develops or uses several composite indices

- Of Internal Market (†)
- Of Innovation
- Of knowledge based economy
- Of firm readiness to take up e-business (e-readiness)

... Not mentioning the historic ones as GDP, CPI, ...



A list of new "structural indicators" to be developed by the EC (Information Note to the College of EFIN October 2005) includes:

1. Price convergence between EU Members States
2. Healthy Life Years
3. Biodiversity
4. Urban population exposure to air pollution by ozone and
5. Urban population exposure to air pollution by particles (PM10)
6. Consumption of toxic chemicals
7. Generation of hazardous waste
8. Recycling rate of selected materials
9. Resource productivity
10. E-business indicator

Can you guess how many of these are composite?



ALL OF THEM. (One is a ratio of composites)

1. Price convergence between EU Members States
2. Healthy Life Years
3. Biodiversity
4. Urban population exposure to air pollution by ozone and
5. Urban population exposure to air pollution by particles (PM10)
6. Consumption of toxic chemicals
7. Generation of hazardous waste
8. Recycling rate of selected materials
9. Resource productivity: **The definition of this indicator has now been established as the ratio of Gross Domestic Product (GDP, at constant prices) over Domestic Material Consumption (DMC).**
10. E-business indicator



... and yet CI's can be so different from one another that one wonders how they can be grouped under a single heading without adding oranges and pears!





At one extreme, a composite indicator can be a quick and dirty aggregation of a battery of indicators loosely connected by a common heading:

- No Theory

- Hardly accepted by any

- Used as a summary of a set of variables

Using Jesinghaus' dashboard software, we have already collected about one-hundred of such 'tentative' CI's ...

At the other extreme a CI may come with a full theoretical background and purport to have a "natural" scale for aggregation (e.g. GDP or CPI):

- Full theory

- Accepted by most

- Used at face value





At one extreme, an index can be driven by academic desire to uncover non-evident dimensions. It is built by practitioners and addressed to their peers (example: index of consumer goods regulation).

At the other extreme a CI may be advocacy-driven, to attract attention to the cause espoused by proponents. It is built by NGO's, stakeholders and aims to capture the headlines (example: environmental sustainability index).





In its impact on society, an index may just ruffle feathers and modify expectation, without automated implications for policy or agents behaviour (example: WEF Global Competitiveness index).

At the other extreme, an index may determine rapid and automated reactions among actors (Example: Moody's or Fitch rating)





We have already mentioned that an index may be supported by a sophisticated theoretical model and/or a 'natural' aggregation metric (example: GDP but greenhouse gas emission index as well, where atmospheric chemistry provide a theory for aggregation).

Increasing the scale of sophistication we may have country rankings produced using non compensatory metrics (e.g. from multicriteria analysis).

At the other extreme an index may both lack a natural scale of measurements (such as dollars or CO_2 equivalents) as well as any consideration of compensation or trade off.





... and yet regardless of their degree of sophistication CI use is controversial.

- Composite indicators' controversy



<< [...] it is hard to imagine that debate on the use of composite indicators will ever be settled [...] official statisticians may tend to resent composite indicators, whereby a lot of *work in data collection and editing is “wasted” or “hidden” behind a single number of dubious significance*. On the other hand, the *temptation* of stakeholders and practitioners to summarise complex and sometime elusive processes (e.g. sustainability, single market policy, etc.) into a single figure to benchmark country performance *for policy consumption* seems likewise irresistible. >>

Saisana M., Saltelli A., Tarantola S. (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.



Michaela Saisana



Stefano Tarantola

Unclassified

STD/DOC(2005)3

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

09-Aug-2005

English - Or. English

STATISTICS DIRECTORATE

STD/DOC(2005)3
Unclassified

HANDBOOK ON CONSTRUCTING COMPOSITE INDICATORS: METHODOLOGY AND USER GUIDE

OECD Statistics Working Paper

**by Michela Nardo, Michaela Saisana, Andrea Saltelli and Stefano Tarantola (EC/JRC)
Anders Hoffman and Enrico Giovannini (OECD)**

See (<http://www.oecd.org/publications/>)



On the OECD-JRC handbook on CI the 'pros'

Composite indicators:

- Can summarise complex or multi-dimensional issues in view of supporting decision-makers.
- Easier to interpret than trying to find a trend in many separate indicators.
- Facilitate the task of ranking countries on complex issues in a benchmarking exercise.



On the OECD-JRC handbook on CI the 'pros'

Composite indicators:

- Can assess progress of countries over time on complex issues.
- Reduce the size of a set of indicators or include more information within the existing size limit.
- Place issues of country performance and progress at the centre of the policy arena. (Advocacy)
- Facilitate communication with general public (i.e. citizens, media, etc.) and promote accountability. (Advocacy)



... while composite indicators' 'cons' are:

- May send misleading policy messages if they are poorly constructed or misinterpreted.
- May invite simplistic policy conclusions.
- May be misused, e.g., to support a desired policy, if the construction process is not transparent and lacks sound statistical or conceptual principles.



... and (cons):

- The selection of indicators and weights could be the target of political challenge. (a CI could exacerbate disagreement rather than focus minds)
- May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.
- May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action. (the problem of compensability^[*])

[*] G. Munda. Multiple Criteria Decision Analysis and Sustainable Development. In J. Figueira, S. Greco, and M. Ehrgott, editors, Multiple Criteria Decision Analysis: State of the Art Surveys, pages 953-988. Springer Verlag, Boston, Dordrecht, London, 2005.



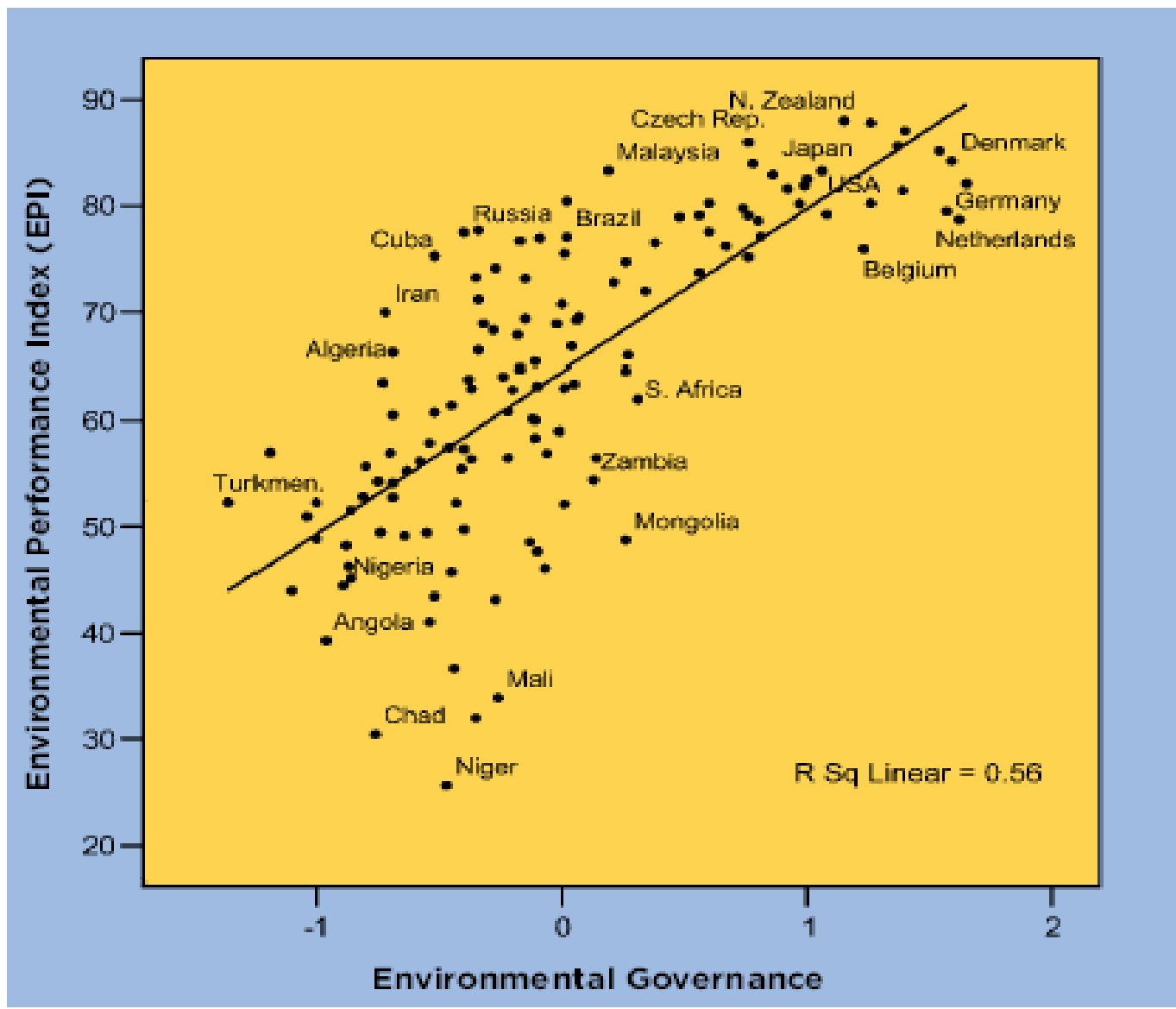
... two more 'pros' not in the handbook:

- Constructing/underpinning narratives for lay or literate audiences. (later in this talk)



... and
• Comparing effectively complex dimensions with one another.

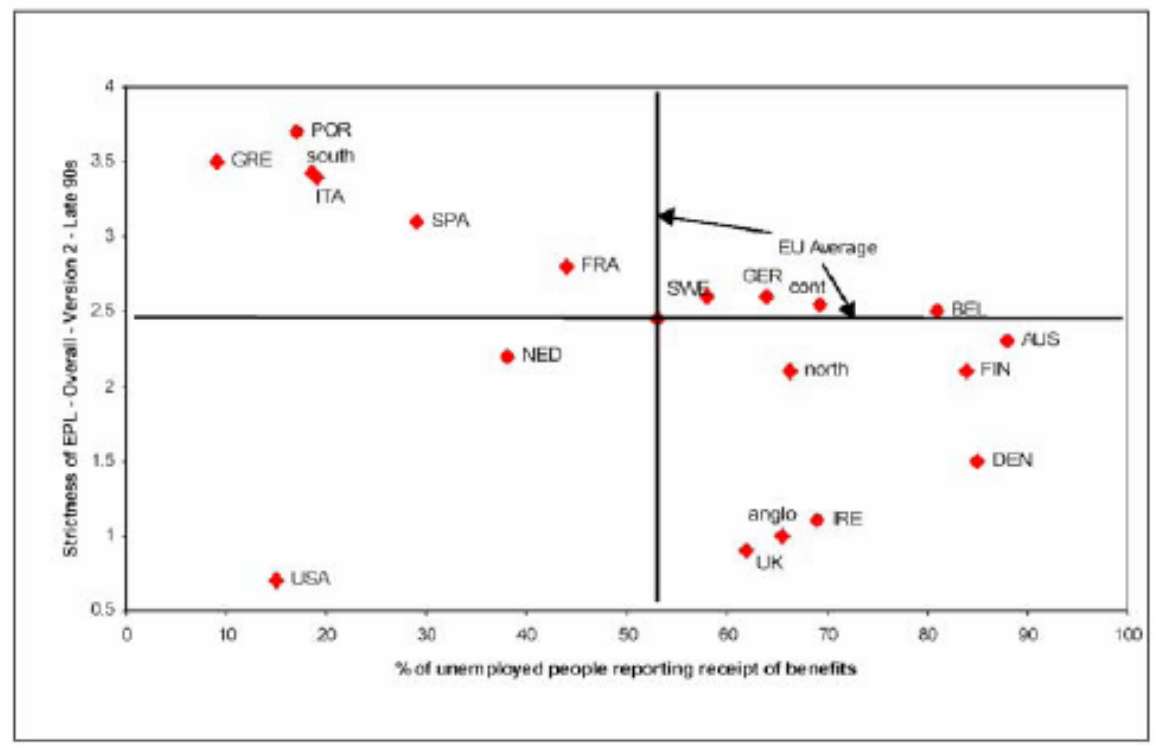
Good environmental results correlate significantly with good governance.





- Comparing effectively complex dimensions with other variables. Andre' Sapir's work (*Globalisation and the Reform of European Social Models, 2005*). Strictness of employment legislation versus % of unemployed people reporting benefits.

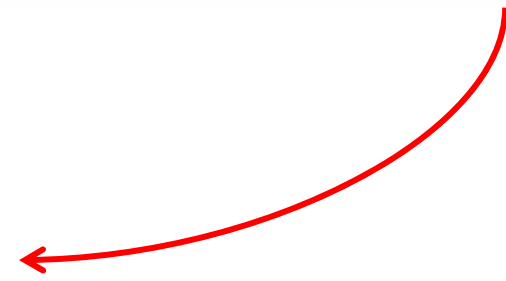
Figure 2
 The Employment Protection Legislation/Unemployment Benefits Trade-off



Source: Boeri (2002)

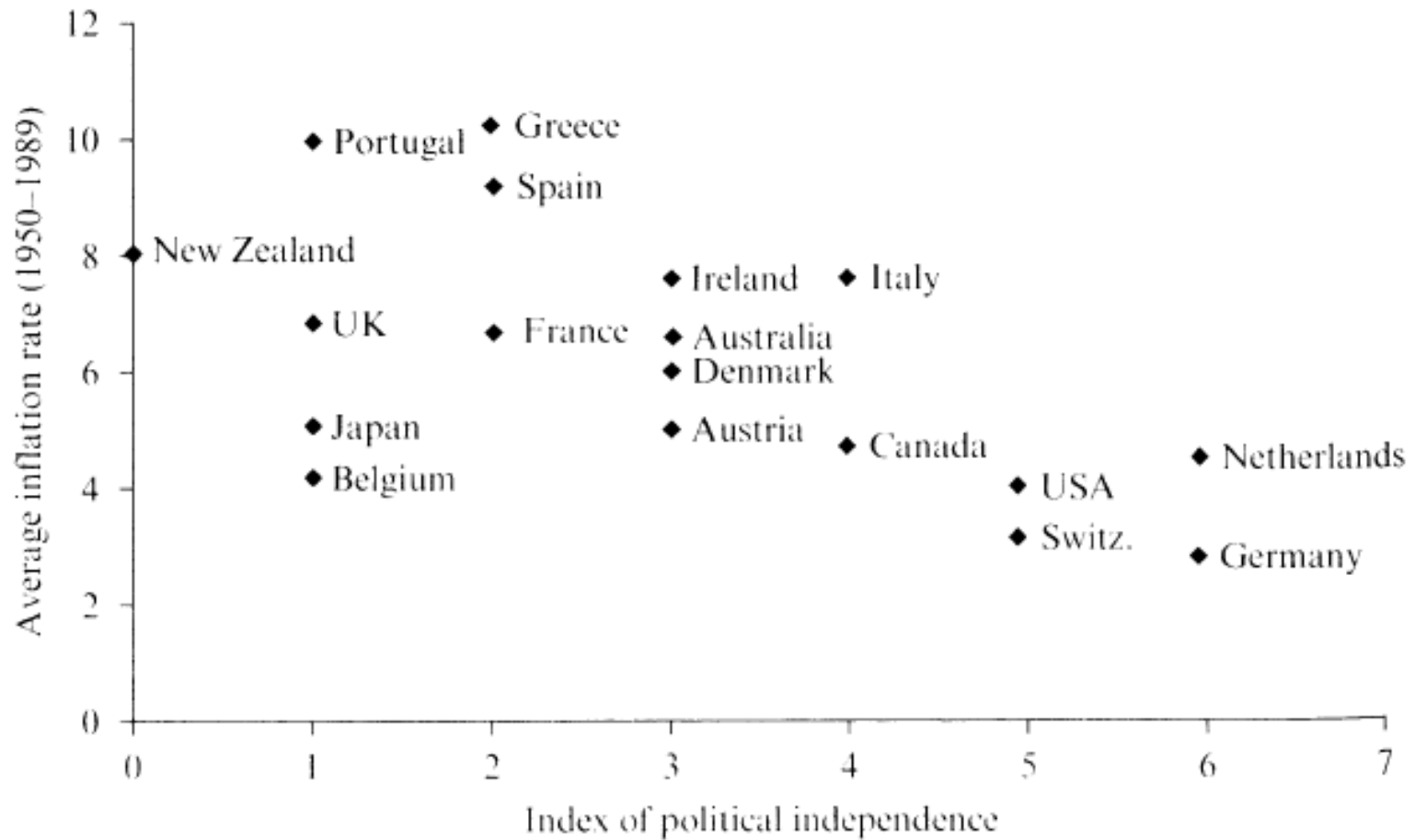
Table 1
 The Four European Models: A Typology

		EFFICIENCY	
		Low	High
EQUITY	High	Continental	Nordic
	Low	Mediterranean	Anglo-Saxon





- Comparing effectively complex dimensions with other variables. *Average inflation rate versus index of Central Banks' independence, from Economics and Politics of an Enlarged Europe, by Carlo Altomonte and Mario Nava.*



Source: Author's elaboration on the basis of data contained in V. Grilli, D. Masciandaro and G. Tabellini (1991) 'Political and monetary institutions and public financial policies in the industrial countries', *Economic Policy*, October, 341-92.

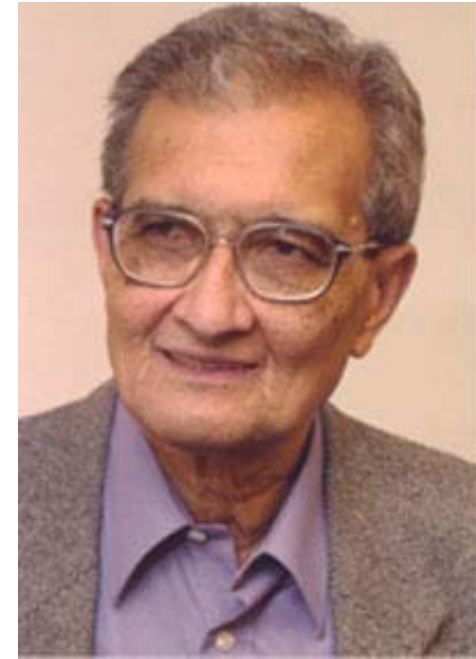


<<Composite indicators are much like mathematical or computational models. As such, their construction owes more to the craftsmanship of the modeller than to universally accepted scientific rules for encoding. As for models, the justification for a composite indicator lays in its fitness to the intended purpose and the acceptance of peers (Rosen, 1991) >> [*].

[*] OECD-JRC Handbook



The economist A. K. Sen, Nobel prize winner in 1998, was initially opposed to composite indicators but was eventually seduced by their ability to put into practice his concept of 'Capabilities' ('the range of things that a person could do and be in her life') in the UN Human development index [*].



[*] Sen A. 1989 Development as Capabilities Expansion, *Journal of Development Planning*, **19**, 41-58



- Can good practices help ?



To what extent a good technical preparation for a CI can make it more robust (to uncertainties in data, weights,...) resilient (remain relevant over time), defensible (in dialogue with stakeholders...) and facilitate negotiation rather than stand off?

(Snippets from the JRC-OECD handbook)



From the handbook.

Step 1. Developing a theoretical framework

What is badly defined is likely to be badly measured ...



Step 2. Selecting variables

A composite indicator is above all the sum of its parts...

Excerpt: The **strengths and weaknesses** of composite indicators largely derive from the **quality of the underlying variables**. [...] While the choice of indicators must be guided by the theoretical framework for the composite, the data selection process can be quite subjective as there may be **no single definitive set of indicators**.

As in
mathematical
models

Step 3. Multivariate analysis

Analysing the underlying structure of the data is still an art ...



Step 4. Imputation of missing data.

The idea of imputation could be both seductive and dangerous

...

Step 5. Normalisation of data

Avoid adding up apples and oranges ...

Step 6. Weighting and aggregation

The relative importance of the indicators can become the substance of a negotiation ...



Step 7. Robustness and sensitivity

Sensitivity analysis can be used to assess the robustness of composite indicators ...

Step 8. Links to other variables

Composite indicators can be linked to other variables and measures ...

Step 9. Back to the details

De-constructing composite indicators can help extend the analysis ...

Step 10. Presentation and dissemination

A well-designed graph can speak louder than words ...

The four-quadrant model of the Sustainable Project Appraisal Routine (SPeAR®).



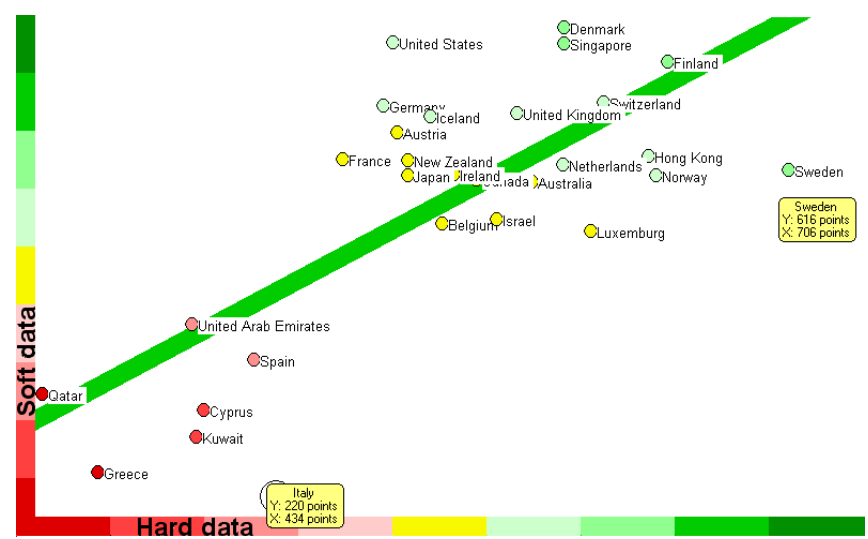
About de-constructing composite indicators - an example:

from *Measuring competitiveness: implications for policy makers*

By Paola Dubini, Elena Di Biase of Bocconi University and

Jochen Jesinghaus, Stefano Tarantola Joint Research Centre, European Commission

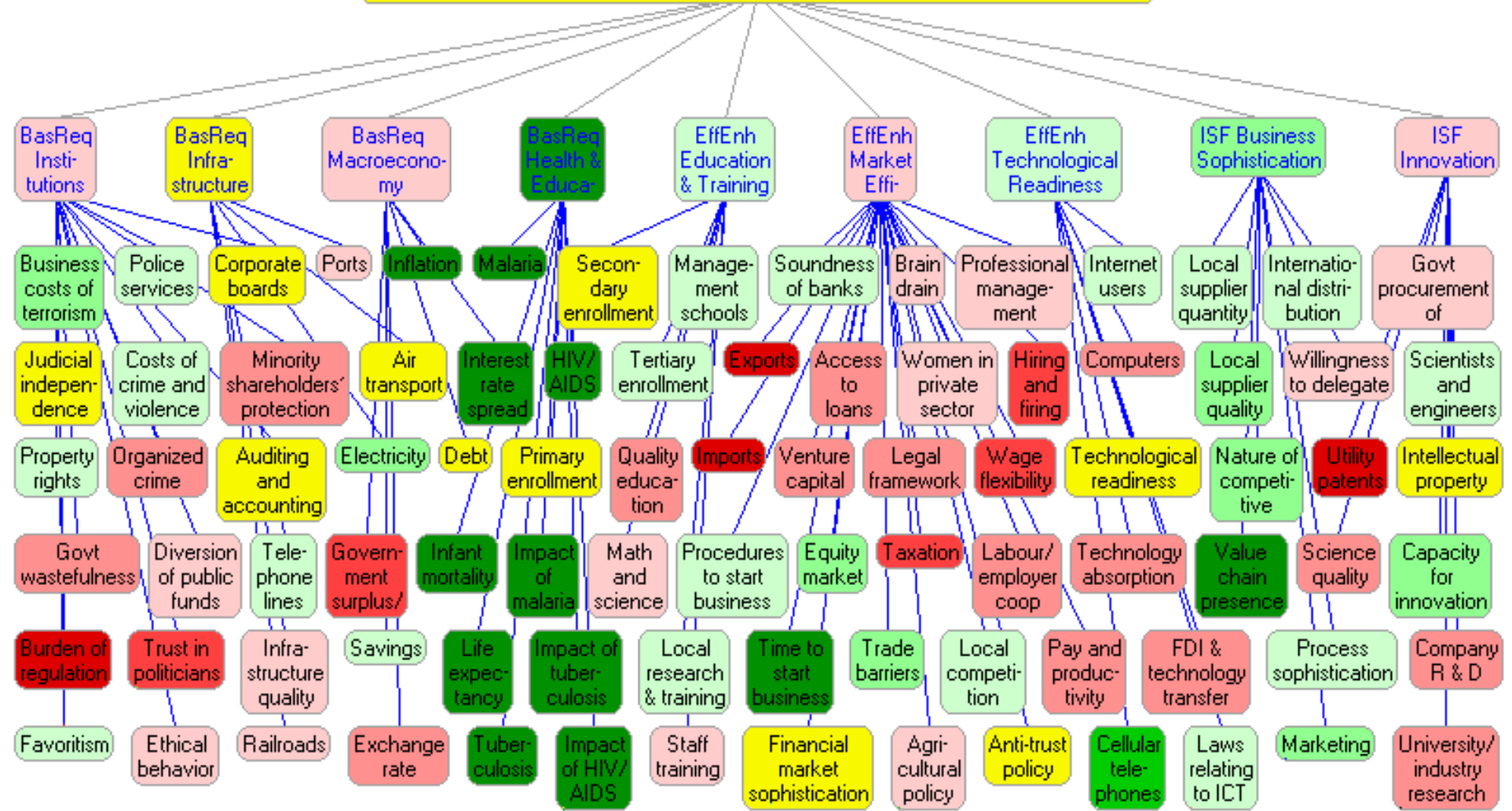
Submitted to *CONTEMPORARY ECONOMIC POLICY*, August 2006

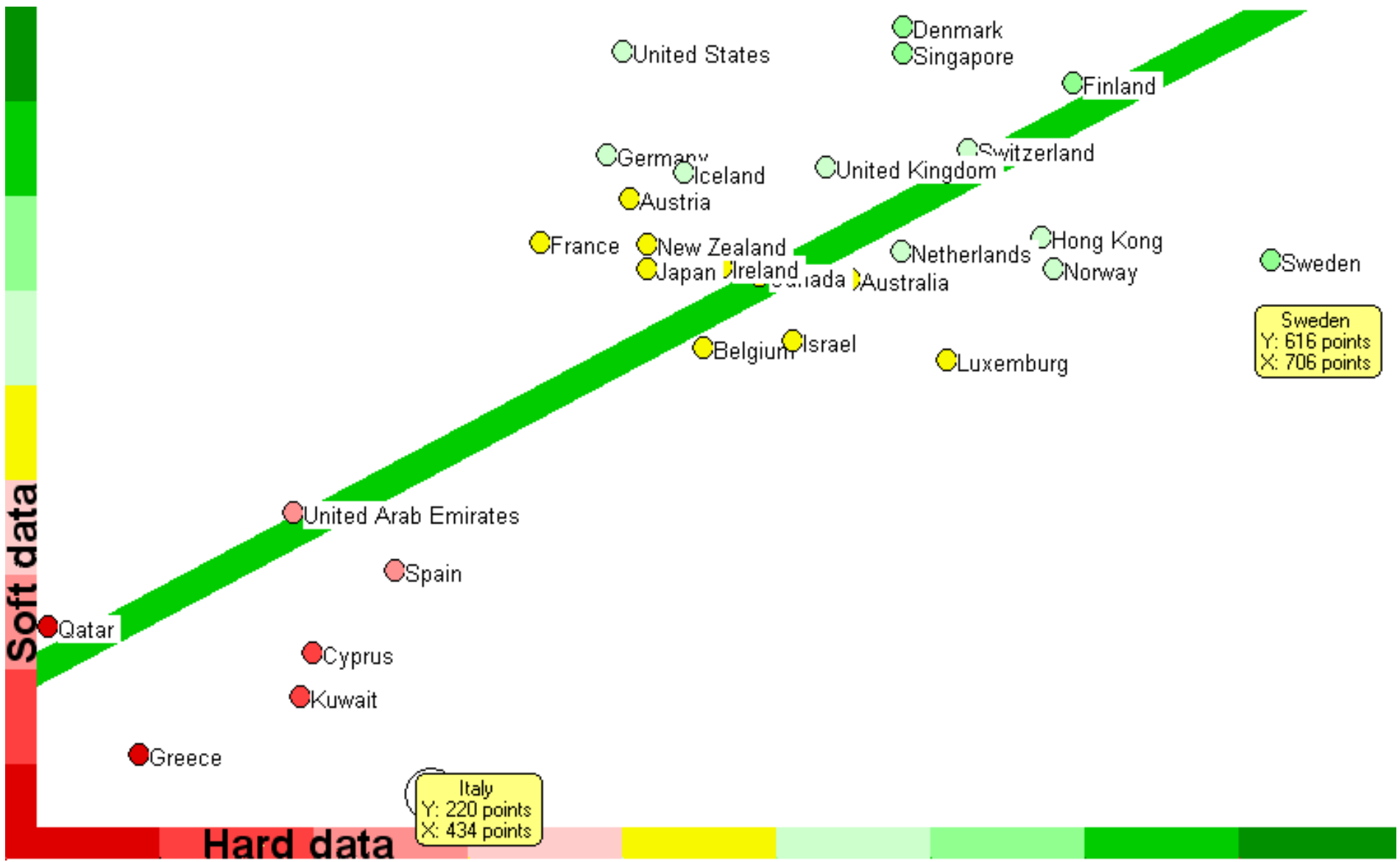




Global Competitiveness Index

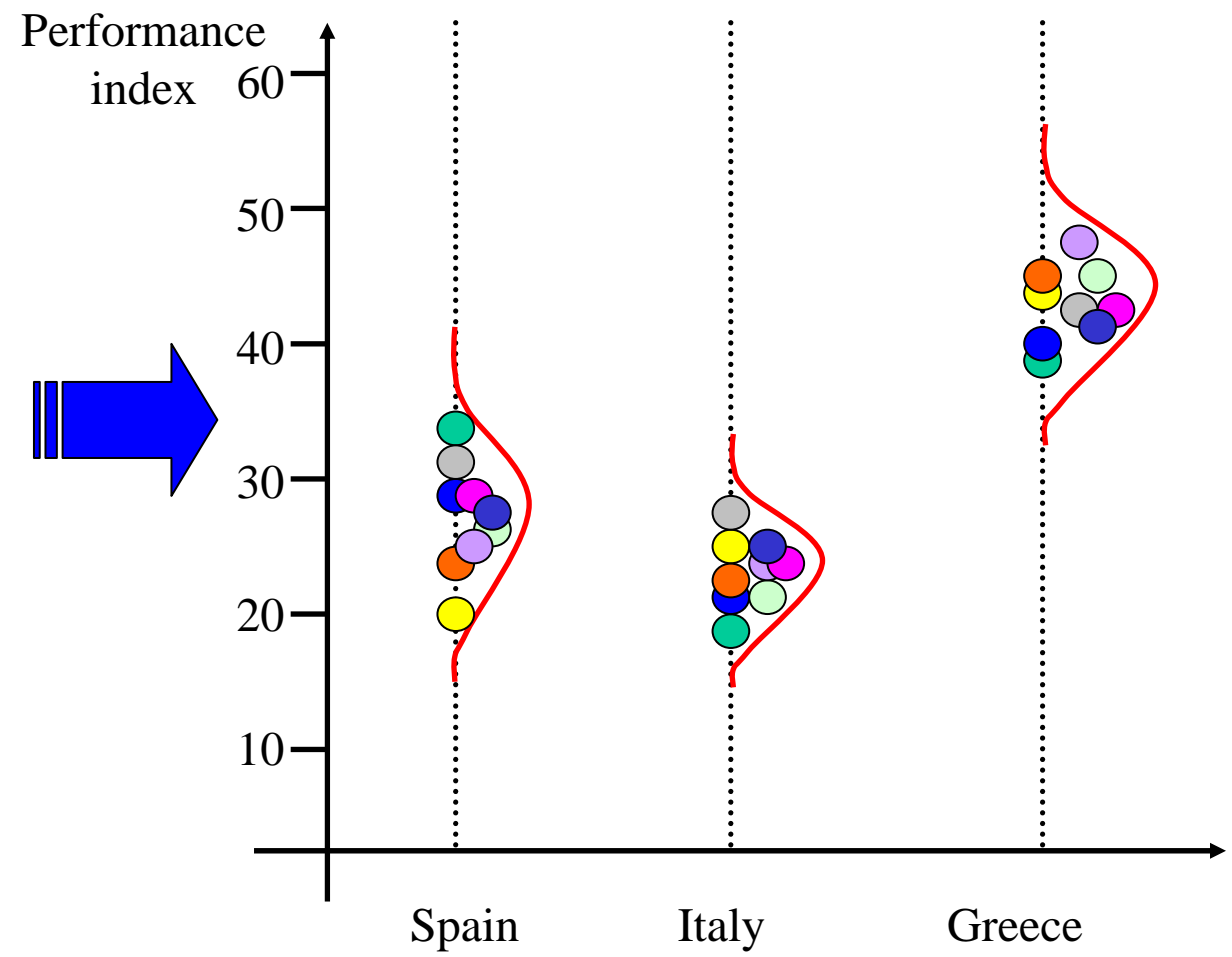
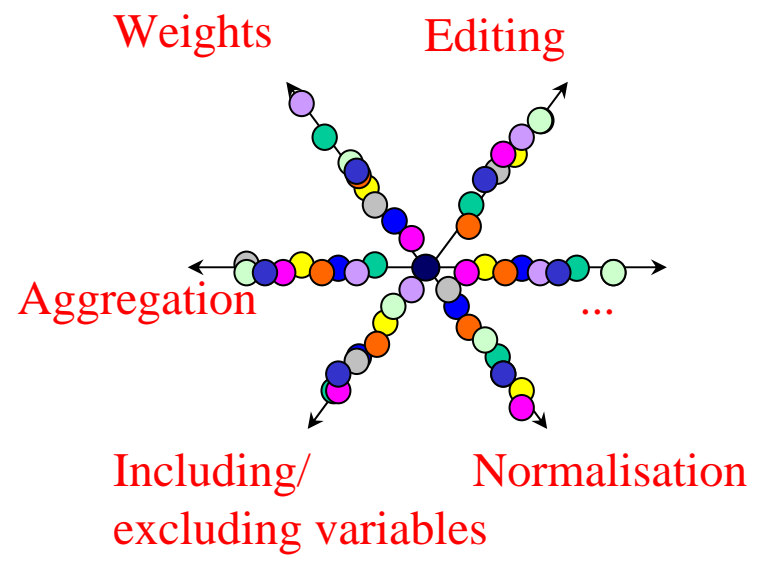
Italy





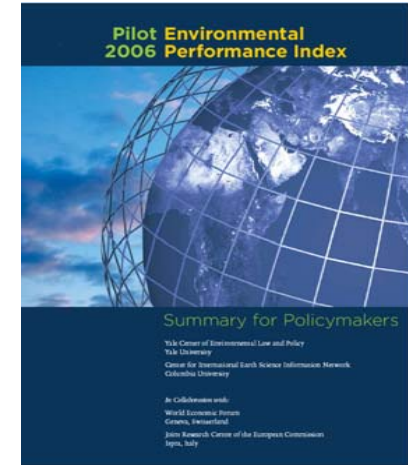
Statistical test of robustness by simultaneously changing all uncertain factors...

Space of alternatives



Model averaging: as we don't trust one model to make inference, we use more models

These practices are already being applied to existing composite indicators, e.g. the 2006 EPI from Yale, Columbia, WEF, JRC.



- Composite indicators and narratives

CI can be built by the press itself



Source: Spring Report, European Commission 2004

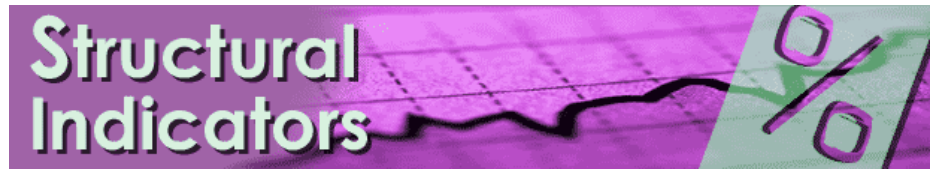
From structural indicators (EUROSTAT, short, long lists) to league table (Financial Times)

Long list of indicators (> 100)

Short List of 14

Synoptic tables

League tables



Relative performance of the 15 Member States according to the structural indicators on the shortlist

Level	FR	BE	NL	DE	ES	IT	PT	GR	UK	IE	FI	DK	SE	LU	AT
GDP per capita in PPS (€1000)	119	107	102	115	88	94	83	74	103	104	102	104	114	87	93
Unemployment (EU-15 avg)	8.1	7.8	7.7	8.1	10.2	9.1	9.8	11.9	7.9	8.1	8.1	8.1	8.1	8.1	8.1
Employment rate (%)	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3
Research and development expenditure (% of GDP)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Educational attainment (2000-2005)	85	81	75	82	84	82	87	81	84	81	88	73	47	82	76
Research and development expenditure (% of GDP)	1.9	2.2	2.2	2.4	1.6	1.5	2.2	1.5	1.5	1.5	1.7	1.9	1.9	1.9	2.1
Business investment (% GDP)	12.9	12.3	12.3	12.3	11.9	11.9	12.3	11.7	12.3	12.3	12.3	12.3	12.3	12.3	12.3
Median price levels (EU-15 avg)	98	98	100	98	97	98	113	98	98	98	98	98	98	98	98
Amount of public debt (%)	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Long-term unemployment (%)	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Depositor of deposit insurance (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Shareholder gains (relative to total value)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Energy intensity of the economy	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Volume of transport	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

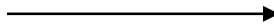


- FREE DATA
- Long-term indicators
 - Structural indicators
 - General economic background
 - Employment
 - Innovation and research
 - Economic reform
 - Social cohesion
 - Environment





Composite indicators
 can be an ingredient to
 build narratives
 grounded on measured
 data...





And as noted by A. K. Sen, composite indicators are a powerful tool for advocacy. The hunger of the economically literate press for statistic based narrative is noticeable.

FINANCIAL TIMES

EUROPE | WEDNESDAY DECEMBER 1 2004

OECD says deficits hurt children

Chief economist warns that leading economies are failing to face up to reality ● Inadequate capital accumulation and slower growth seen as consequence

By Chris Giles in London

Leading countries which continue to run persistent budget deficits are "sacrificing" their children, the Organisation for Economic Co-operation and Development warned yesterday.

OECD member countries' "policy objectives are fine", with commitments to halve the US deficit and reduce persistent budget deficits in Europe, but "we are worried because we cannot forecast any reduction in structural deficits".

The consequence of inaction in leading economies. The organisation cut its forecasts for economic growth in 2005, mainly as a result of an oil price-induced "pervasive sense of uncertainty" which had reduced consumer confidence in OECD countries even though world economic growth in 2004

robust growth across leading economies, the OECD called for higher interest rates, particularly in the US. It said the Federal Reserve should raise short-term interest rates by a quarter of a percentage point every quarter for the next

plans for reducing budget deficits. The OECD concluded that, though it might be hoped that "prudent private agents would react to public profligacy by stepping up their own saving efforts", the general rule was that "pr-

our parents and grandparents, but we should do the same for the next generation," Mr Cotis said. He said OECD countries' plans to improve budget deficits did not give him any comfort because the projected fiscal tightening in the

aded for €3.7bn
 s assets sell-off
 emps Redoute, the
 conglomerate, is to
 electrical equipment
 a €3.7bn deal,
 two-year
 asset sales.
 Page 14

est begins
 sition Socialist
 day on whether to
 constitutional



All this is very relevant to the so-called Lisbon strategy and its revision. Wim Kok warns in his now famous report:

'An ambitious and broad [Lisbon] reform agenda needs a clear narrative'.

... yet the production of anti-Lisbon narratives seem to have been more intense:

- The stability pact 'strangles' the EU economies,
- EU regulations are a systemic hindrance to business,
- Services directive fosters 'social dumping' ...



Narratives in the EU

Could EU leaders make more effective use of statistical information to build effective narratives to promote structural reform and growth in the EU?

"[...] it is a pity that attempts to use even comparatively bland measures - such as the "naming and shaming" of laggards - have been dropped. In other areas, such as the implementation of single-market legislation or state-aid controls, "scoreboards" have played a useful role in bringing peer pressure to bear on national decision-makers."

Mario Monti, FT, March 21, 2005.



Mario Monti

... and the debates goes on and on:

Governance's recommendations of the Kok report:

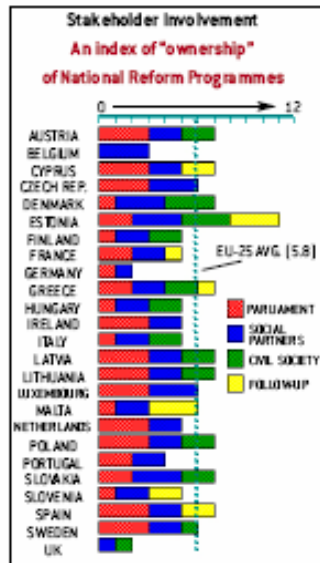
- Naming, shaming and faming
- Increasing ownership
- Refocusing budget



LAST EXIT TO LISBON

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SUMMARY The Lisbon agenda was reborn a year ago with its economic goals prioritised and a new system of governance. Of the three key changes advocated in the Kok report, only National Reform Programmes (NRPs) drawn up by the member states made it off the drawing board. The proposals to provide appropriate EU funding to support the Lisbon goals, and "name and shame" poor performing member states were rejected. **The driving force of Lisbon 2 is thus national "ownership" of the reforms.** Taking evidence of stakeholder involvement we have developed a 12-point scale in an attempt to measure how far the NRPs have been taken to heart in individual countries. In practice, the outcome is mixed at best. There is no explicit methodology behind the evaluation of the NRPs by the Commission. Also, even though the rationale for coordination of reform is strongest for countries in a currency union, Lisbon 2 lacks an explicit euro area dimension.



POLICY CHALLENGE

There is still value in the Lisbon agenda, but with just one of the three "legs" of governance remaining, that leg must be made stronger and be complemented. If Lisbon 2 is to be salvaged, policymakers need to strengthen the rationale for EU involvement in a range of matters that are the direct responsibility of the member states. The EU guidelines on which the NRPs are supposed to be based are far too complex and must be simplified. The publication of comparative performance indicators should be resumed. The methodology for evaluation of NRPs and the underpinnings of country-specific recommendations need to be spelled out more explicitly in order to encourage national debate on key areas of underperformance in individual countries. We feel the lack of an explicit euro area aspect is also a major weakness and should be addressed by the Eurogroup as a matter of urgency.

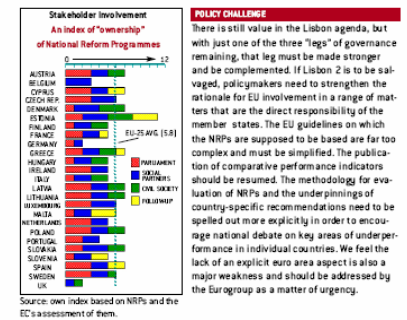
Source: own index based on NRPs and the EC's assessment of them.

“[...] However, the Commission strongly rejected the proposal to 'name and shame' and nearly abandoned benchmarking altogether [...] The Commission thus decided to stop lecturing the member states [...]”

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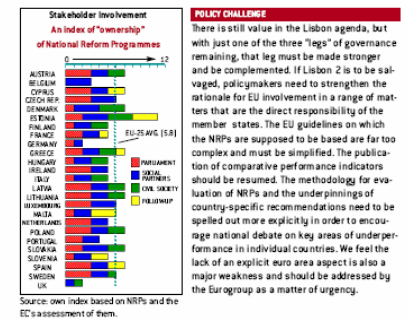


“[...] civil societies *learn* from the experience of others. Such *policy learning* can be enhanced by initiatives that facilitate cross country comparison and benchmarking. A telling example in this respect is [...] PISA.”

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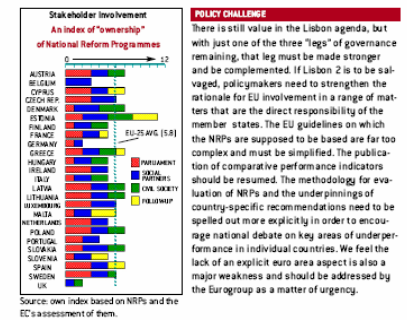


“[...] peer pressure and benchmarking should be integral parts of the political process that underpins Lisbon 2. Transparency benefits the democratic process as it empowers national electorates to review the performance of their own governments and it helps focus the debate on key areas of underperformance. **The use of league tables facilitates this process.**”

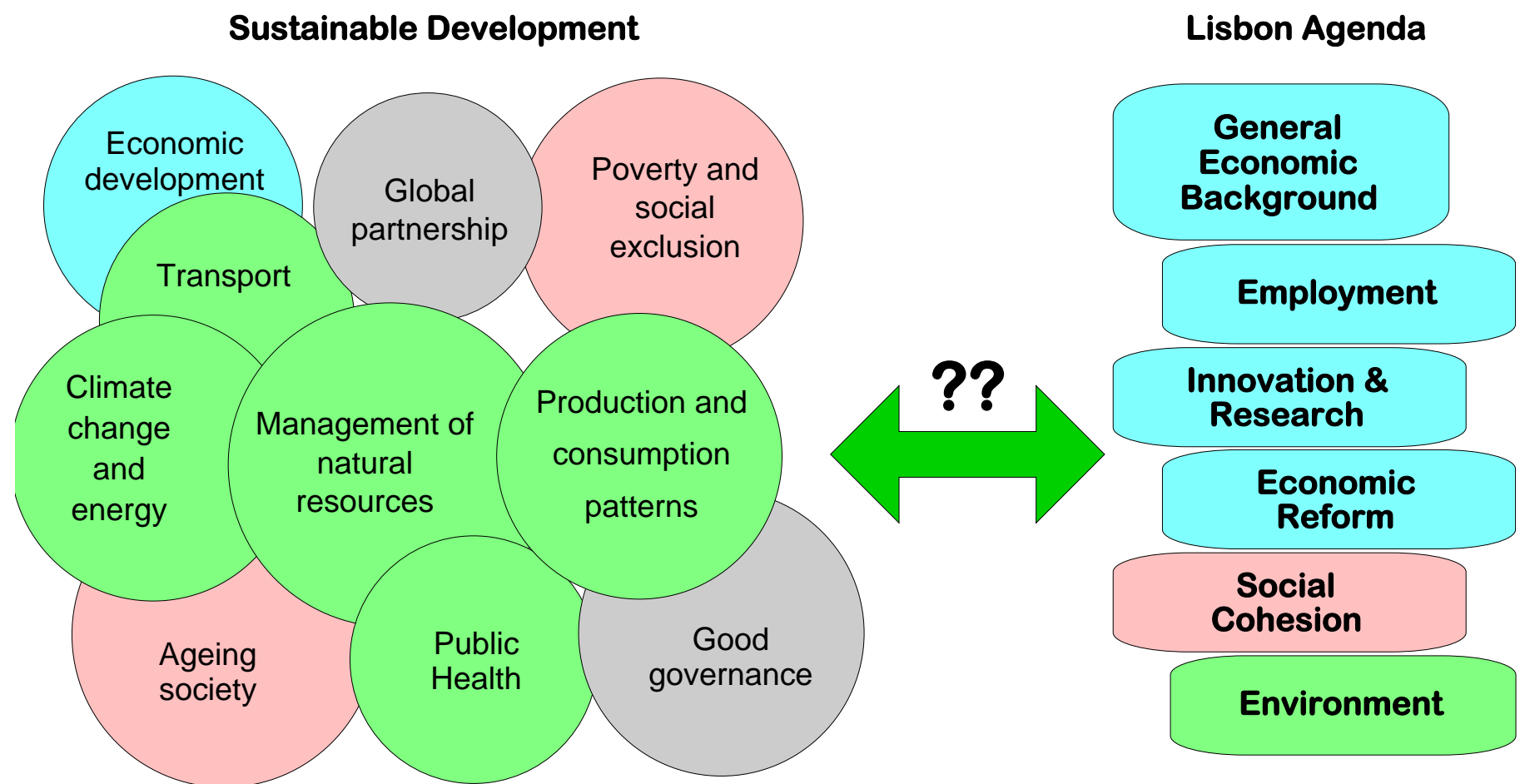
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How things are in the EU? Two overarching EU policy frameworks co-exist: Sustainable Development and Lisbon ...



Source: Jochen Jesinghaus, JRC-CRELL/OECD Workshop on Measuring Well-being and Societal Progress, Milan, 19-21 June 2006