European Innovation Scoreboard (EIS): Evolution and Lessons Learnt

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European Innovation Scoreboard

The European Innovation Scoreboard (EIS)

- Was introduced as part of the Lisbon strategy
- Measures, on a yearly basis, the innovation performance of Member States, drawing on statistics from a variety of sources (a.o. the Community Innovation Survey)

History of the European Innovation Scoreboard

- 2000-2003: MERIT, SPRU
  - Pilot launched in 2000, Full versions in 2001, 2002, 2003
  - Thematic papers (15+) on Biotechnology, Life-long Learning, National Innovation Systems, …
- 2004-2007: MERIT (+JRC)
  - Full versions in 2004, 2005, 2006, 2007
  - Thematic papers (20+) on Services Innovation, Innovation Efficiency, Non-R&D Innovation, Global Innovation Scoreboard, …
- 2008-2010: MERIT, SPRU, CNR (+JRC)
  - Revised EIS in 2008
  - Thematic papers on Design and Creativity, Global Innovation Scoreboard, …

EIS: Benchmarking innovation performance

- We use data for a wide range of innovation (related) indicators
- Average innovation performance is summarized using a composite indicator: the “Summary Innovation Index” (SII)
- Choice of indicators and methodology for calculating the SII have changed over time:
  - More indicators, new indicators
  - Increased use of Community Innovation Survey
  - More countries (37 in 2007)
  - Use of composite indicators from 2003 onwards

Changes over time: 2000-2007

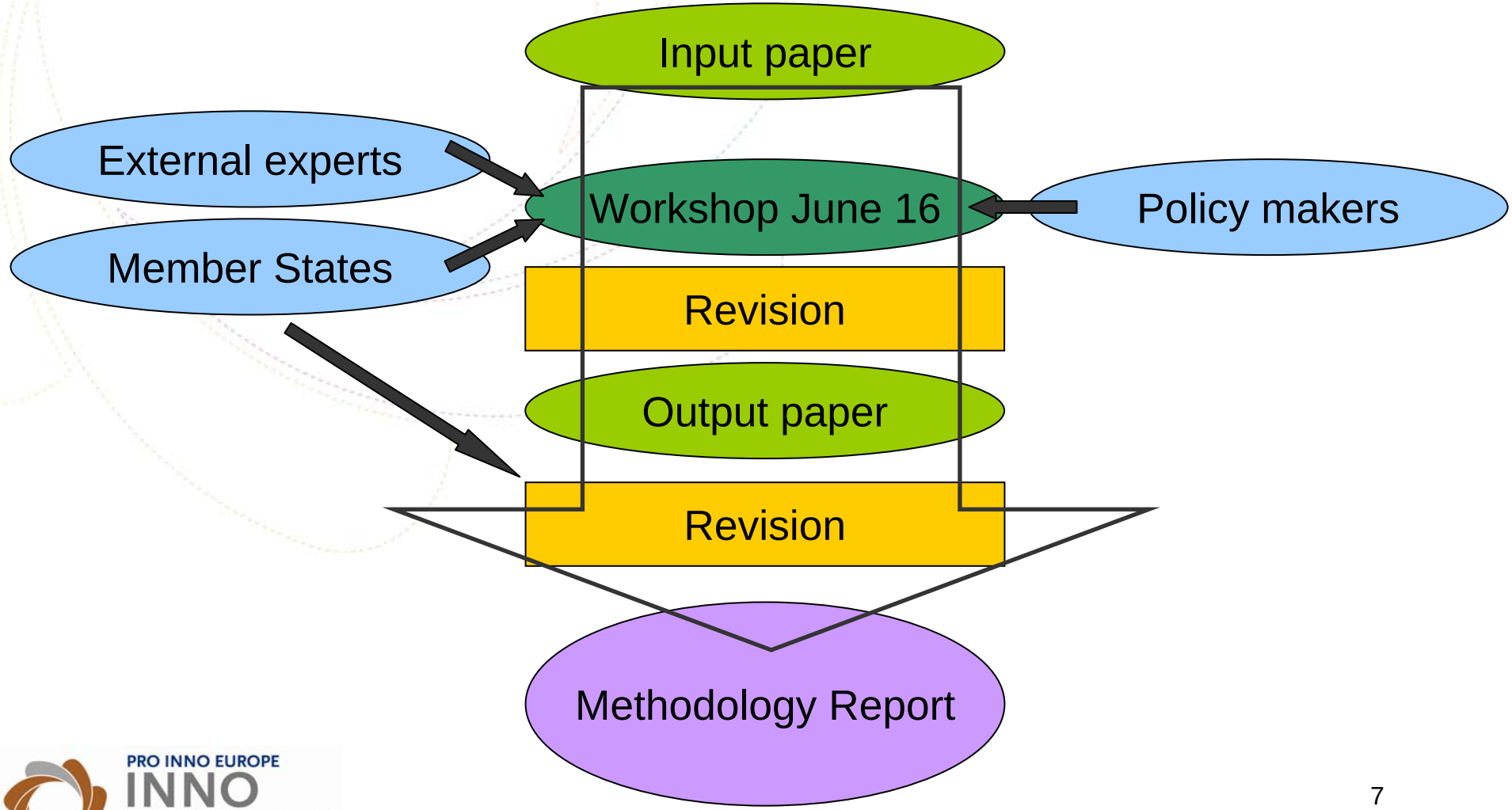
	EIS 2000 (Pilot)	EIS 2001	EIS 2002	EIS 2003	EIS 2004	EIS 2005	EIS 2006	EIS 2007
Number of indicators	16	18	18	22	22	26	25	25
Dissimilarity with previous EIS		(28%)	3%	34%	14%	35%	4%	0%
Number of groups/dimensions	4	4	4	4	4	5	5	5
Indicators based on CIS	4	4	4	5	6	7	7	7
Summary Innovation Index (Composite Indicator)	No	Yes	No	Yes (CI)	Yes (CI)	Yes (CI)	Yes (CI)	Yes (CI)
Countries	17: EU15, US, JP	17	33: EU27, US, JP, IS, NO, CH; TR	33	33	33	34: + HR	37: + AU, CA, IL
INNOVATION DRIVERS								
S&E (Science and Engineering) graduates	Share of post-secondary graduates	Share of population aged 20-29	<=	<=	<=	<=	<=	<=
Share of working-age population with tertiary education	<=	<=	<=	<=	<=	<=	<=	<=
Broadband penetration rate						<=	<=	<=
Participation in life-long learning		<=	<=	<=	<=	<=	<=	<=
Youth education attainment level						<=	<=	<=
KNOWLEDGE CREATION								
Public R&D expenditures (% of GDP)	GOVERD only	GOVERD+HERD	GERD – BERD	<=	<=	<=	GOVERD+HERD	<=
Business R&D expenditures (% of GDP)	<=	<=	<=	<=	<=	<=	<=	<=
Share of medium-high/high-tech R&D in manufacturing						<=	<=	<=
Share of enterprises that receive public funding for innovation (CIS)						<=	<=	<=
Share of university R&D funded by private sector						<=		
INNOVATION & ENTREPRENEURSHIP								
Share of SMEs innovating in-house (CIS)	Manufacturing sector	<=	<=	<= + Services sector	Total business sector	<=	<=	<=
Share of SMEs co-operating in innovation (CIS)	Manufacturing sector	<=	<=	<= + Services sector	Total business sector	<=	<=	<=
Innovation expenditures (% of turnover) (CIS)	Manufacturing sector	<=	<=	<= + Services sector	Total business sector	<=	<=	<=
Venture capital (% of GDP)	Early stage and expansion stage	<=	<=	Early stage only	<=	<=	<=	<=
ICT expenditures (% of GDP)	<=	<=	<=	<=	<=	<=	<=	<=
Share of SMEs using organisational innovations (CIS)					Using non-technological change	<=	Using organisational innovation	<=
High-tech venture capital		Share of GDP	<=	<=	Share of venture capital			
Internet use	Users per 100 population	Share of households	<=	Composite indicator for households and firms	<=			
Capitalisation of new markets (% of GDP)	<=	<=	<=	<=				
Volatility rates of SMEs								
APPLICATIONS								
Share of high-tech services employment	<=	<=	<=	<=	<=	<=	<=	<=
Share of high-tech exports						<=	<=	<=
New-to-market products (% of turnover) (CIS)	Manufacturing sector	<=	<=	<= + Services sector	Total business sector	<=	<=	<=
New-to-firm products (% of turnover) (CIS)				Manufacturing + Services sector	Total business sector	<=	<=	<=
Share of medium-high/high-tech manufacturing employment	<=	<=	<=	<=	<=	<=	<=	<=
Share of high-tech manufacturing value-added	Percent change	Share of value-added	<=	<=	<=			
INTELLECTUAL PROPERTY								
EPO patents per million population				<=	<=	<=	<=	<=
USPTO patents per million population				<=	<=	<=	<=	<=
Triad patents per million population						<=	<=	<=
Community trademarks per million population						<=	<=	<=
Community designs per million population						<=	<=	<=
High-tech EPO patents per million population	<=	<=	<=	<=	<=			
High-tech USPTO patents per million population		<=	<=	<=	<=			

EIS: New methodology for 2008 - 2010

- Criticism since the introduction of the EIS:
  - Technology bias (focus on high-tech sectors)
  - Choice of dimensions and indicators (“Lack of model”)
  - Use of composite indicators

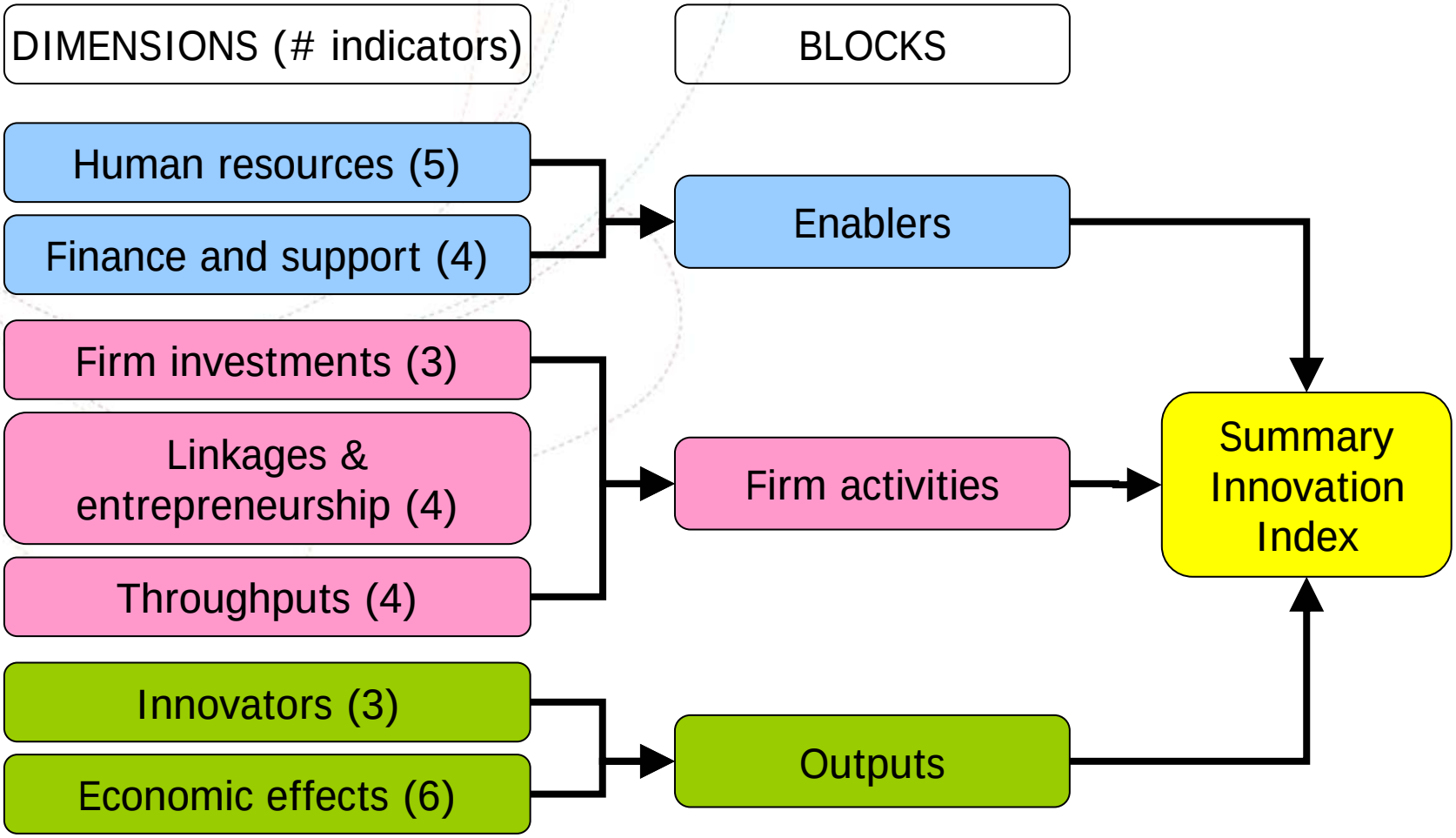
- Challenges as discussed in the EIS 2007 report:
  - New forms of innovation: services, user, open innovation
  - Assessing overall innovation performance
  - Comparability at national, international and regional level
  - Measuring changes over time

Process of revising the methodology



Available at: http://www.proinno-europe.eu/metrics

New EIS methodology



ENABLERS

Captures the main drivers of innovation that are external to the firm:

- **Human resources** – the availability of high-skilled and educated people – are one of the most important innovation drivers

- **Finance and support** – the availability of finance for innovation projects and the support of governments for innovation activities are important drivers of innovation

ENABLERS

		Data source
	Human resources	
1.1.1	S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education)	Eurostat
1.1.2	S&E and SSH doctorate graduates per 1000 population aged 25-34 (second stage of tertiary education)	Eurostat
1.1.3	Population with tertiary education per 100 population aged 25-64	Eurostat
1.1.4	Participation in life-long learning per 100 population aged 25-64	Eurostat
1.1.5	Youth education attainment level	Eurostat
	Finance and support	
1.2.1	Public R&D expenditures (% of GDP)	Eurostat
1.2.2	Venture capital (% of GDP)	EVCA/ Eurostat
1.2.3	Private credit (relative to GDP)	IMF
1.2.4	Broadband access by firms (% of firms)	Eurostat

FIRM ACTIVITIES

Captures innovation efforts at the firm level:

- **Firm investments** – Covers a range of different investments needed to generate new products or processes as well as for introducing “softer” innovations as marketing and organisational innovations

- **Linkages & entrepreneurship** – Captures the entrepreneurial efforts and the related collaboration efforts among innovating firms and also with the public sector

- **Throughputs** – Captures the Intellectual Property Rights (IPR) generated as a throughput in the innovation process and Technology Balance of Payments (TBP) flows

FIRM ACTIVITIES

		Data source
	Firm investments	
2.1.1	Business R&D expenditures (% of GDP)	Eurostat
2.1.2	IT expenditures (% of GDP)	EITO/Eurostat
2.1.3	Non-R&D innovation expenditures (% of turnover)	Eurostat (CIS)
	Linkages & entrepreneurship	
2.2.1	SMEs innovating in-house (% of SMEs)	Eurostat (CIS)
2.2.2	Innovative SMEs collaborating with others (% of SMEs)	Eurostat (CIS)
2.2.3	Firm renewal (SMEs entries + exits) (% of SMEs)	Eurostat
2.2.4	Public-private co-publications per million population	Thomson/ ISI
	Throughputs	
2.3.1	EPO patents per million population	Eurostat
2.3.2	Community trademarks per million population	OHIM
2.3.3	Community designs per million population	OHIM
2.3.4	Technology Balance of Payments flows (% of GDP)	World Bank

OUTPUTS

Captures the outputs of firm activities:

- **Innovators** – Captures the success of innovation by the number of firms that have introduced innovations onto the market or within their organisations. It covers both technological and non-technological innovations

- **Economic effects** – Captures the economic success of innovation in employment, exports and sales due to innovation activities

OUTPUTS

		Data source
	Innovators	
3.1.1	Technological (product/service/process) innovators (% of SMEs)	Eurostat (CIS)
3.1.2	Non-technological (marketing/organisational) innovators (% of SMEs)	Eurostat (CIS)
3.1.3	Resource efficiency innovators Unweighted average of the following 2 indicators: o Reduced labour costs (% of firms) o Reduced use of materials and energy (% of firms)	 Eurostat (CIS) Eurostat (CIS)
	Economic effects	
3.2.1	Employment in medium-high & high-tech manufacturing (% of workforce)	Eurostat
3.2.2	Employment in knowledge-intensive services (% of workforce)	Eurostat
3.2.3	Medium and high-tech exports (% of total exports)	Eurostat
3.2.4	Knowledge-intensive services exports (% of total services exports)	Eurostat
3.2.5	New-to-market sales (% of turnover)	Eurostat (CIS)
3.2.6	New-to-firm sales (% of turnover)	Eurostat (CIS)

Need for synthetic view

- Make sense of data for 29 indicators
- Build a picture

⇒ Use composite indicators to summarize performance for a large set of related but different indicators

Measuring average innovation performance using composite indicators: Methodology (1)

- **Step 1: Transform data**
  - Most of the EIS indicators are fractional indicators with values between 0% and 100%.
  - Some EIS indicators are unbound indicators, where values are not limited to an upper threshold. These indicators can be highly volatile and have skewed data distributions. For these indicators – Public-private co-publications, EPO patents, Community trademarks and Community designs, all measured per million population – data are transformed using a square root transformation.

- **Step 2: Identify outliers**
  - Positive (negative) outliers are identified as those relative scores which are higher (smaller) than the EU27 mean plus (minus) 3 times the standard deviation. These outliers are not included in determining the Maximum and Minimum scores in the normalisation process (cf. Step 5).

Measuring average innovation performance using composite indicators: Methodology (2)

- **Step 3: Set reference years**
  - For each indicator a reference year is identified based on data availability for all core EIS countries, i.e. those countries for which data availability is at least 75%. For most indicators this reference year will be lagging 1 or 2 years behind the year to which the EIS refers. Thus for the EIS 2008 the reference year will be 2006 or 2007 for most indicators.

- **Step 4: Sort data over time**
  - Reference year data are then used for “2008”, etc. If data for a year-in-between is not available we substitute with the value for the previous year (except for indicators using CIS data where we use the average of 2004 and 2006 to impute for 2005). If data are not available at the beginning of the time series, we replace missing values with the latest available year.

Measuring average innovation performance using composite indicators: Methodology (3)

- **Step 5: Extrapolate data**
  - For all indicators and countries we extrapolate data for 2009 and 2010 by assuming the same percentage increase between “2008” and “2007”. The rationale for this extrapolation is to take account of further increases in indicator values beyond the maximum or below the minimum values found within the observed 5 year time period. This way we fix the Maximum and Minimum scores (cf. Step 6) for the EIS 2009 and EIS 2010 to ensure full comparability of SII scores.

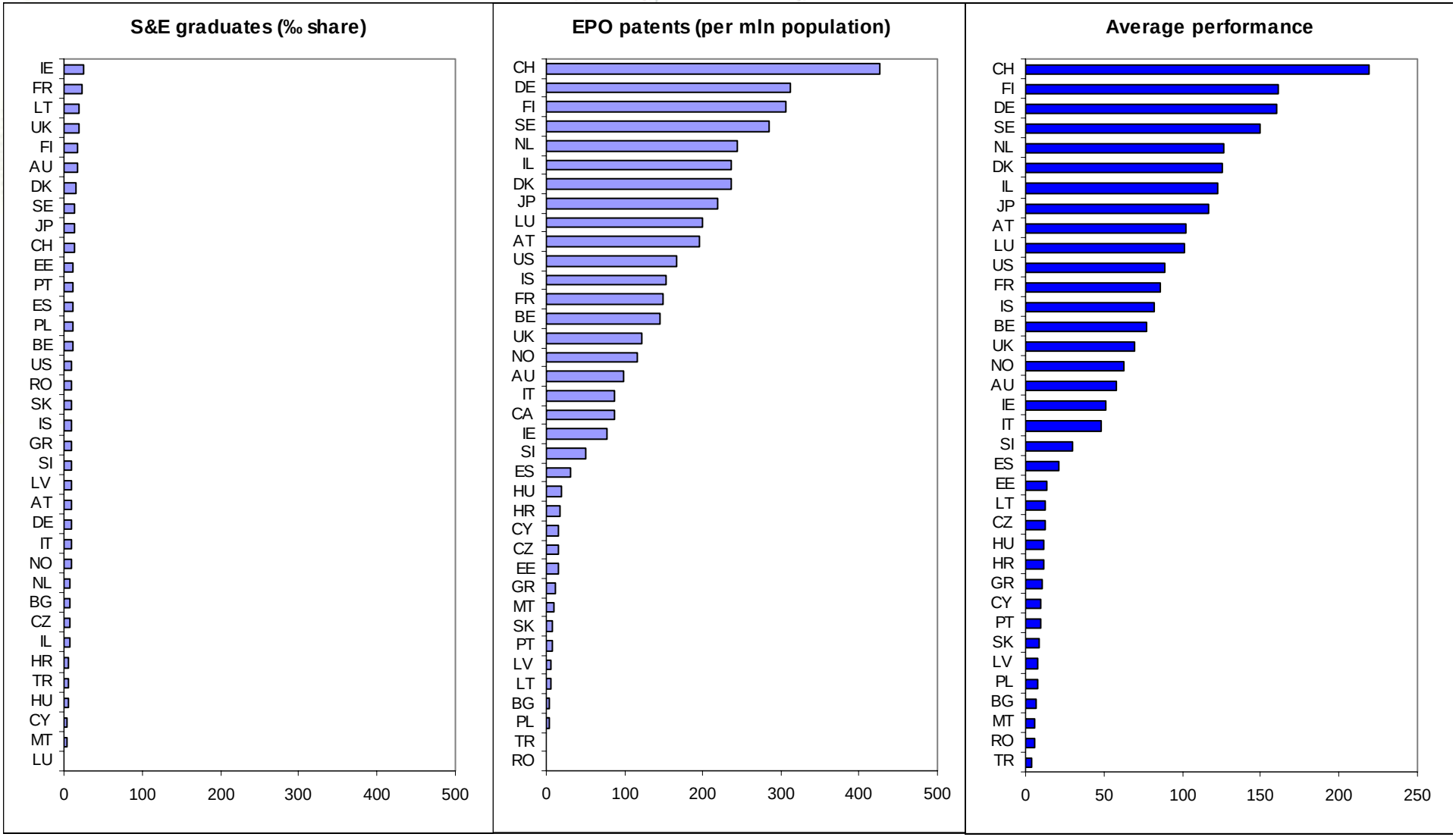
- **Step 6: Determine Maximum and Minimum scores**
  - The Maximum (Minimum) score is the highest (lowest) relative score found for the whole time period (including the two extrapolated years) within the group of core EIS countries (i.e. those countries for which data availability is at least 75%) excluding positive (negative) outliers and ‘small’ countries with populations of 1 million or less (i.e. Cyprus, Iceland, Luxembourg and Malta).

Measuring average innovation performance using composite indicators: Methodology (4)

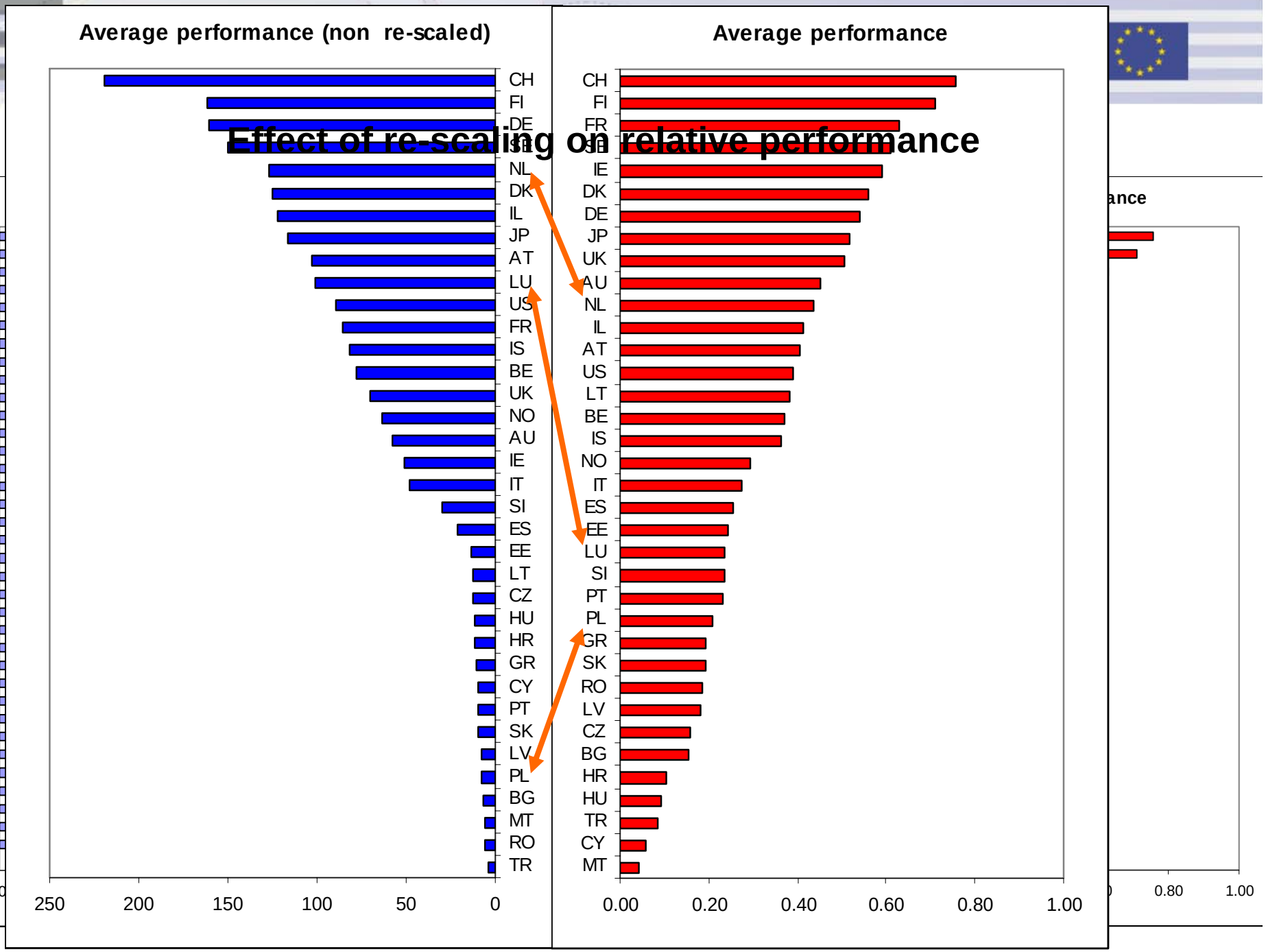
- **Step 7: Calculate re-scaled scores**
  - Re-scaled scores of the relative scores for all years are calculated by first subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum re-scaled score is thus equal to 1 and the minimum re-scaled score is equal to 0. For positive and negative outliers and small countries where the value of the relative score is above the Maximum score or below the Minimum score, the re-scaled score is set equal to 1 respectively 0.

- **Step 8: Calculate composite innovation indexes**
  - For each year and for each innovation dimension a dimension composite innovation index (DCII) is calculated as the unweighted average of the re-scaled scores for all indicators within the respective dimension. For each year the Summary Innovation Index (SII) is calculated as the unweighted average of the re-scaled scores for all indicators. The SII will only be calculated if data are available for at least 70% of the indicators.

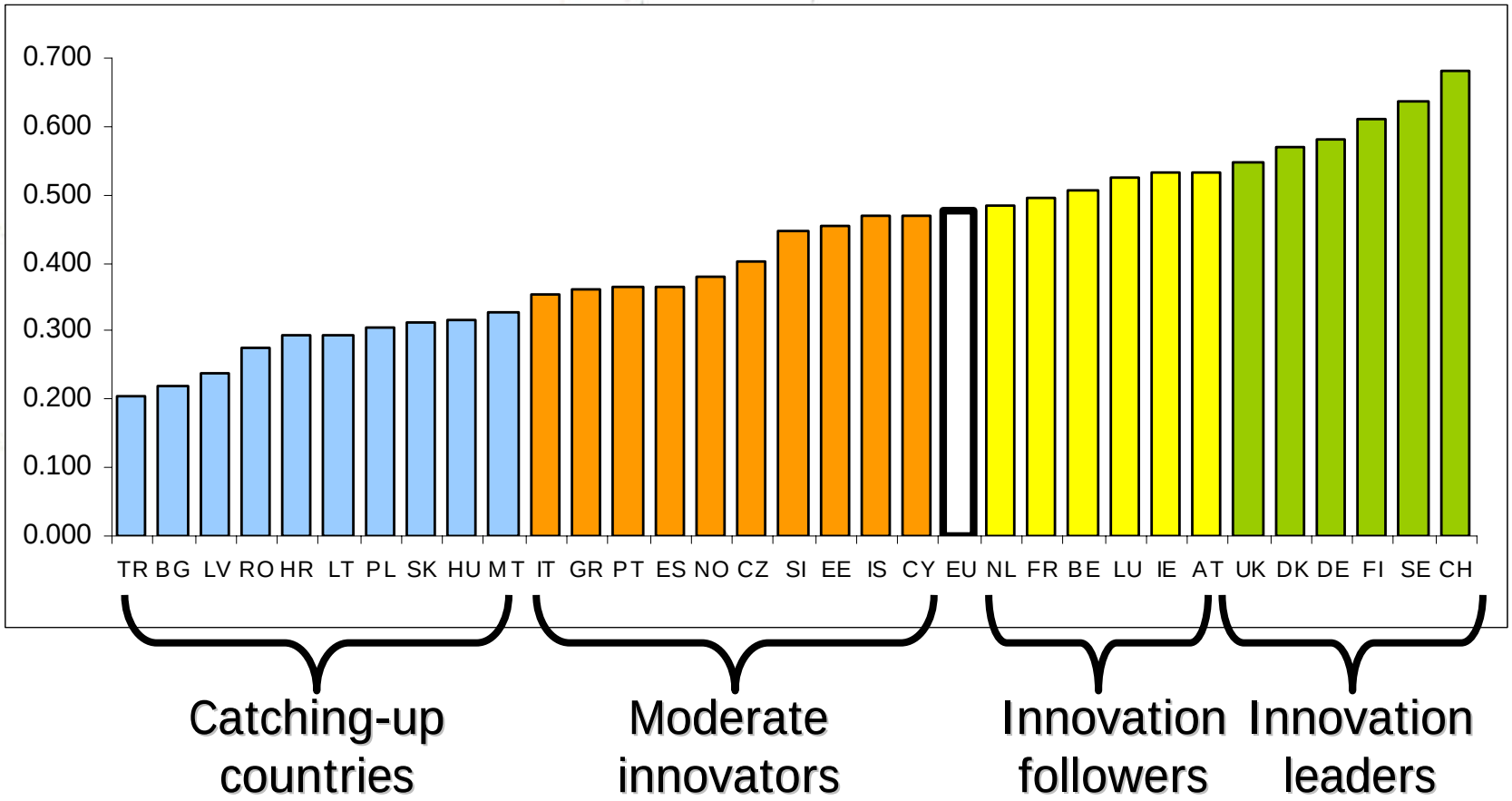
Why do we rescale the indicators?



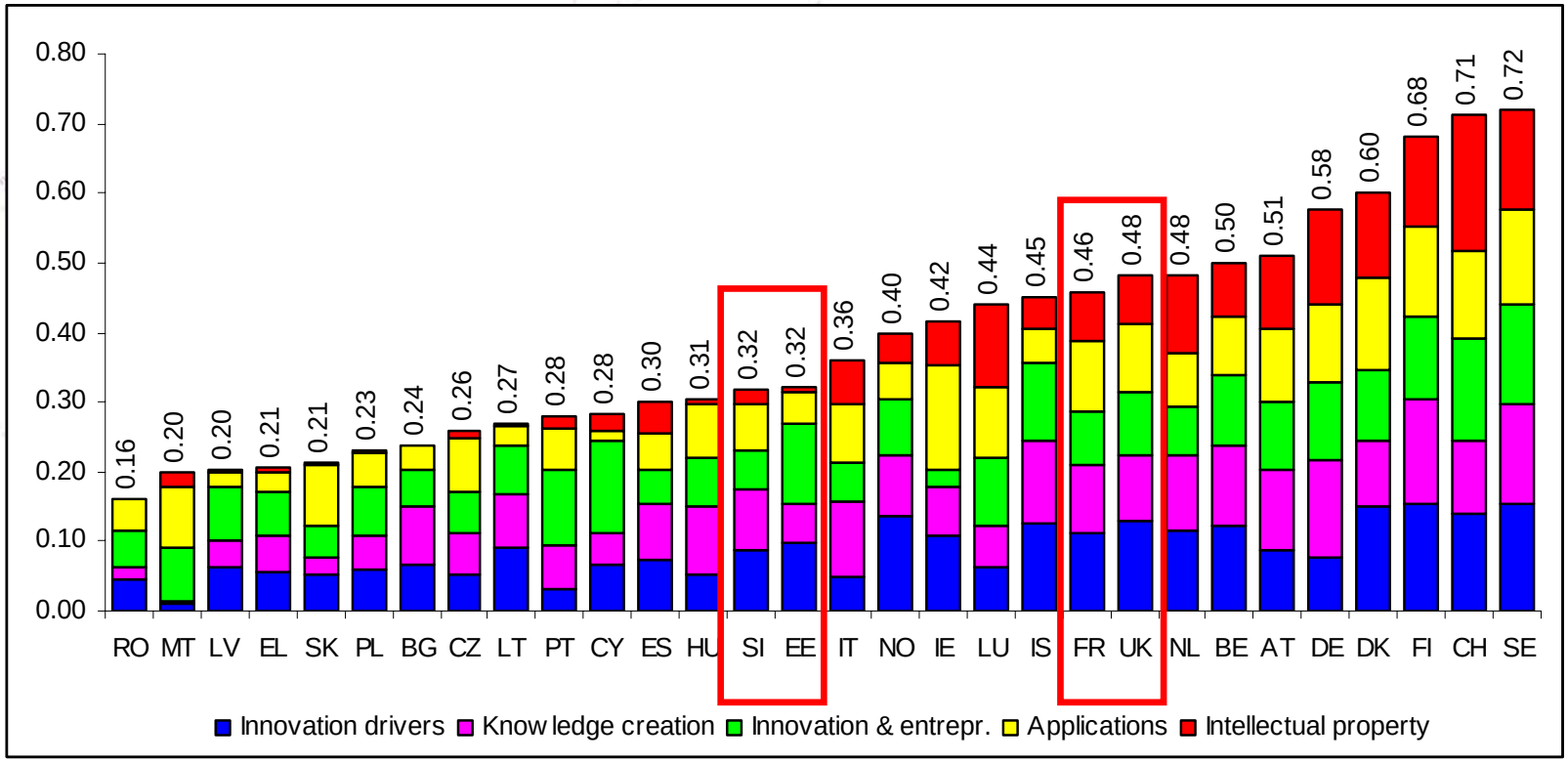
Effect of re-scaling on relative performance



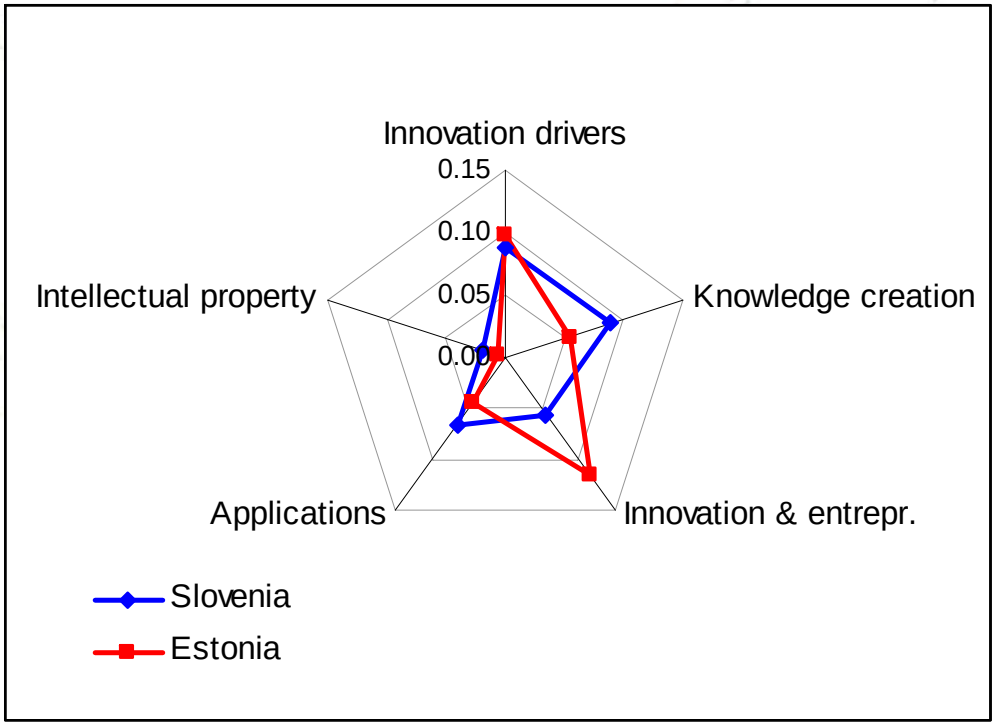
EIS 2008: innovation performance



Composite indicators: Two examples



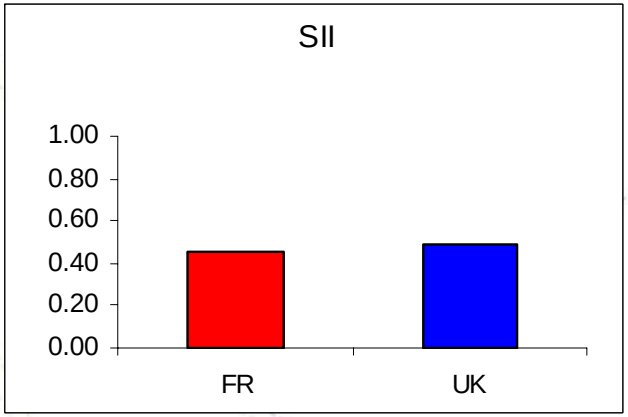
Same SII, different composition

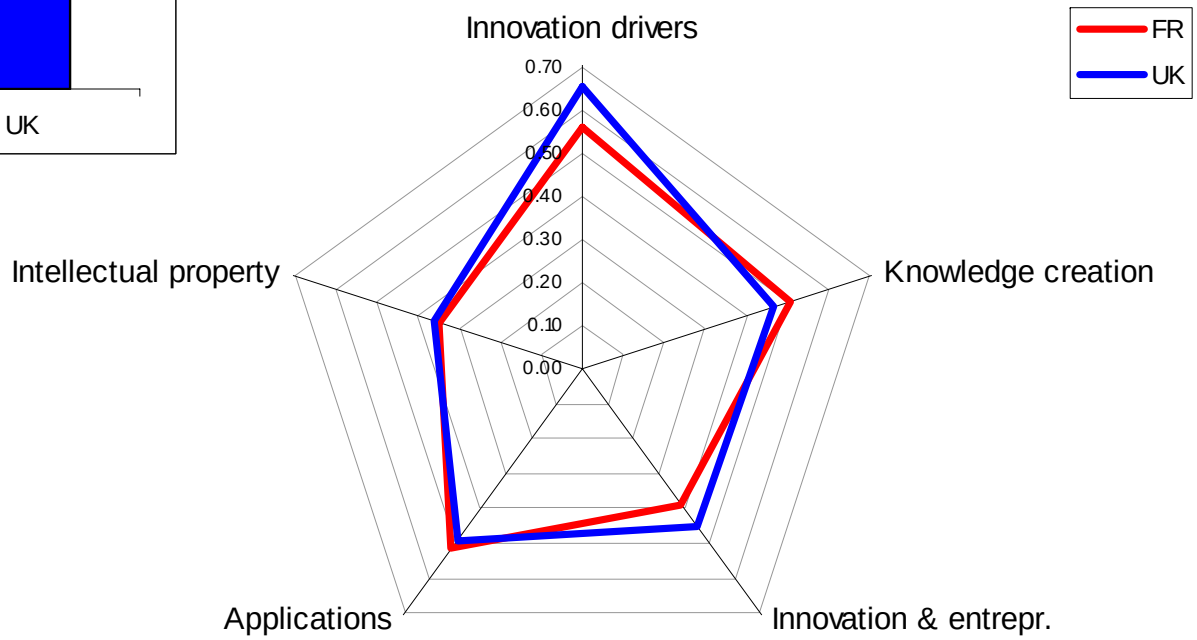


Estonia and Slovenia have a similar SII, but:

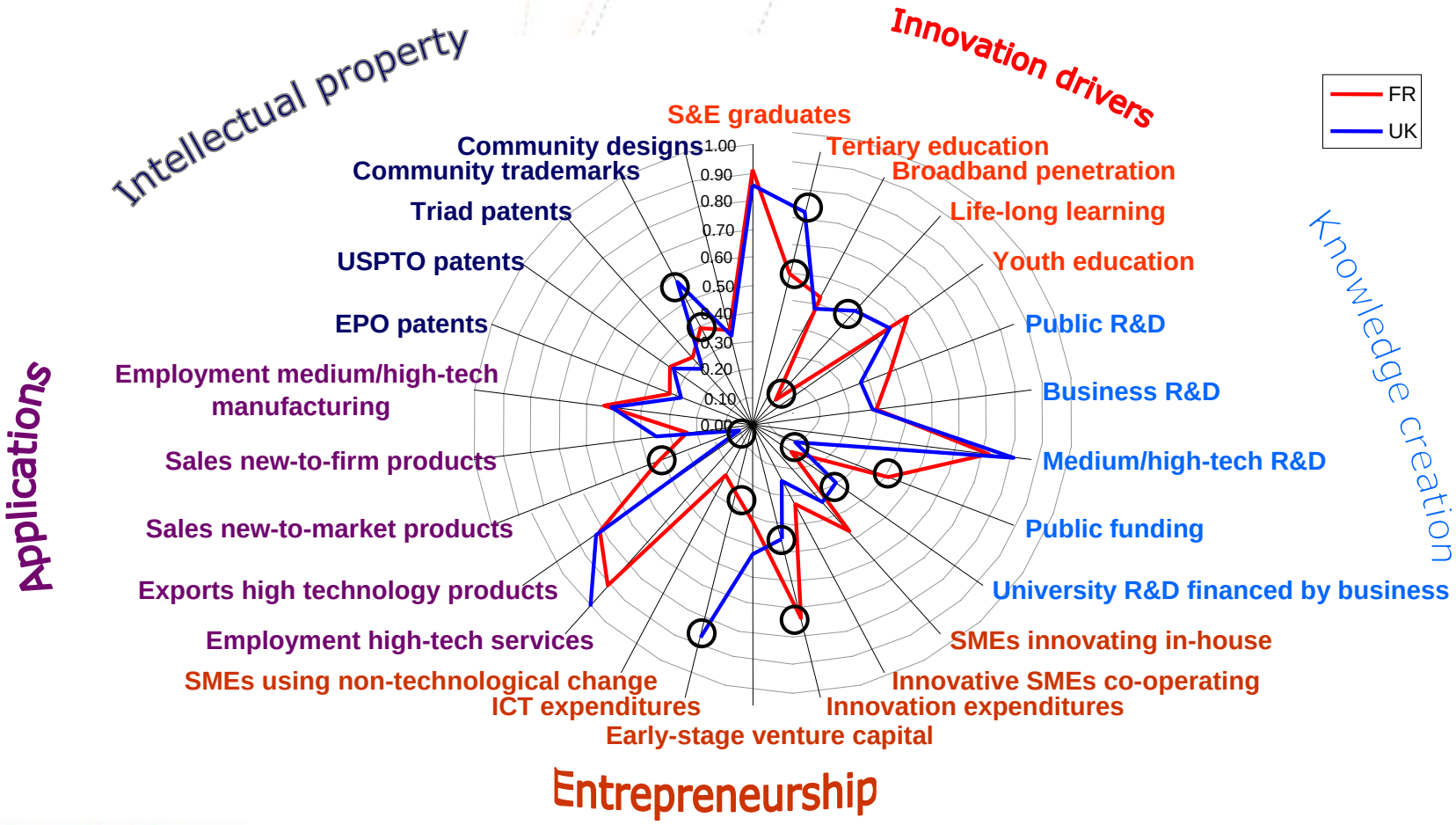
- Slovenia performs better in Knowledge creation, Applications
- Estonia performs better in Innovation & entrepreneurship

Composite indicators: Similar SII, similar composition …





… but different indicator performance



Strengths and weaknesses of composite indicators

Strengths

- Composite indicators are useful in summarizing information (SII summarizes data from 29 indicators)
- Composite indicators produce easy to read graphs
- Composite indicators reach larger public and thereby raise media, policy and public attention

Weaknesses

- Composite indicators hide differences in underlying indicator performance
- Composite indicators can lead to wrong policy conclusions

Lessons learnt

- Innovation performance can be measured using a selection of indicators which either directly or indirectly ('proxies') measure innovation
- Average performance can be captured using composite indicators thereby facilitating the interpretation and visualization of innovation performance
- But we have to be aware that we need to look beyond composite indicator scores
- We always need to find explanations for differences in composite indicator scores and composite indicator components

Global Innovation Scoreboard

- Attempt to implement the EIS methodology on a larger sample of non-EU countries
  - 1st report published in 2006
  - 2nd report published last Tuesday

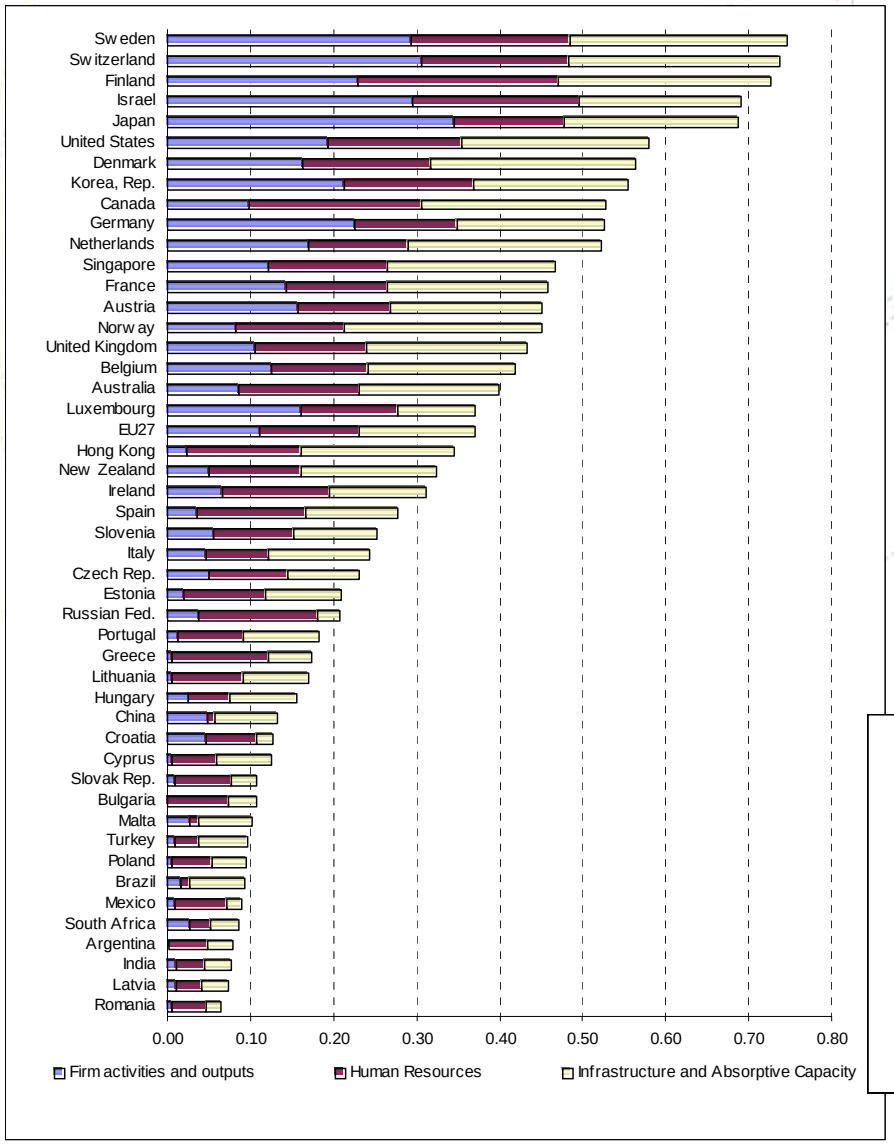
(Available at: http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=282&parentID=51)

2008 Global Innovation Scoreboard

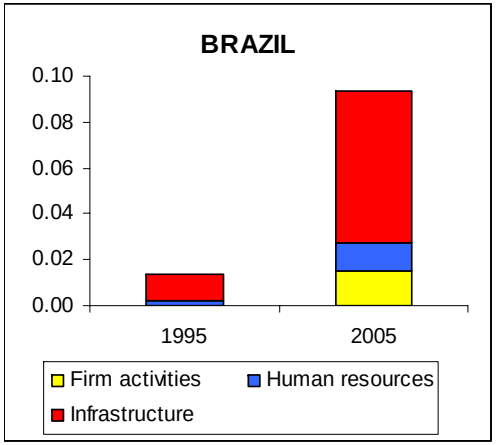
- Limited data availability => smaller set of indicators
- 48 countries included, incl. Argentina, Brazil and Mexico

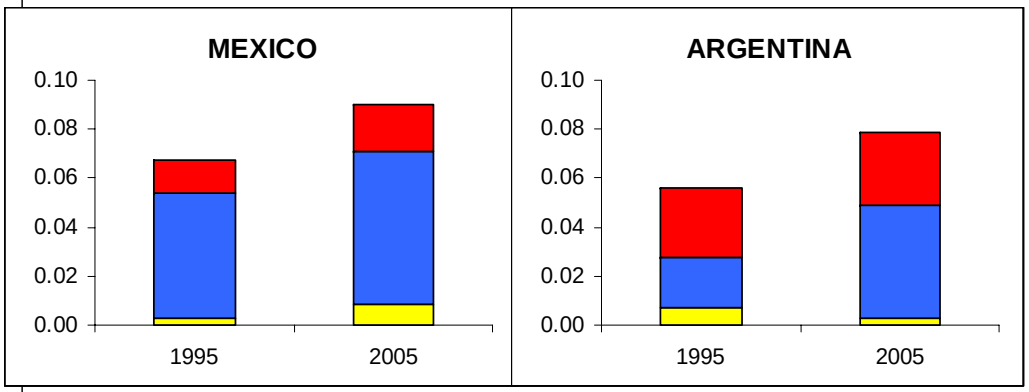
GIS pillars, indicators and weights

Pillar	Indicator	Contribution to the total GIS value
Firm Activities and Outputs (40%)	Triadic patents per population (3 years average)	20%
	Business R&D - BERD - (%GDP)	20%
Human Resources (30%)	S&T tertiary enrolment ratio	7,5%
	Labour force with tertiary education (% total labour force)	7,5%
	R&D personnel per population	7,5%
	Scientific articles per population	7,5%
Infrastructures and Absorptive Capacity (30%)	ICT expenditures per population	10%
	Broadband penetration per population	10%
	Public R&D - (HERD + GOVERD) - (%GDP)	10%



- Brazil at rank 42, Mexico at rank 43, Argentina at rank 45
- Growing innovation performance, in particular Brazil





- Thank you!

- For questions or comments, please contact:

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