

# Measuring Innovation in Europe for Future Growth

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**Business Clusters, Networks and Economic Development**



# Expertise, Outreach and Value Co-creation



**Innovation, Clusters and Network Connectivity – as drivers of Economic Growth; network governance and governance of innovation; building value co-creation practices; mapping global value chains, knowledge clusters, and global connectivity**



**Innovation in designing and developing institutional business models; Innovation in strategic transformation, competitive advantage and institutional change; Preparing leaders with innovation mindset; Innovation in developing individuals and groups; Innovation in systems management, stakeholder engagement and quality customer service**



**The advancement of knowledge and practice in developing national innovation systems, university-industry interactions, knowledge transfer hubs and platforms, governance of innovation and triple helix intermediation.**

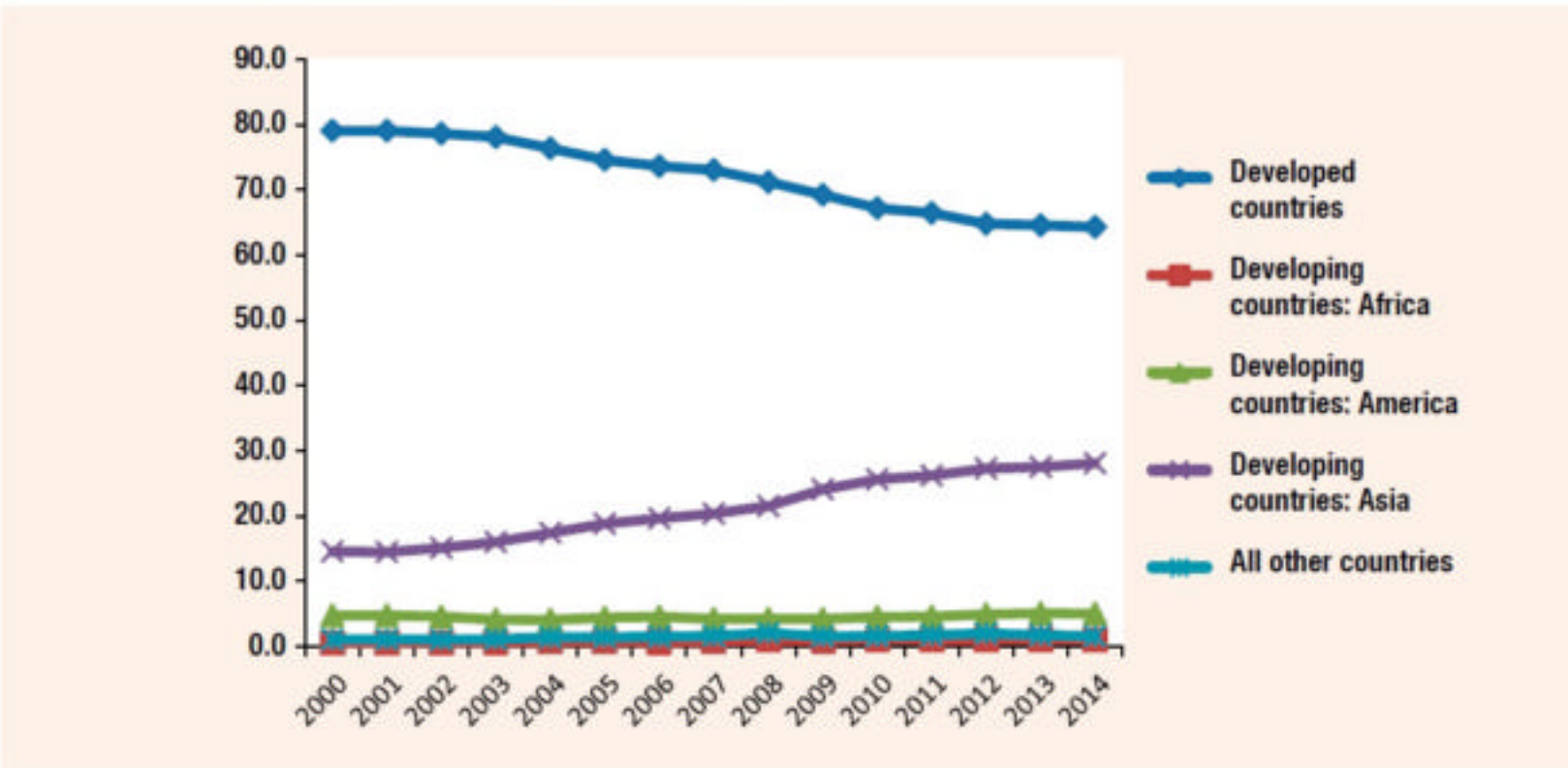
# Innovation Context

- Knowledge Economy Index (World Bank) – since 1995
- World Bank (Open Knowledge Repository)
  - Government as the “Gardener of Innovation”
- The Global Innovation Index (INSEAD) – since 2008 (*143 economies around the world using 81 indicators*)
- Global Business Leaders Conference (INSEAD) – since 2012
- Research and Innovation Performance in the EU: Innovation Union Progress at Country Level (2014) – data from 2011
- Innovation Union Scoreboard (2014) ) - 8 years comparison
- UAE Innovation Strategy (2015)
- The Abu Dhabi Innovation Index (with INSEAD) (NRCs, using 38 indicators)
- Towards Abu-Dhabi Innovation Policy: Indicators, Benchmarking, and Natural Resource Rich Economies (IKED, 2010)



# Medium Technology Exports by Country Category

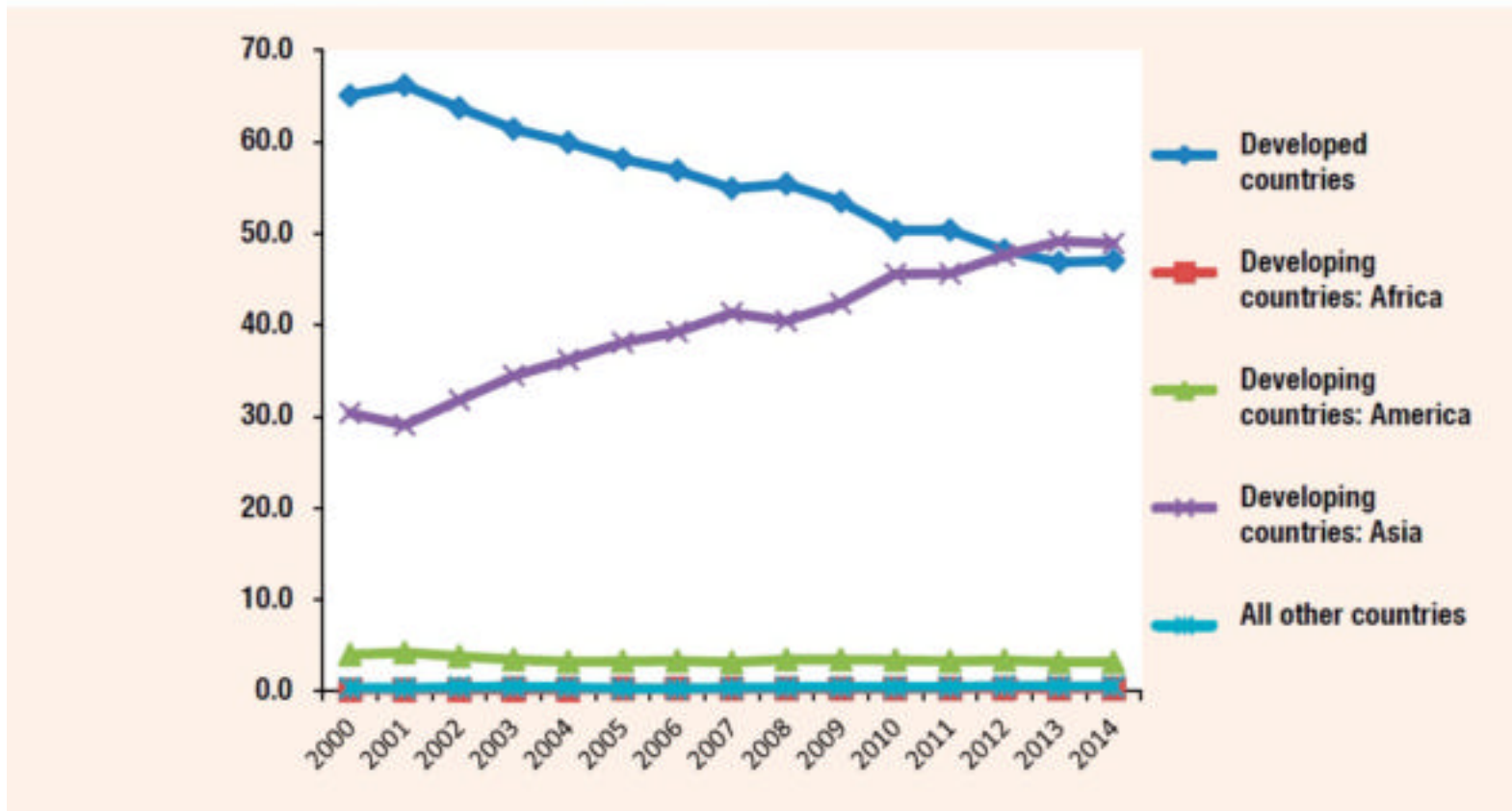
Figure 1.2: Distribution of medium-technology manufacturing exports by different country groups, 2000-2014 (in per cent)



Source: UNCTADstat (accessed on 20 Oct 2015).

# High Technology Exports by Country Category

Figure 1.3: Distribution of high-technology manufacturing exports by different country groups, 2000-2014 (in per cent)



Source: UNCTADstat (accessed on 20 Oct 2015).

# Innovation Capabilities and the Knowledge-Based Economy



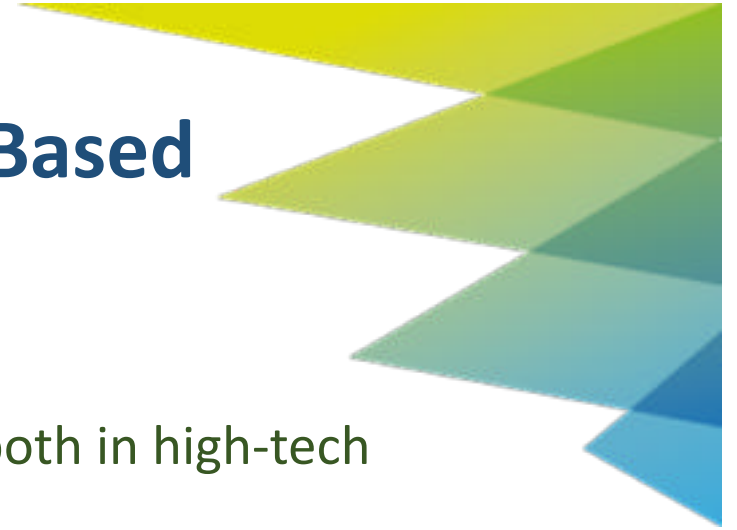
Innovation capabilities, as well as technological capabilities, are the result of learning processes, which are conscious and purposeful, costly and time-consuming, non-linear, path-dependent and cumulative.

OECD (Oslo Manual)

Innovations, therefore, emerge from the complex thinking, acting, and interacting of people going about their everyday work under certain framework conditions.

# Fundamentals of the Knowledge-Based Economy

- The advance of the knowledge-based economy both in high-tech and traditional sectors
- Government policy aiming to create public good
- Innovation policy must take into account the evolving interface between globalization, technical progress and organizational change
- The Factors of Global Production require continuous upgrade through innovation
  - ✓ Labour
  - ✓ Capital
  - ✓ Land
  - ✓ Technology
  - ✓ Knowledge
  - ✓ Entrepreneurship





# Further Elaboration on the Core Pillars of the Knowledge-Based Economy

- Education
- Free flow of information
- ICT infrastructure
- Cultural definitions of talent
- Encouraging Knowledge Hubs and Star-up Programmes
- Dispersed capabilities require match-making, facilitation, intermediation and coordination
- Global platform outreach
- Cross-border mobility
- Building regional comparative advantage
- Local market knowledge
- Global network access





# Evolution of Innovation Metrics



First Generation Input Indicators (1950s–60s)	Second Generation Output Indicators (1970s–80s)	Third Generation Innovation Indicators (1990s)	Fourth Generation Process Indicators (2000s plus emerging focus)
<ul style="list-style-type: none"><li>• R&amp;D expenditures</li><li>• S&amp;T personnel</li><li>• Capital</li><li>• Tech intensity</li></ul>	<ul style="list-style-type: none"><li>• Patents</li><li>• Publications</li><li>• Products</li><li>• Quality change</li></ul>	<ul style="list-style-type: none"><li>• Innovation surveys</li><li>• Indexing</li><li>• Benchmarking innovation capacity</li></ul>	<ul style="list-style-type: none"><li>• Knowledge</li><li>• Intangibles</li><li>• Networks</li><li>• Demand</li><li>• Clusters</li><li>• Management techniques</li><li>• Risk/return</li><li>• System dynamics</li></ul>

Source: Milbergs and Vonortas (2004)

# The 3 Strands of Innovation



# Pillars of the Knowledge Economy (World Bank)



Figure 1 The four pillars of the knowledge economy

<b>PILLAR 1</b> <b>Economic and institutional regime</b>	<b>PILLAR 2</b> <b>Education and skills</b>	<b>PILLAR 3</b> <b>Information and communication infrastructure</b>	<b>PILLAR 4</b> <b>Innovation system</b>
<p>The country's economic and institutional regime must provide incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.</p>	<p>The country's people need education and skills that enable them to create and share, and to use it well.</p>	<p>A dynamic information infrastructure is needed to facilitate the effective communication, dissemination, and processing of information..</p>	<p>The country's innovation system—firms, research centers, universities, think tanks, consultants, and other organizations—must be capable of tapping the growing stock of global knowledge, assimilating and adapting it to local needs, and creating new technology.</p>

# Knowledge Economy Pillars (WB)

<i>Pillar</i>	<i>Indicator</i>
Economic and institutional regime	<ul style="list-style-type: none"><li>• Tariff and non-tariff barriers</li><li>• Regulatory quality</li><li>• Rule of law</li></ul>
Education and skill of population	<ul style="list-style-type: none"><li>• Adult literacy rate</li><li>• Gross secondary enrollment rate</li><li>• Gross tertiary enrollment rate</li></ul>
Information infrastructure	<ul style="list-style-type: none"><li>• Telephones per 1,000 people</li><li>• Computers per 1,000 people</li><li>• Internet users per 1,000 people</li></ul>
Innovation system	<ul style="list-style-type: none"><li>• Royalty payments and receipts, US\$ per person</li><li>• Technical journal articles per million people</li><li>• Patents granted to nationals by the U.S. Patent and Trademark Office per million people</li></ul>





# Knowledge Assessment Methodology

## Basic Indicators

### **Performance**

Average annual GDP growth (%)  
Human Development Index

### **Economic Incentive and Institutional Regime**

Tariff and non-tariff barriers  
Regulatory Quality  
Rule of Law

### **Education and Human Resources**

Adult literacy rate (% age 15 and above)  
Secondary enrolment  
Tertiary enrolment

### **Innovation System**

Researchers in R&D, per million population  
Patent applications granted by the USPTO, per million population  
Scientific and technical journal articles, per million population

### **Information Infrastructure**

Telephones per 1,000 persons, (telephone mainlines + mobile phones)  
Computers per 1,000 persons  
Internet users per 10,000 persons

# Knowledge Economy and Economic Performance (WB 2008)

Figure 4. The Knowledge Economy and current economic performance



Source: World Bank.

# Knowledge Economy Improvement

Figure 3. The Knowledge Economy Index, 1995 and most recent

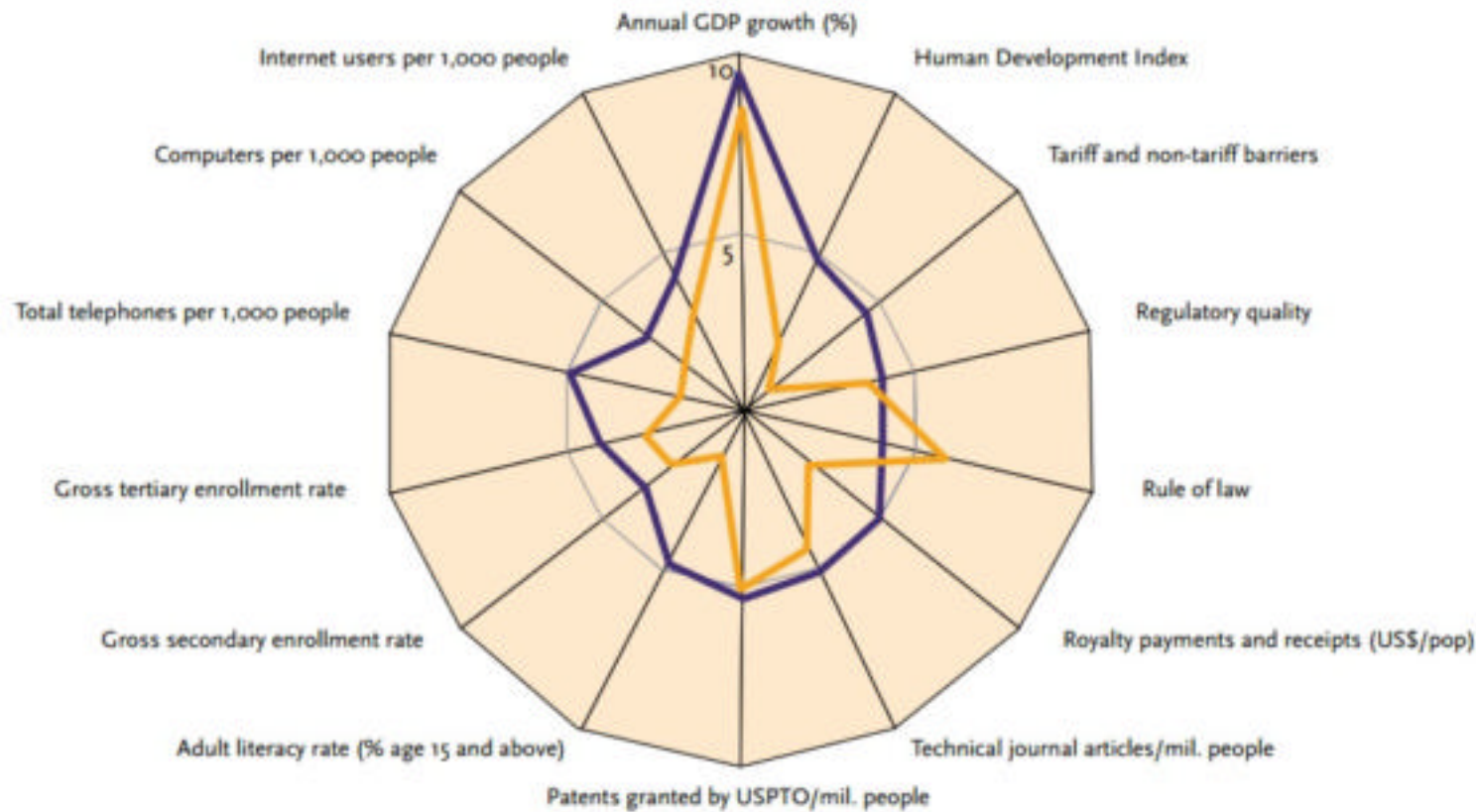


Source: KAM 2008



# China India Knowledge Economy WB

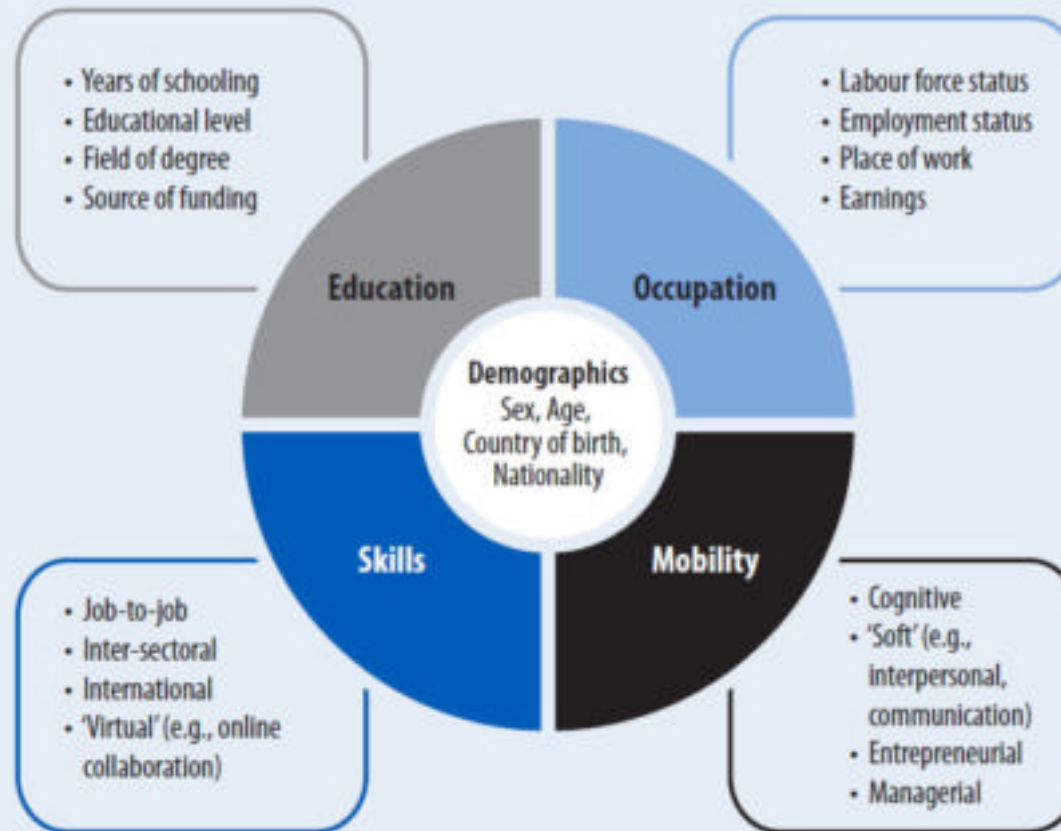
Figure 2. Basic Knowledge Economy Scorecard for China (—) and India (—)



Comparison group: All countries; Type: weighted; Year: most recent (KAM 2007—[www.worldbank.org/kam](http://www.worldbank.org/kam))

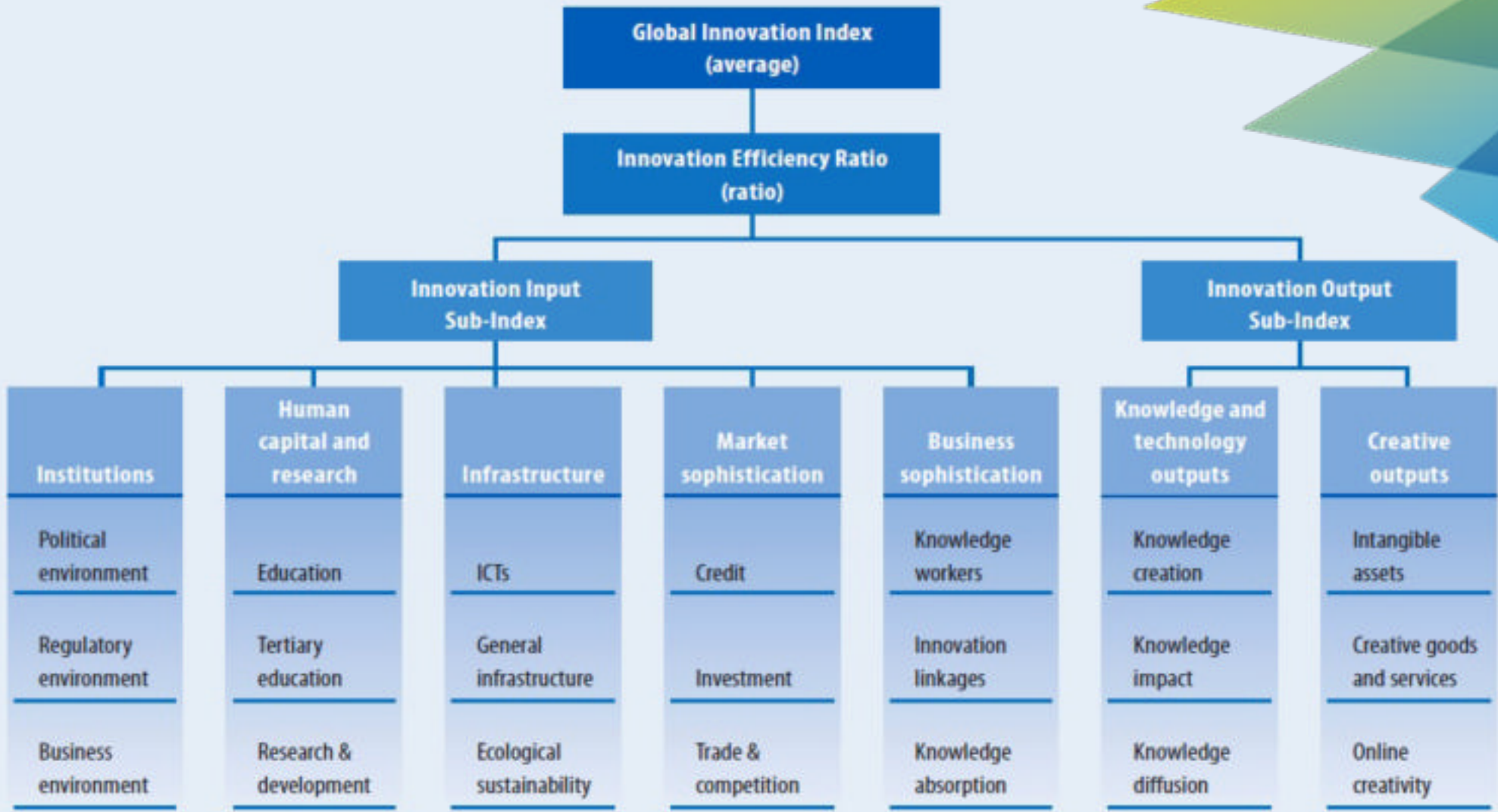
# GII Data Pillars

**Figure 1.1: Measurement dimensions of interest for a statistical and analytical framework of the highly skilled**



Source: OECD Secretariat.

Note: The variables listed in the figure are not exhaustive, but rather are a minimal set of variables for which data are considered most informative.



**Global Innovation Index  
(average)**

**Innovation Efficiency Ratio  
(ratio)**

**Innovation Input  
Sub-Index**

**Innovation Output  
Sub-Index**

**Institutions**

Political environment

Regulatory environment

Business environment

**Human capital and research**

Education

Tertiary education

Research & development

**Infrastructure**

ICTs

General infrastructure

Ecological sustainability

**Market sophistication**

Credit

Investment

Trade & competition

**Business sophistication**

Knowledge workers

Innovation linkages

Knowledge absorption

**Knowledge and technology outputs**

Knowledge creation

Knowledge impact

Knowledge diffusion

**Creative outputs**

Intangible assets

Creative goods and services

Online creativity



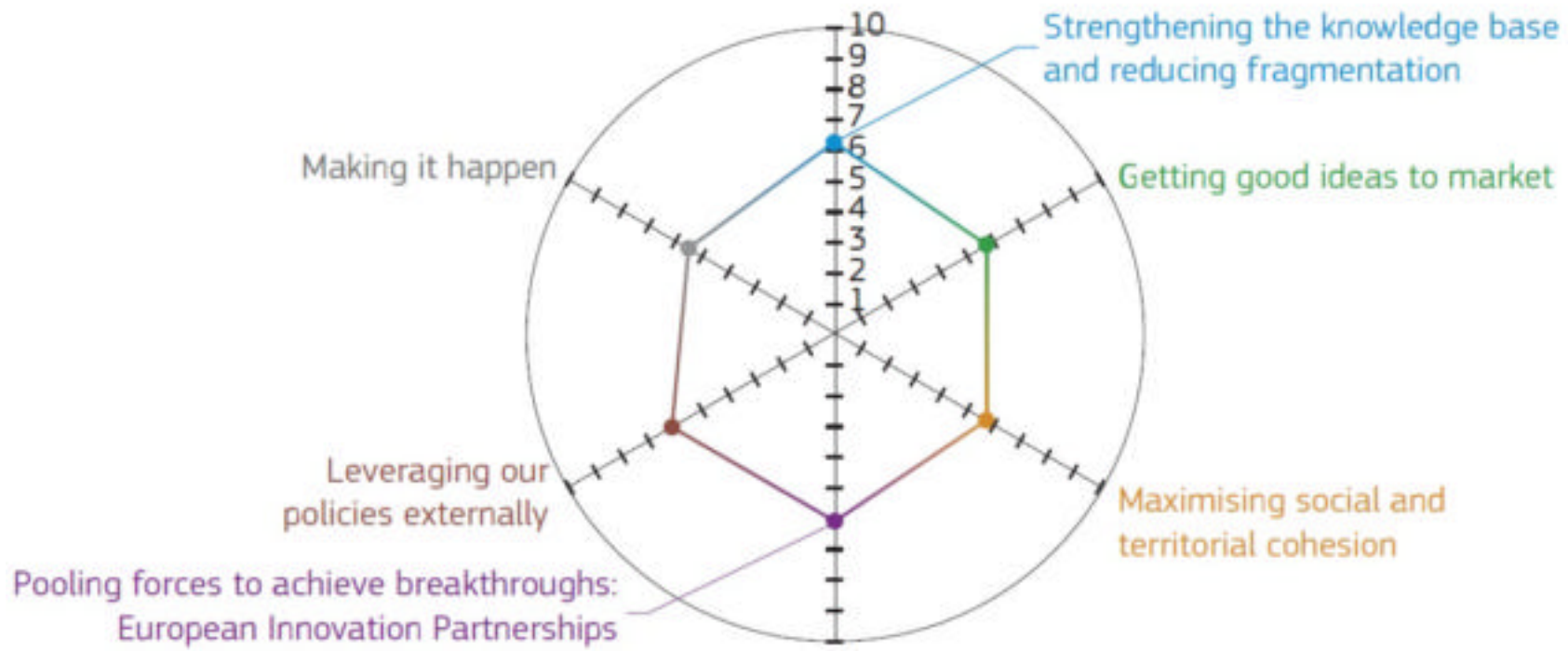
# Key Challenges of the Innovation Union

- **Quality of the science base**
- **Sufficient public research funding**
- **Adequate reforms of the public funding system**
- **Full mobilization of the capacities**
- **Developed framework conditions for business R&D**
- **Removing bottlenecks for firm growth in innovative sectors**
  
- **Participation in life-long learning**
- **Broadband access (ICT and key enabling technologies)**
- **Attitudes towards innovation**
- **Employment in strong clusters**
- **Availability of public financial support to innovators**





# Principles of the EU Innovation Policy



# EU Innovation Metrics



## Innovation Inputs (Enablers)

- (1) Institutions
- (2) Human capital and research
- (3) Infrastructure
- (4) Market sophistication
- (5) Business sophistication

## Innovation Outputs

- (6) Knowledge and technology outputs
- (7) Creative outputs

**The Innovation Efficiency Ratio** - is the ratio of the Output Sub-Index over the Input Sub-Index. It shows how much innovation output a given country is getting for its inputs.

**R&D Intensity** - The new indicator on innovation output is based on four components chosen for their policy relevance, data quality (international availability and cross-country comparability) and robustness of results:

- 1) technological innovation;
- 2) employment in knowledge-intensive activities (KIA);
- 3) competitiveness of knowledge-intensive goods and services;
- 4) employment in fast-growing firms of innovative sectors.

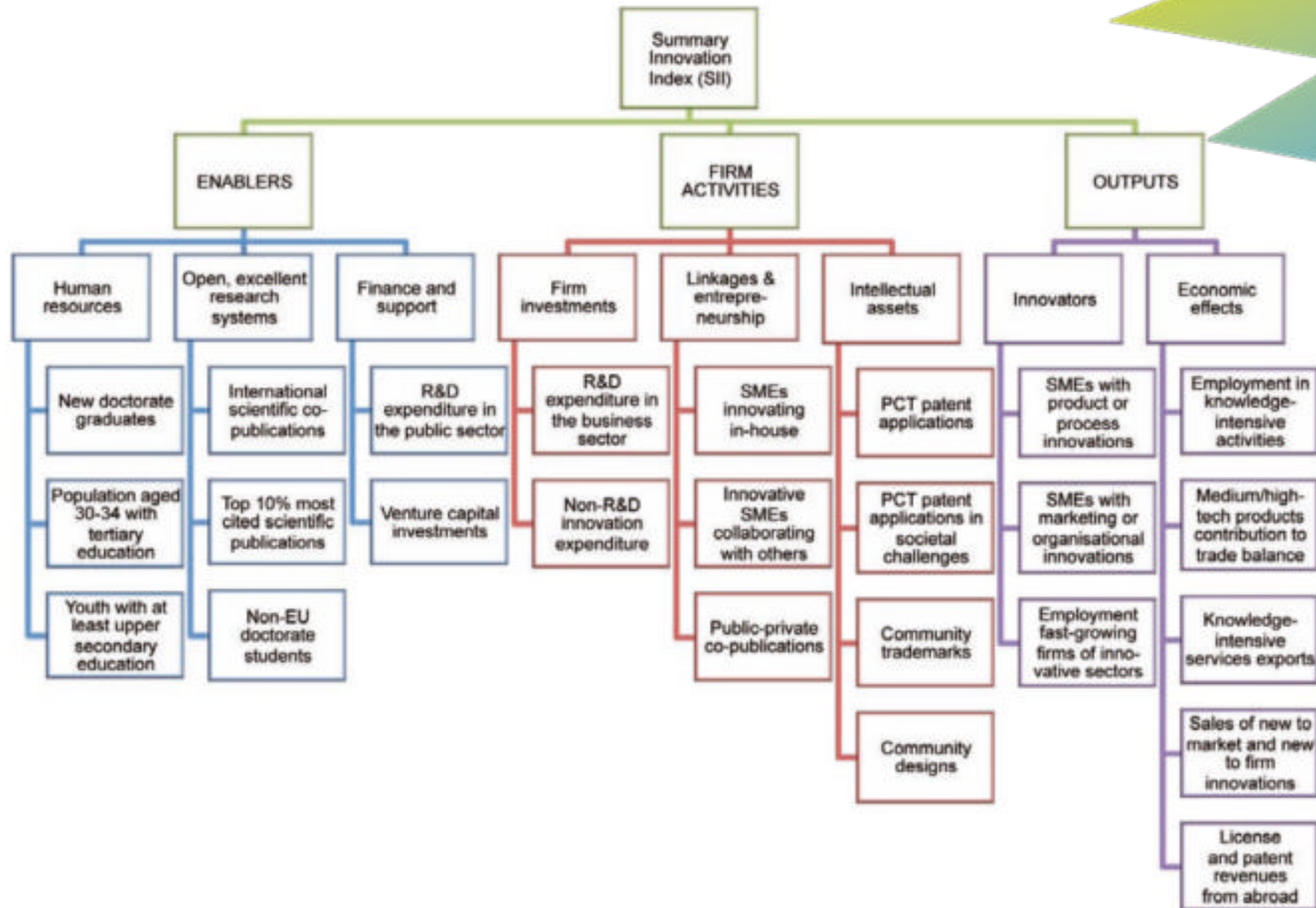


# Outputs from the Innovation System

- **(Labour) Productivity**
- **Diversification**
- **Science and Technology Output**
- **Entrepreneurship**
- **Human capital – skills, tertiary education and doctoral training**
- **Mobility**
- **Quality of living**
- **Connectivity and ‘hub-ness’**



# Innovation Union Scoreboards Indicators



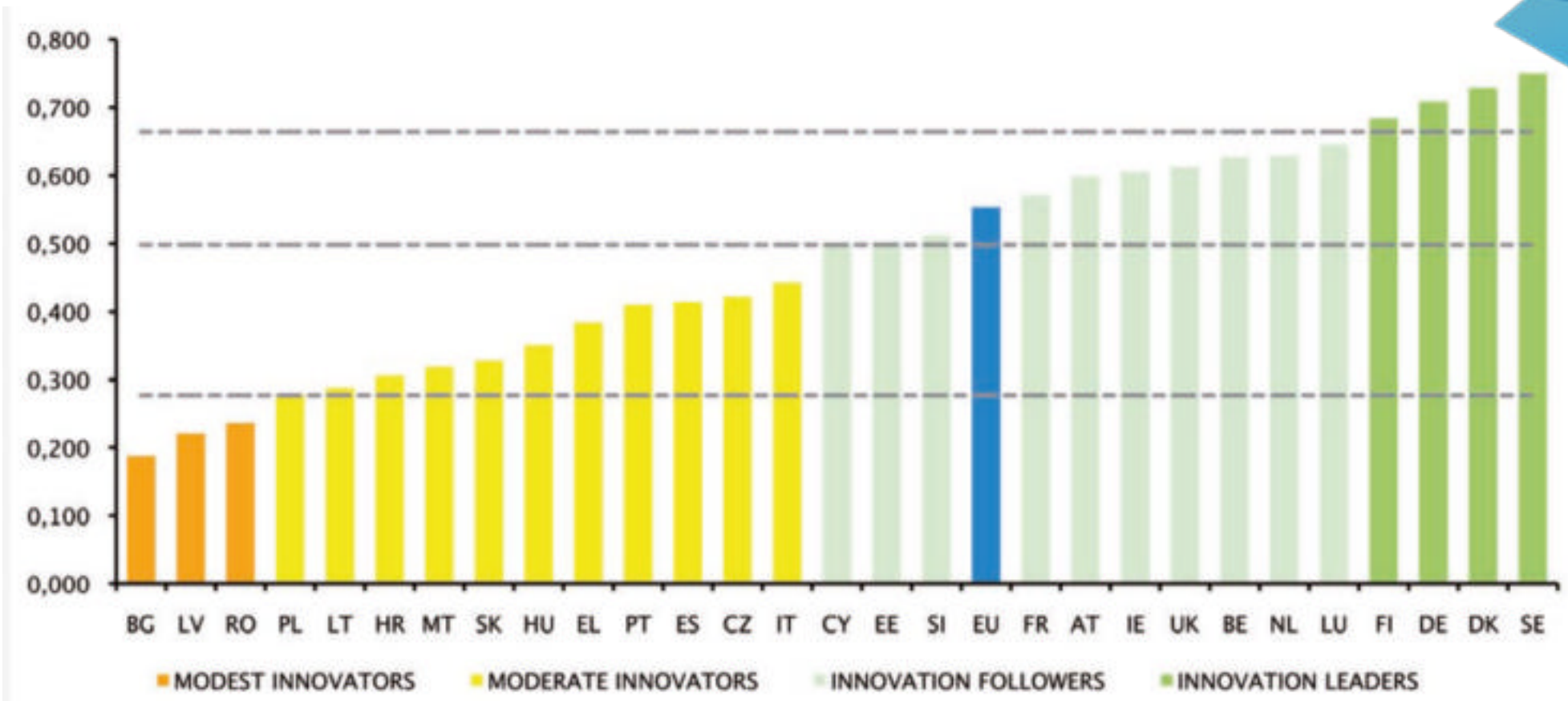
# EU Innovation Performance (2011)

EU27

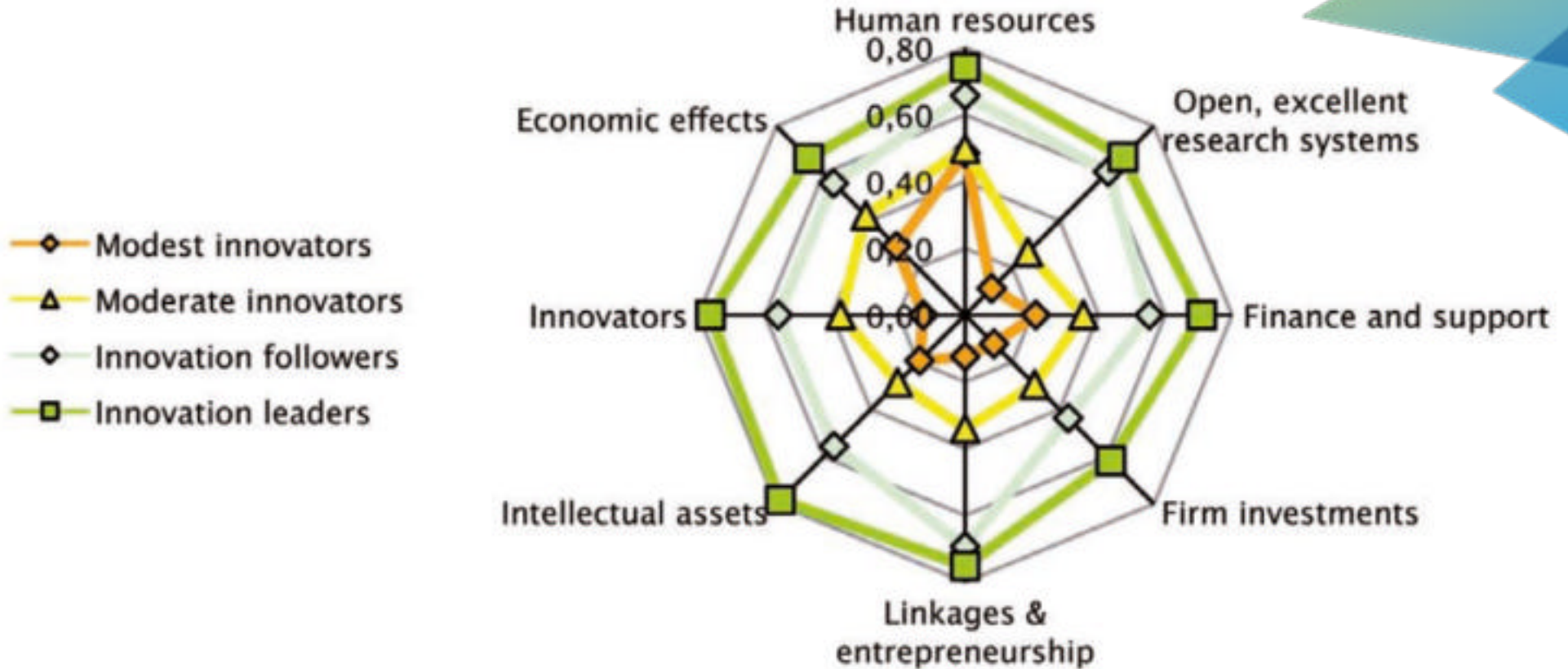
ENABLERS	
Human resources	
1.1.1 New doctorate graduates	1,7
1.1.2 Population completed tertiary education	35,8
1.1.3 Youth with upper secondary level education	80,2
Open, excellent and attractive research systems	
1.2.1 International scientific co-publications	343
1.2.2 Scientific publications among top 10% most cited	11,0
1.2.3 Non-EU doctorate students	24,2
Finance and support	
1.3.1 R&D expenditure in the public sector	0,75
1.3.2 Venture capital investments	0,277
FIRM ACTIVITIES	
Firm investments	
2.1.1 R&D expenditure in the business sector	1,31
2.1.2 Non-R&D innovation expenditure	0,56
Linkages & entrepreneurship	
2.2.1 SMEs innovating in-house	31,8
2.2.2 Innovative SMEs collaborating with others	11,7
2.2.3 Public-private co-publications	7,3
Intellectual Assets	
2.3.1 PCT patent applications	1,98
2.3.2 PCT patent applications in societal challenges	0,92
2.3.3 Community trademarks	5,91
2.3.4 Community designs	4,75
OUTPUTS	
Innovators	
3.1.1 SMEs introducing product or process innovations	38,4
3.1.2 SMEs introducing marketing/organisational innovations	40,3
3.1.3 Fast-growing innovative firms	16,2
Economic effects	
3.2.1 Employment in knowledge-intensive activities	13,9
3.2.2 Contribution MHT product exports to trade balance	1,27
3.2.3 Knowledge-intensive services exports	45,3
3.2.4 Sales of new to market and new to firm innovations	14,4
3.2.5 License and patent revenues from abroad	0,77



# EU Member States Innovation Performance



# EU member R&I Performance per Country Group and per Dimension



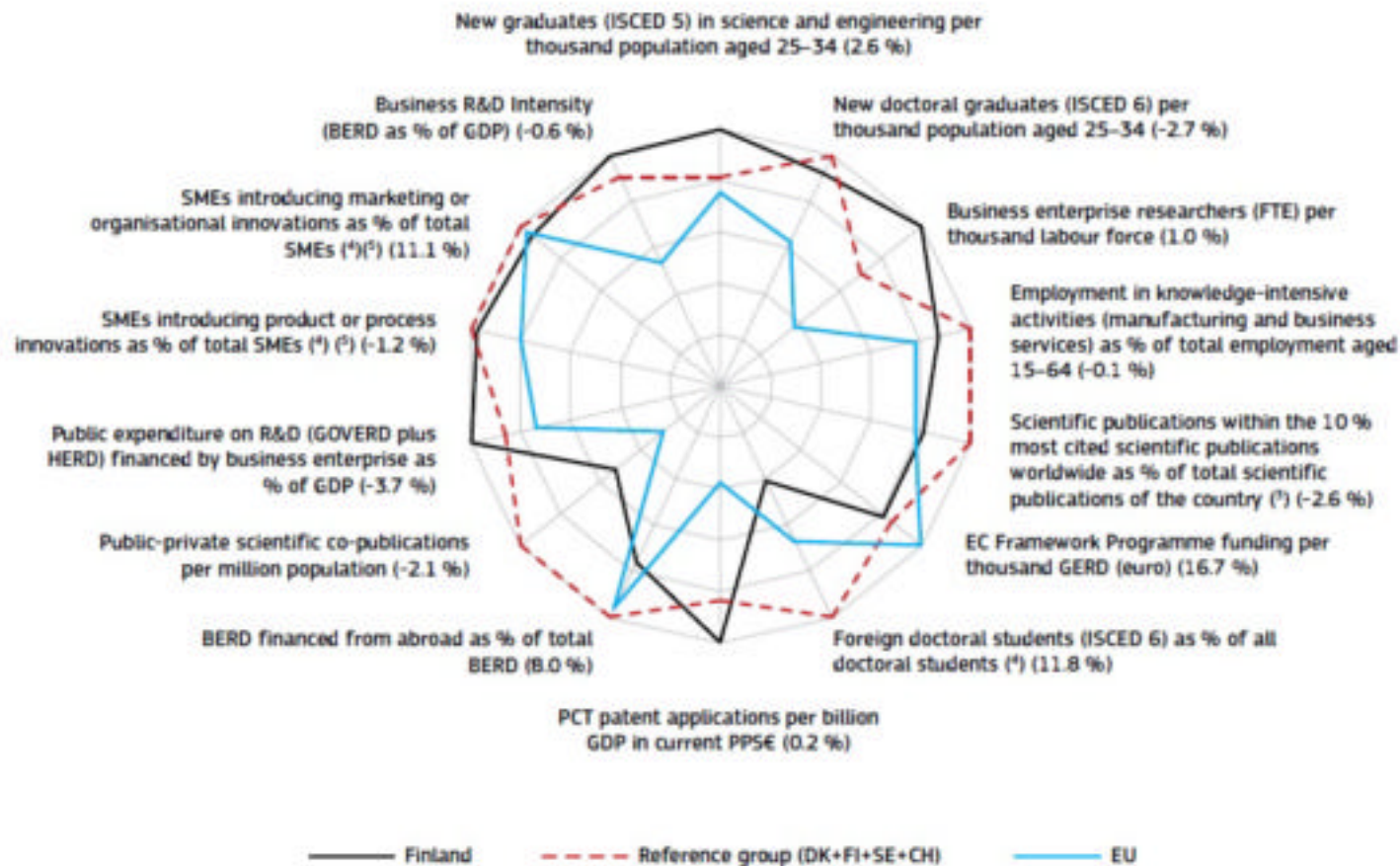


# EU R&I Performance Member States 2014 (2012)

	Country	R&D intensity (%) 2012		Excellence in S&T 2012		Innovation output indicator (%) 2012	Knowledge- intensity of economy 2012		HT&MT contribution to trade balance (%) 2012	
		value	growth rate (%)	value	growth rate (2007-2012)		value	growth rate (2007-2012)	value	growth rate (%)
EU	European Union	2.07 %	+2.4 %	47.8	+2.9 %	101.6	51.2	+1.0 %	4.2 %	+4.8 %
AT	Austria	2.84 %	+2.5 %	51.9	+3.6 %	100.1	45.3	+1.7 %	3.5 %	+10.0 %
BE	Belgium	2.24 %	+3.4 %	61.1	+3.2 %	94.8	60.8	+0.7 %	2.3 %	+7.0 %
BG	Bulgaria	0.64 %	+7.1 %	24.5	+0.3 %	65.3	33.5	+2.8 %	-5.2 %	n.a.
HR	Croatia	0.75 %	-1.3 %	18.9	+9.6 %	68.1	n.a.	n.a.	1.0 %	+44.8 %
CY	Cyprus	0.46 %	+0.9 %	28.1	+1.4 %	82.8	40.7	+0.3 %	2.4 %	+31.9 %
CZ	Czech Republic	1.88 %	+6.6 %	26.1	+0.7 %	89.7	41.4	+1.6 %	3.8 %	+1.5 %
DK	Denmark	2.98 %	+3.0 %	81.1	+4.4 %	114.6	56.2	+2.0 %	-3.3 %	n.a.
EE	Estonia	2.18 %	+15.1 %	29.4	+13.4 %	81.7	49.5	+2.7 %	-2.9 %	n.a.
FI	Finland	3.55 %	+0.5 %	69.9	+5.1 %	115.7	55.8	+0.4 %	1.2 %	-5.7 %
FR	France	2.29 %	+1.0 %	49.5	+3.4 %	105.6	58.1	+0.5 %	5.2 %	+2.2 %
DE	Germany	2.98 %	+3.3 %	59.0	+2.2 %	124.2	47.1	+1.0 %	9.2 %	+1.7 %
EL	Greece	0.69 %	+0.6 %	27.2	-1.9 %	76.3	31.6	+0.8 %	-5.4 %	n.a.
HU	Hungary	1.30 %	+5.7 %	31.5	+2.4 %	92.0	54.4	+2.3 %	5.6 %	+4.5 %
IE	Ireland	1.72 %	+6.1 %	60.9	+14.6 %	116.5	68.2	+3.5 %	2.0 %	+11.6 %
IT	Italy	1.27 %	+1.5 %	36.5	-0.5 %	84.3	37.2	+0.9 %	4.8 %	+2.5 %
LV	Latvia	0.66 %	+2.0 %	19.9	+6.5 %	63.8	37.6	+3.5 %	-4.9 %	n.a.
LT	Lithuania	0.90 %	+2.2 %	14.1	+1.2 %	57.9	32.7	+1.7 %	-0.8 %	n.a.
LU	Luxembourg	1.46 %	-1.6 %	23.5	+1.6 %	116.4	68.1	+1.5 %	-4.4 %	n.a.
MT	Malta	0.84 %	+8.1 %	23.3	+5.6 %	84.8	55.3	+2.1 %	3.4 %	-18.4 %
NL	Netherlands	2.16 %	+0.9 %	79.7	+2.9 %	95.5	61.0	+0.1 %	0.9 %	+24.0 %
PL	Poland	0.90 %	+9.7 %	20.0	+9.8 %	81.4	34.8	+1.5 %	0.6 %	+14.7 %
PT	Portugal	1.50 %	-0.1 %	27.3	+3.7 %	70.1	42.6	+2.3 %	-0.3 %	n.a.
RO	Romania	0.49 %	-4.2 %	13.2	+2.3 %	78.0	27.5	+3.5 %	0.4 %	-14.2 %
SK	Slovakia	0.82 %	+12.3 %	25.2	+8.5 %	85.7	32.0	+0.6 %	3.9 %	+12.2 %
SI	Slovenia	2.80 %	+12.7 %	28.8	+9.9 %	87.4	50.3	+3.7 %	6.5 %	+9.4 %
ES	Spain	1.30 %	+0.5 %	33.2	+0.4 %	80.8	38.0	+2.1 %	3.3 %	+15.9 %
SE	Sweden	3.41 %	-0.2 %	87.9	+5.5 %	122.4	65.3	+2.0 %	1.8 %	+0.5 %
UK	United Kingdom	1.72 %	-0.3 %	63.5	+5.2 %	110.3	60.7	+0.6 %	4.2 %	+9.2 %

► Finland, 2012 <sup>(1)</sup>

In brackets: average annual growth for Finland, 2007–2012 <sup>(2)</sup>



# Finland Innovation Performance

Source: DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies

Data: DG Research and Innovation, Eurostat, OECD, Science-Matrix/Scopus (Elsevier), Innovation Union Scoreboard.

Notes: <sup>(1)</sup> The values refer to 2012 or to the latest available year.

<sup>(2)</sup> Growth rates which do not refer to 2007–2012 refer to growth between the earliest available year and the latest available year for which comparable data are available over the period 2007–2012.

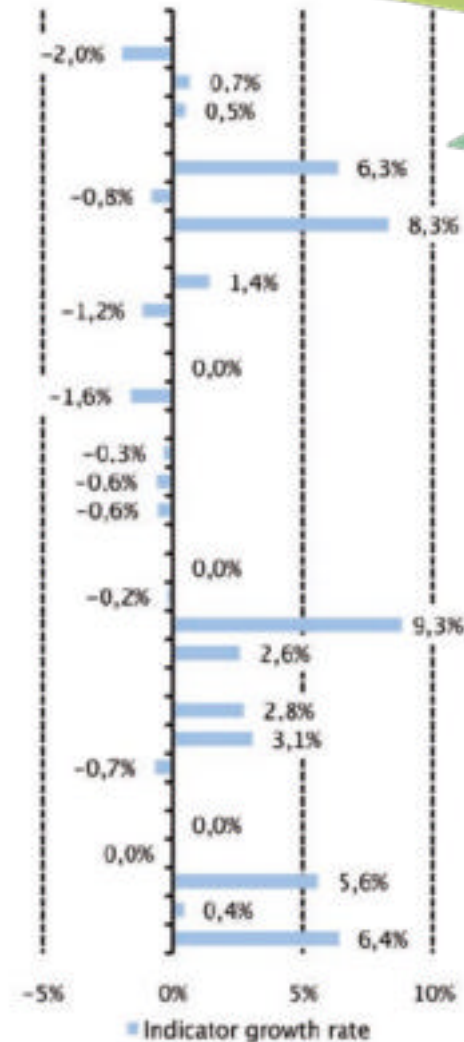
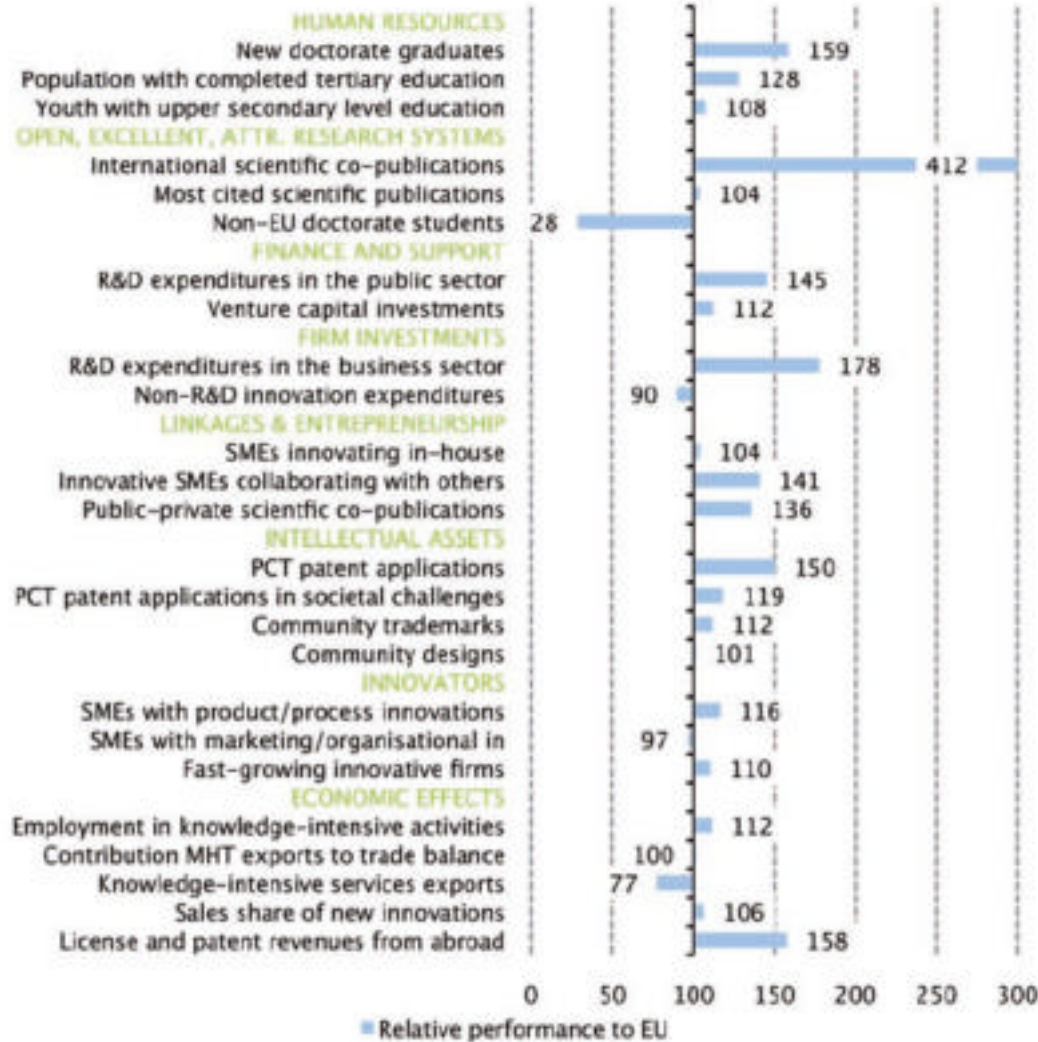
<sup>(3)</sup> Fractional counting method.

<sup>(4)</sup> EU does not include EL.

<sup>(5)</sup> CH is not included in the reference group.

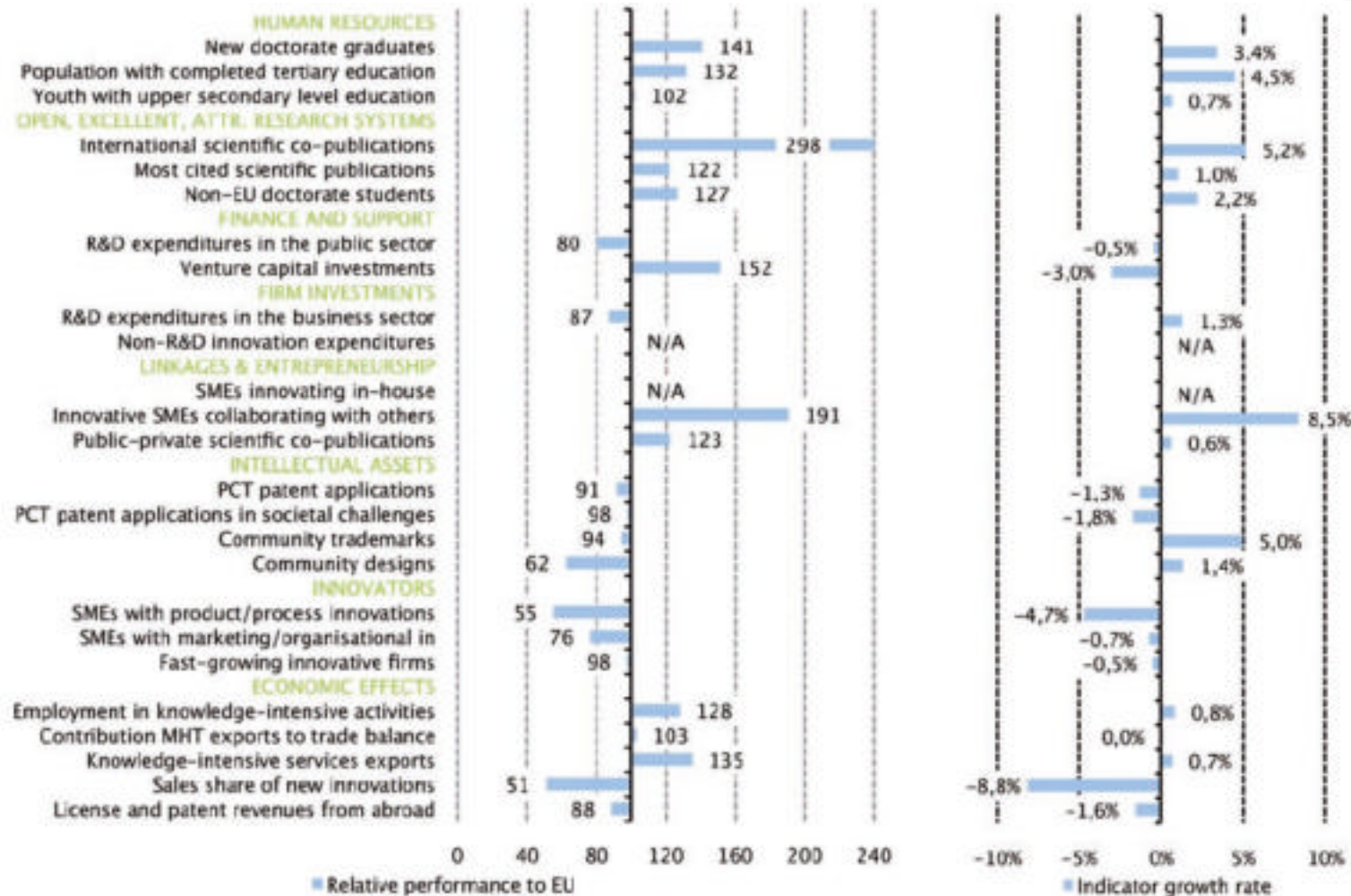


# Innovation performance Finland



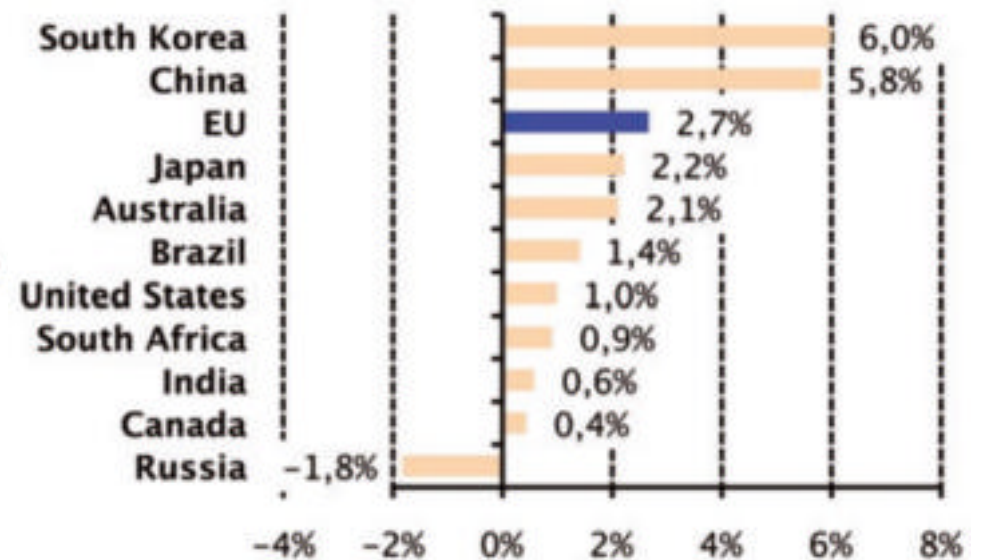
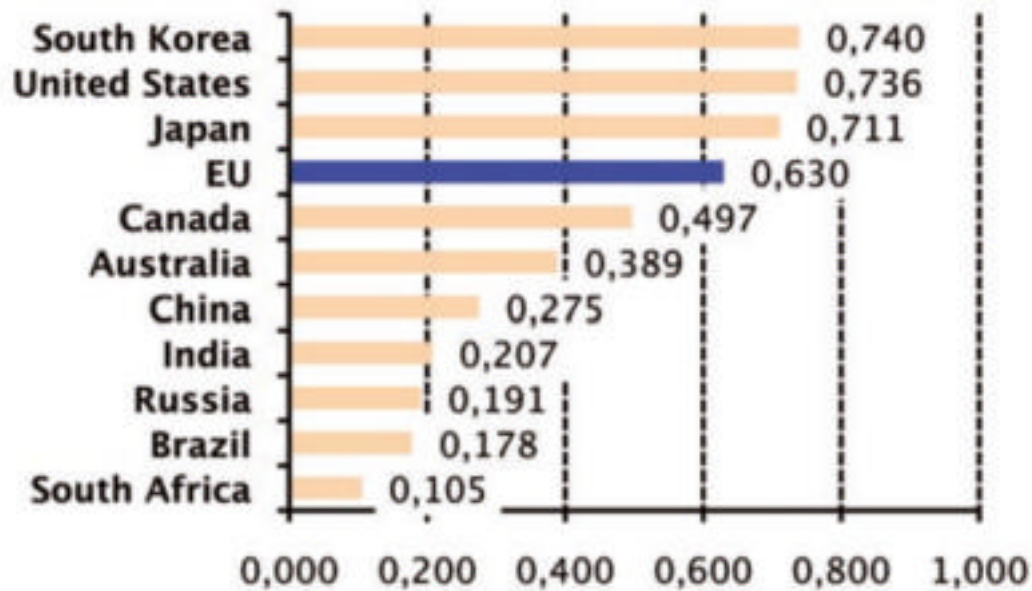
Notes: Performance relative to the EU where the EU = 100.

# Innovation Performance UK



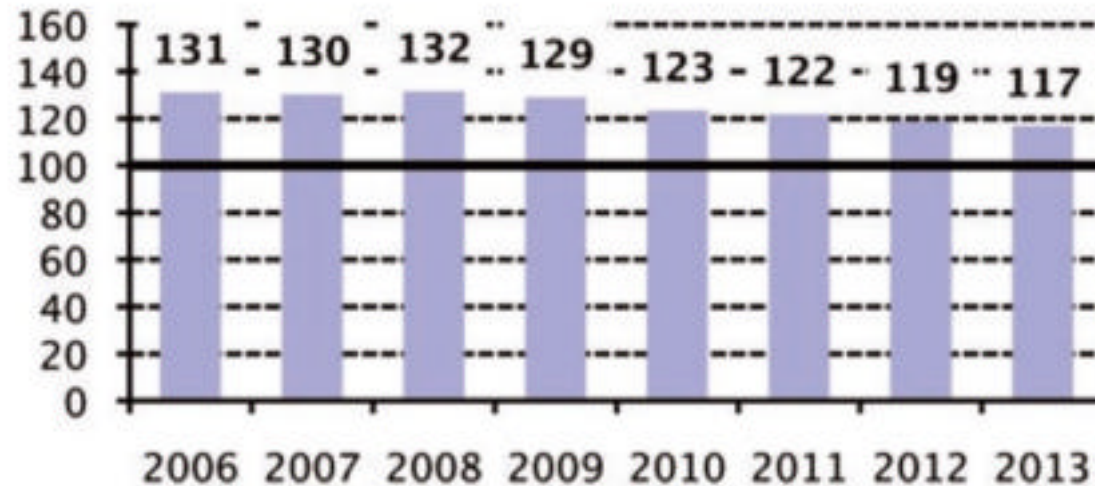
Notes: Performance relative to the EU where the EU = 100. No data for Non-R&D innovation expenditures and SMEs innovating in-house.

# Global Innovation Performance and Growth Rate





# Innovation Performance: United States

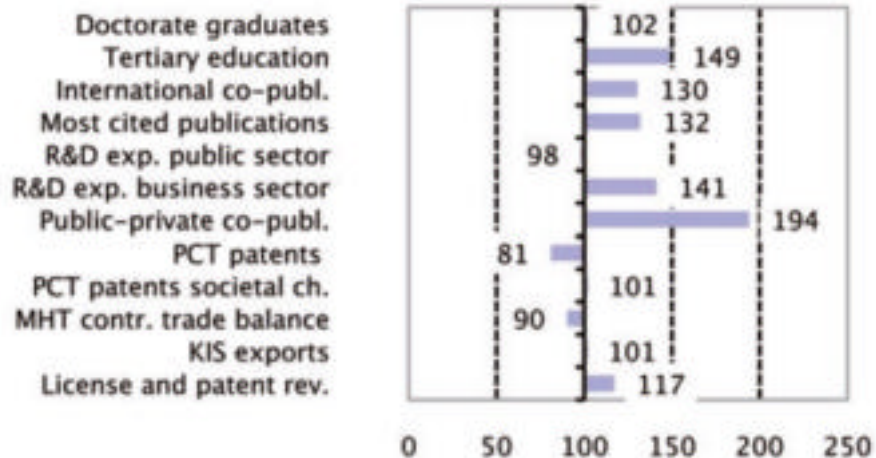


*The performance scores are calculated by dividing the US innovation index by that of the EU and multiplying by 100. The bold line shows average EU performance at 100 (EU=100).*

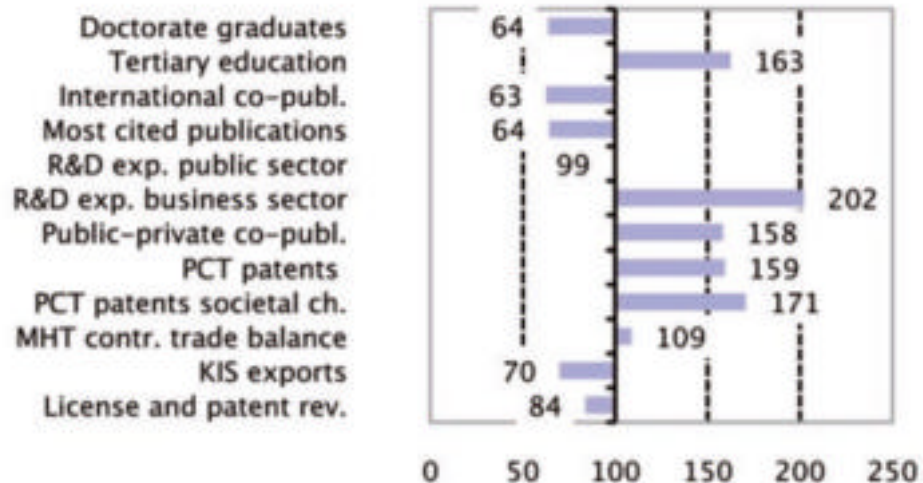
**The strongest relative declines in US innovation performance are observed for:**

- License and patent revenues from abroad,
- Patent applications in societal challenges and
- International scientific co-publications

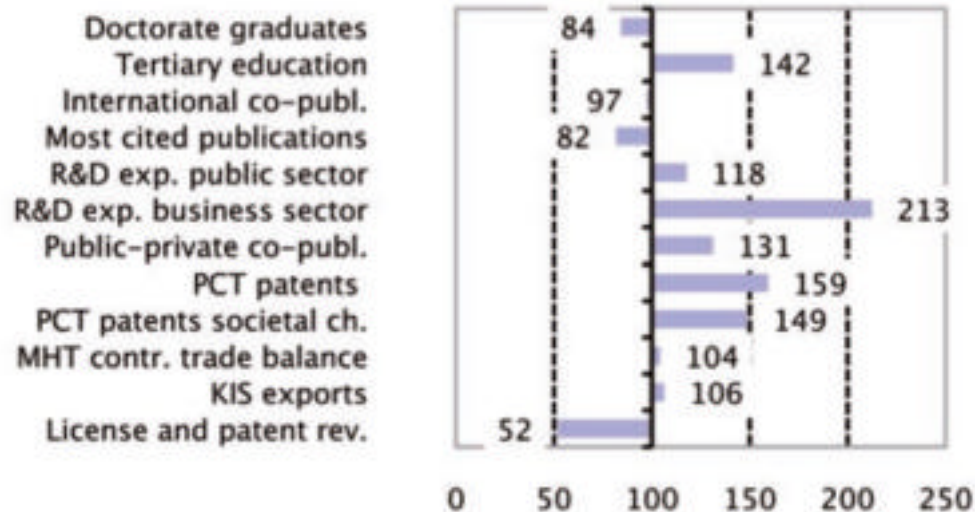
# Performance Lead United States, Japan and South Korea



The scores are calculated by dividing the US indicator value by that of the EU and multiplying by 100.



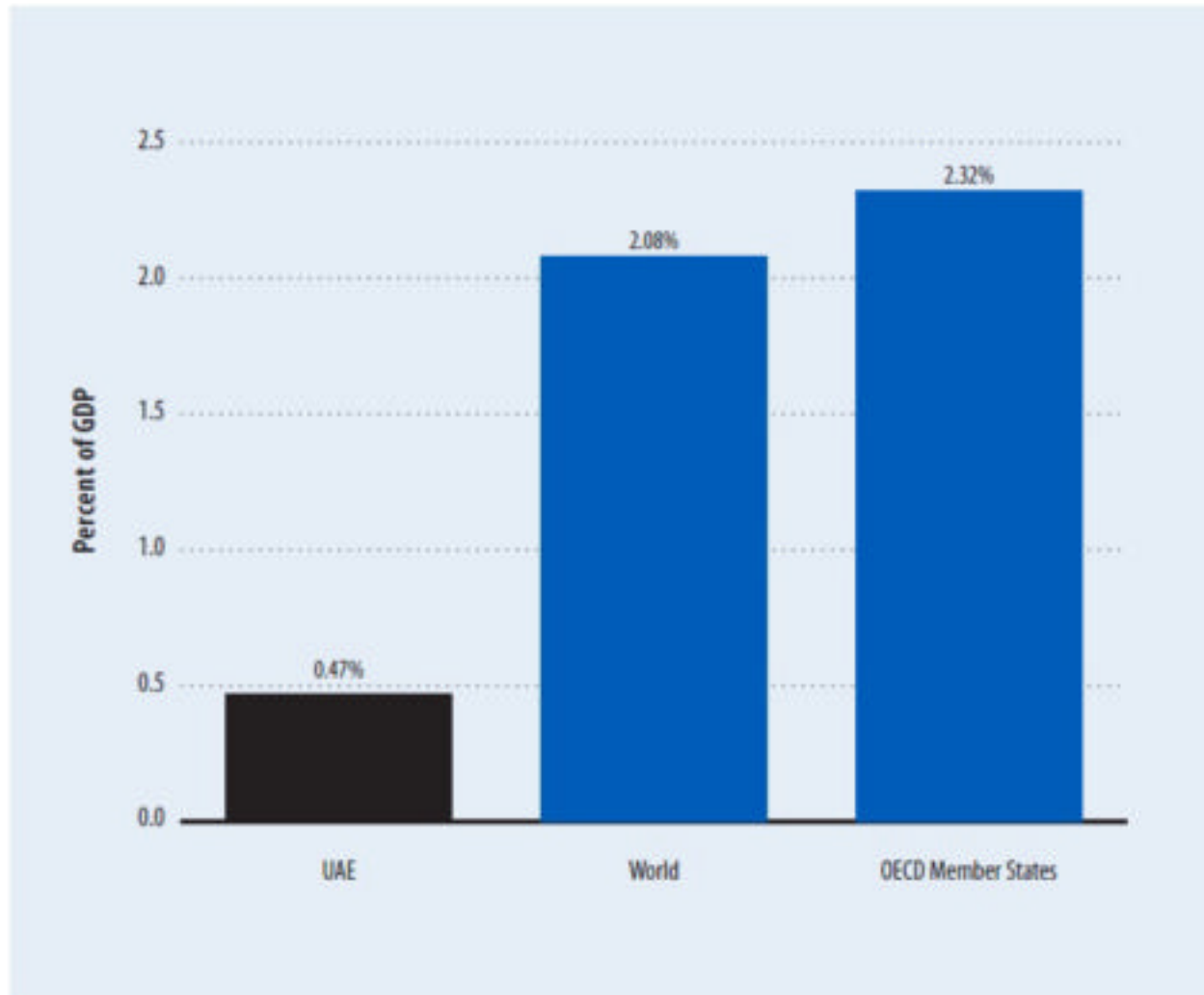
The scores are calculated by dividing the Japanese indicator value by that of the EU and multiplying by 100.



The scores are calculated by dividing the South Korean indicator value by that of the EU and multiplying by 100.

# UAE R&D Expenditure

Figure 4: R&D expenditure as a % of GDP (2011)



Source: World and OECD average data: World Bank, 2013; UAE data: Strategy& analysis.

# Challenges Towards Innovation Policy in UAE

*(IKED, 2010)*

- A. How to lay the basis for a culture of science and research, and link it to the real economy?
- B. How to generate the basis and driving forces for innovation, risk-taking and entrepreneurship?
- C. How to select priority areas for diversification and how to support them?
- D. How to combine increased local dynamism with more effective plugging into global knowledge chains?
- E. How to summon stakeholders to back new growth trajectories within a constructive win-win framework?
- F. How to attract or upgrade relevant skills in the work force and how to put such skills to appropriate use, in support of innovation?
- G. How to strengthen the motivation for innovation, among individuals and firms alike?





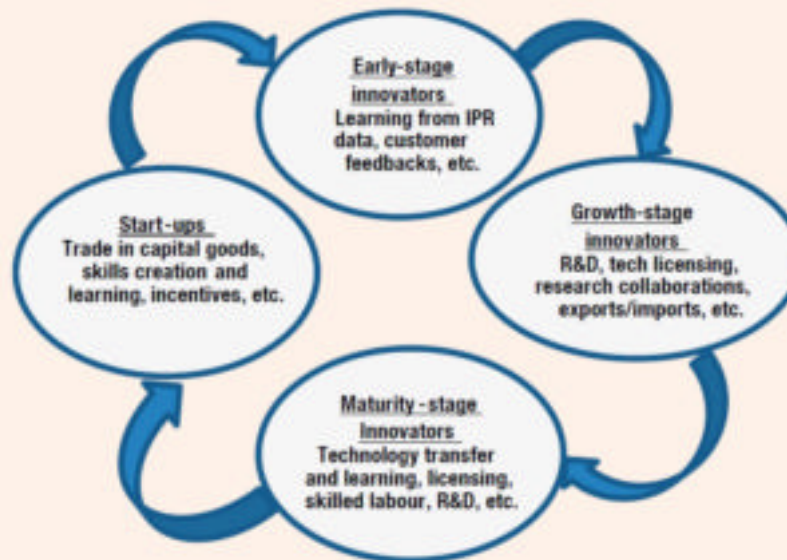
# Challenges for UAE Innovation System

- **Economic diversification**
- **High Turnover of Expatriate's Creative Class**
- **Weak and ad hoc (versus systematic) ties among talented individuals belonging to different organizations**
- **Lacking wellbeing and environmental sustainability policy**
- **Support for growth of entrepreneurship**
- **Low R&D activity and technical innovation**
- **Weak mobilizing of human resources and investment to match opportunities for economic and business development**
- **Governance of innovation collaboration**



# Learning Stages

Figure 2.3: Technological learning, technology flows and technological absorption: Factors and feedback loops



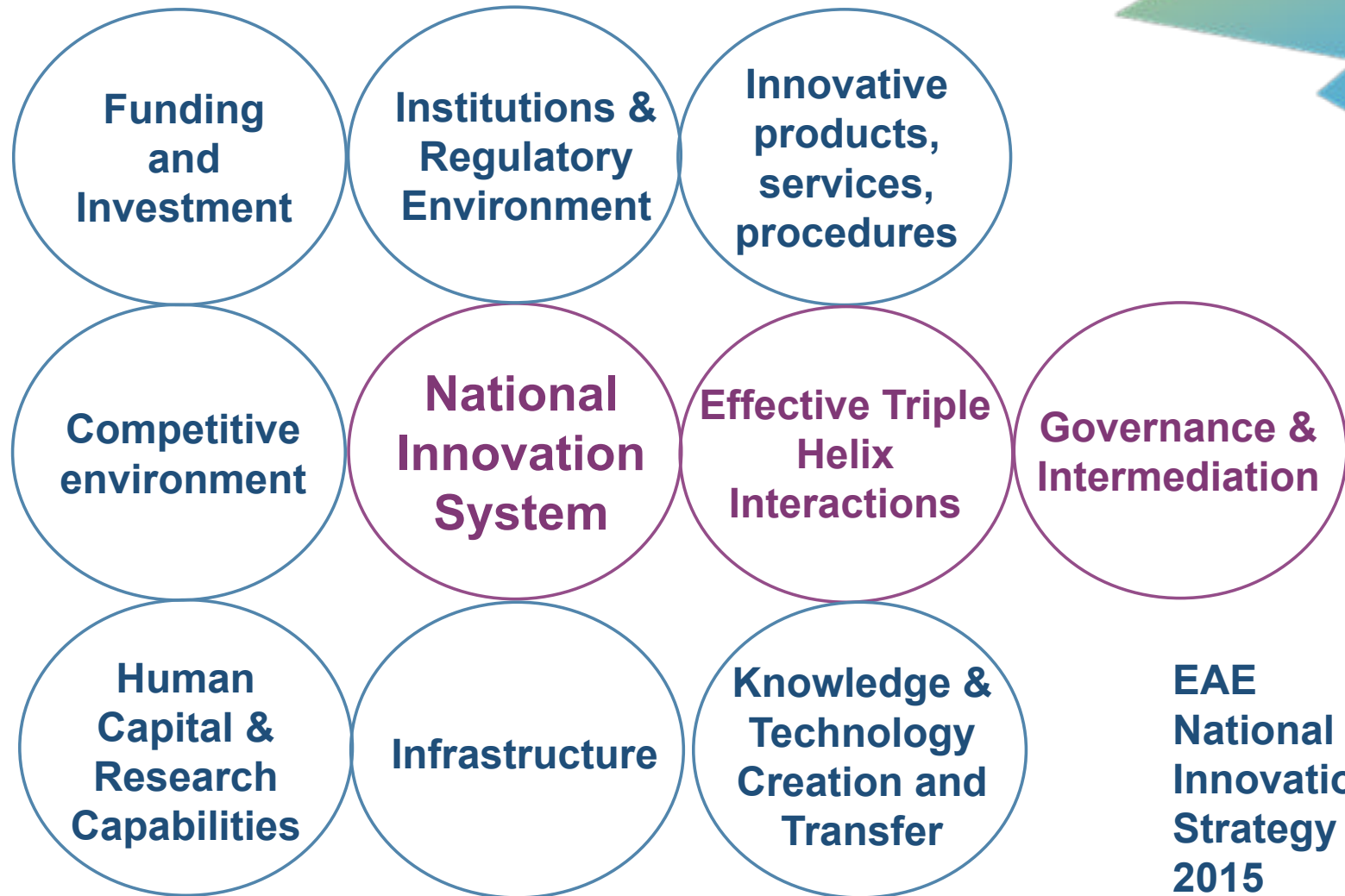
Source: UNCTAD.

## Nurturing the human factor in innovation

- **Connectivity**
- **Growing talent and enabling it – the balance between education and entrepreneurship**
- **Mobility**
- **Innovation activities and skills**

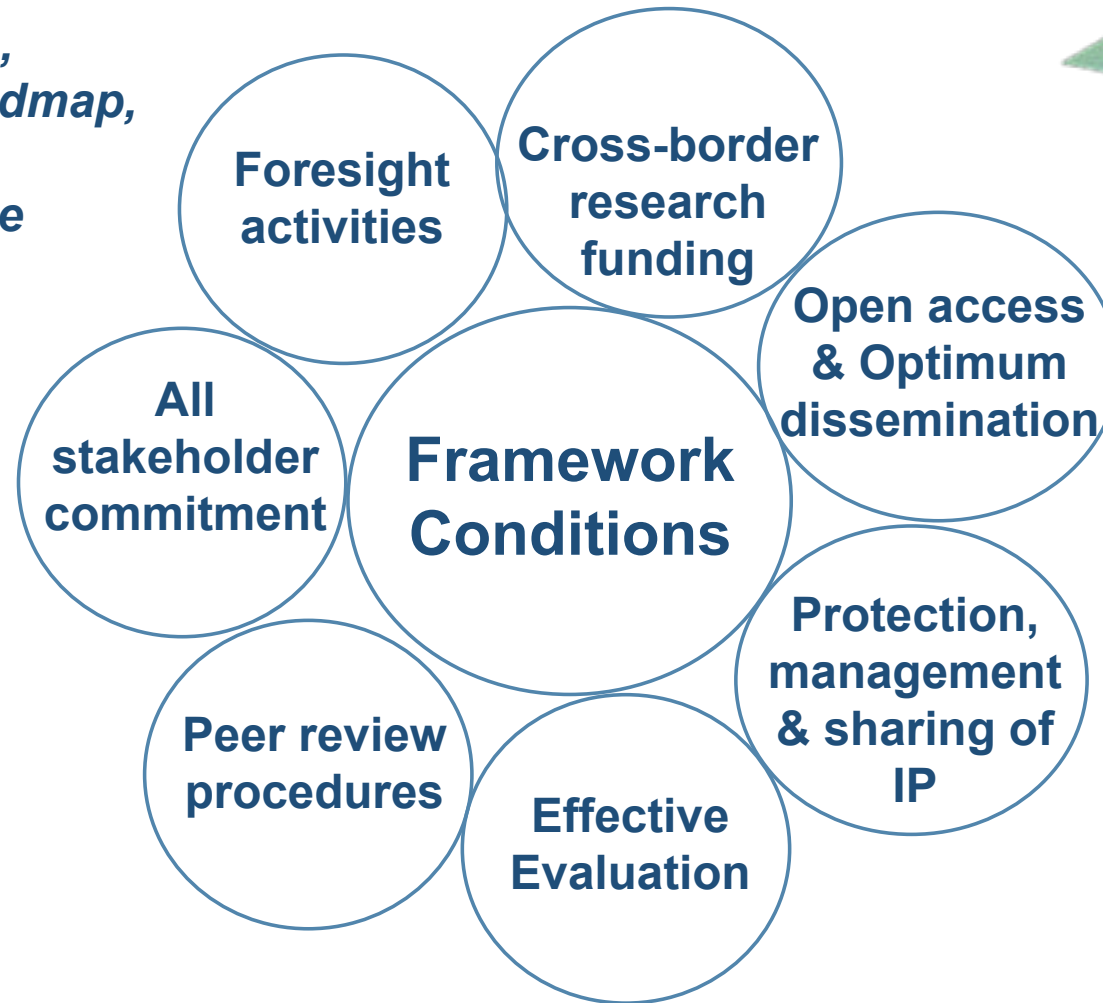


# From Key Constituents of Innovation to Building a Coherent National Innovation System



# Smart Specialisation Strategy for Sustainable and Inclusive Growth

- *Realistic objectives,*
- *Implementation roadmap,*
- *Budget*
- *Full utilisation of the research potential*



EU, Joint Programming in Research, 2010



**We would like to engage with your questions and reactions – how Dubai and the UAE can meet the challenges of accelerated innovation performance?**





# Abu Dhabi Innovation Index

Pillar	Capacity Indicators	Performance Indicators
ACCESS	Internet Users per 100 people	Value Chain Presence
	Total Broadband per 100 people	Breadth of International Markets
	Extent of Business Internet Use	
	Extent of Trade Barriers	
	Quality of Infrastructure	
ANCHOR	Days for Starting a Business	Inward FDI Flow
	Number of Procedures	FDI and Technology Transfer
	Cost of Starting a Business	Foreign Born Immigrants
	Political Stability	
	Protecting Investors	
	Foreign Ownership Restrictions	
DIFFUSION	Literacy Rates	Firm Level Technology Adoption
	Quality of Education System	Buyer Sophistication
	Availability of Scientists and Engineers	Production Process Sophistication
	Extent of Staff Training	ICT Goods Imports
	Local Availability of Specialised Research and Training Services	Gross Capital Formation
CREATION	Gross Domestic Expenditure on R&D (GERD)	Scientific Publications per capita
	Company Spend on R&D	Patent Filings per capita
	Intellectual Property Protection	
	Quality of Scientific Research Institutions	
EXPLOITATION	Venture Capital Availability	Creative Goods
	Local Equity Market Access	Industry Value Added
	Government Procurement of Advanced Technology Products	Services Value Added

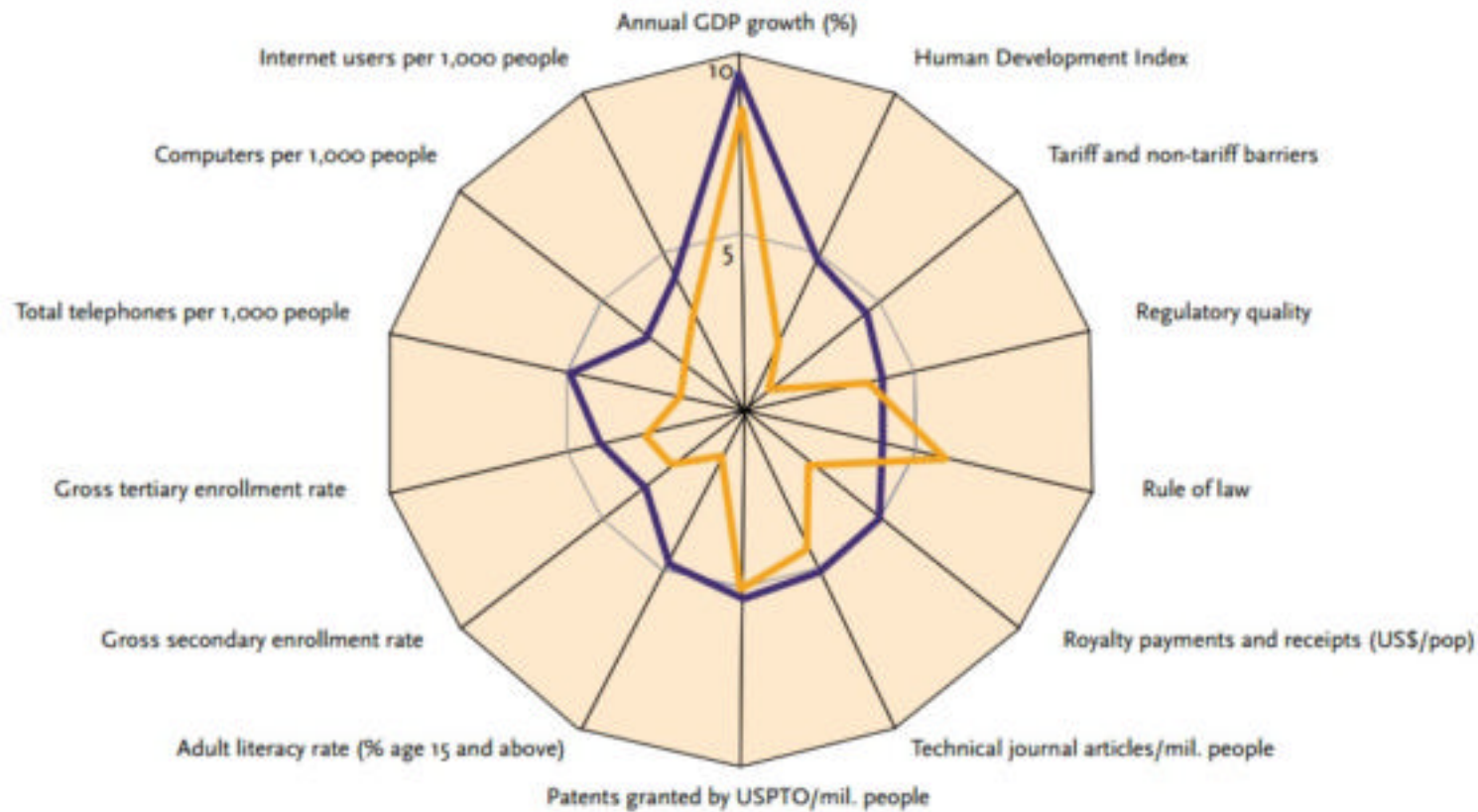


# Abo Dhabi Aggregate Innovation Index

Global Capacity Rank	Economy	Global Performance Rank	Economy
1	Finland	11	Canada
6	Qatar	14	Finland
9	Norway	21	Abu Dhabi
10	Canada	22	Australia
14	Australia	23	Norway
19	New Zealand	24	United Arab Emirates
22	Malaysia	25	Malaysia
24	Abu Dhabi	26	Saudi Arabia
26	United Arab Emirates	29	Qatar
27	Saudi Arabia	32	Brazil
29	Bahrain	35	New Zealand
30	Chile	37	Chile
32	Oman	39	South Africa
45	South Africa	48	Bahrain
57	Jordan	54	Russia
62	Kuwait	55	Jordan
67	Russia	61	Oman
70	Brazil	64	Argentina
77	Botswana	78	Nigeria
93	Nigeria	79	Kuwait
100	Argentina	106	Venezuela
132	Algeria	111	Botswana
140	Venezuela	115	Algeria

# China India Knowledge Economy WB

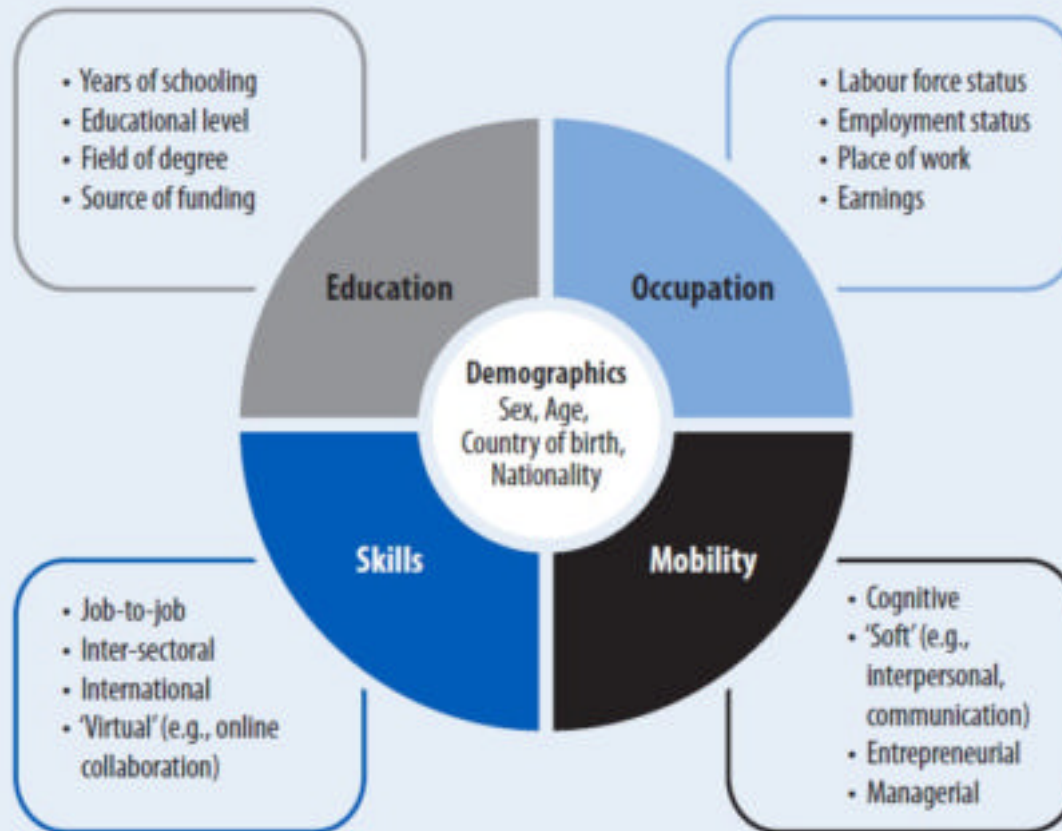
Figure 2. Basic Knowledge Economy Scorecard for China (—) and India (—)



Comparison group: All countries; Type: weighted; Year: most recent (KAM 2007—[www.worldbank.org/kam](http://www.worldbank.org/kam))

# GII Data Pillars

**Figure 1.1: Measurement dimensions of interest for a statistical and analytical framework of the highly skilled**



Source: OECD Secretariat.

Note: The variables listed in the figure are not exhaustive, but rather are a minimal set of variables for which data are considered most informative.