Innovation systems:
Chapters 3 and 4

Jean-Alain HÉRAUD

Chapter 3
Indicators

Jean-Alain Héraud

Measuring inputs and outputs of research

- Inputs of research
    - Expenses: R&D statistics (*)

    (*) Statistical definition of research : OECD "Frascati Manual"

    - Human input: research personnel (full time researchers, or part-time like university teaching personnel)
- Outputs of research (regular examples)
    - Science: publications
    - Technology: patents
    - Innovation: no easy straight-forward definition and quantitative evaluation, but there are national and international enquiries (**)

    (**) Statistical definition of innovation: OECD "Oslo Manual"
- Research in aggregated statistics: to be calculated at any geographical or sectoral level (country, regions, firms, industries, institutions….)
- Major distinctions:
    - public or private research
    - domestic or national (symmetrical to GDP and GNP)

- Human resource (***)
    (***) OECD Canberra Manual

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Example of national statistics of research effort
Share of R&D Expenditures in GDP of selected OECD Countries (1991-2003)
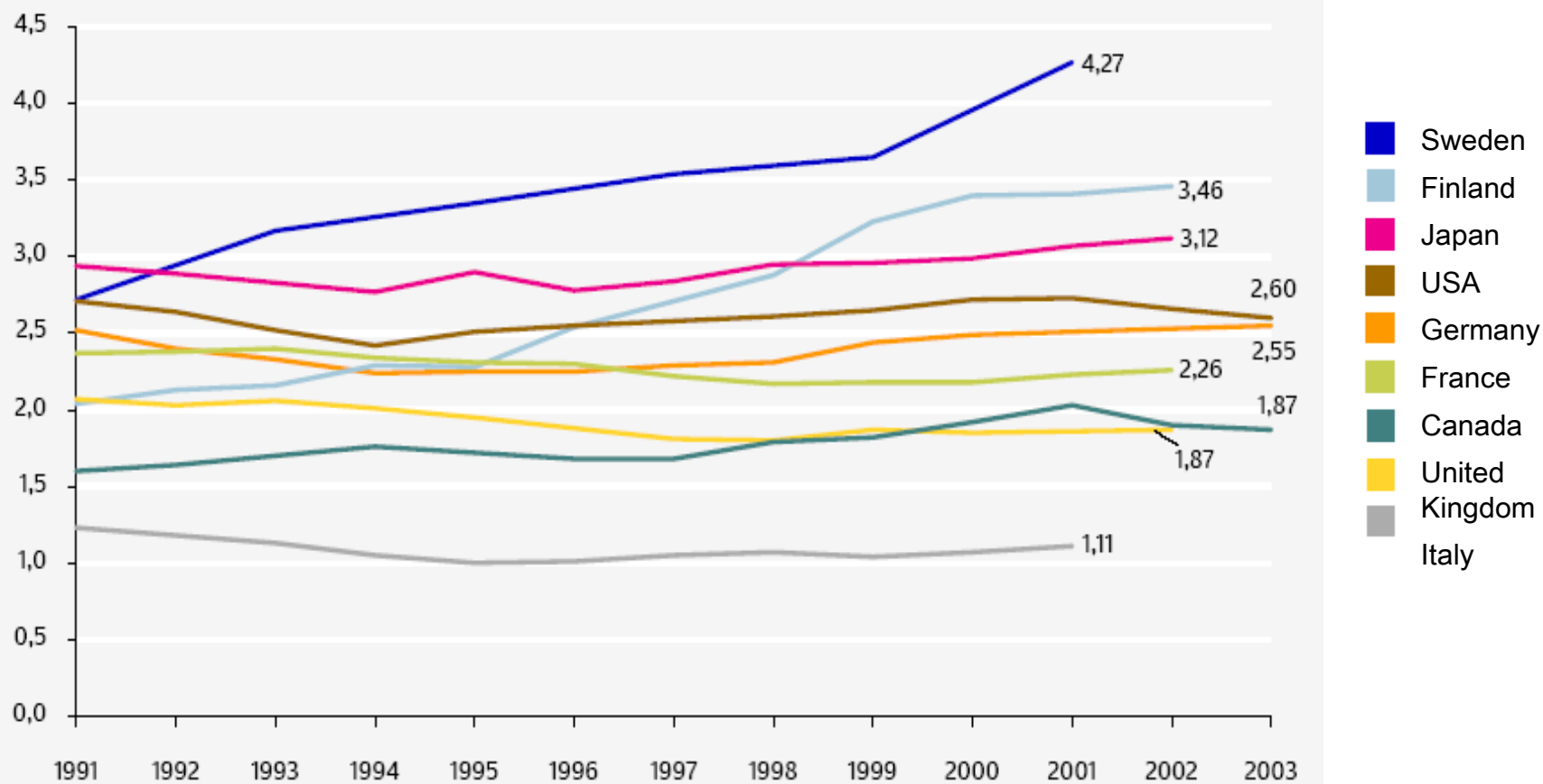
Source: BMBF 2005

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Towards regional indicators of science, technology and innovation

- The theoretical and empirical literature lead to the characterization of innovative regions on the basis of two main knowledge factors:
  - Research activities.
  - Human capital endowment
- Both elements contribute to the creation of new knowledge within the region and also the capacity of the local firms to absorb knowledge (spilling from other firms within or out of he territory, local or external academic production, etc.)
- We therefore need indicators of research activities as well as education levels, on every geographical level: countries, regions,….
- Exemple of the KIT Espon (BEST, Milano) study:
  - **Research activities**
- Input indicators: R&D expenditures and the percentage of employees in R&D
- Output indicators: total number of patents released in the region (all sectors), and number of patents for the subsample of high-tech sectors.
  - **Human capital stock**
- Input indicator : percentage of population employed in the education sector as a proxy of the regional effort to create and promote new knowledge and human capital activities.
- Output indicator: population that has attained at least a university degree.

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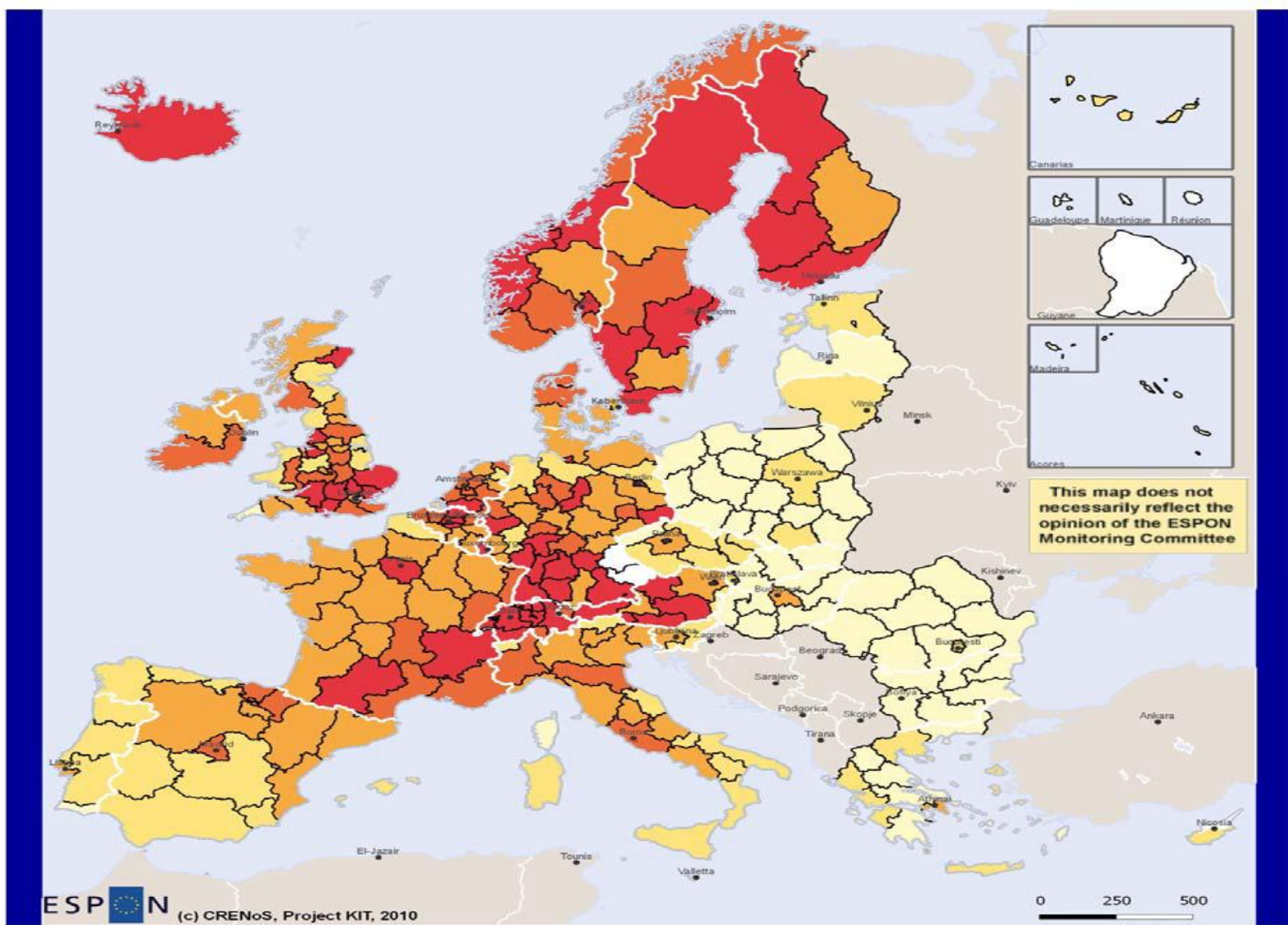Faculté des sciences économiques et de gestion

KIT report

- Knowledge, Innovation, Territory
- Scientific Report Addendum to the Interim Report
- Version 24/02/2011
- This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund
- © ESPON & BEST – Politecnico di Milano, 2011.

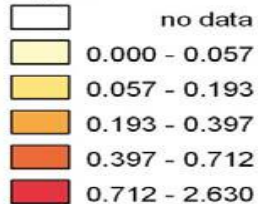**Bureau d'économie théorique et appliquée (BETA)**
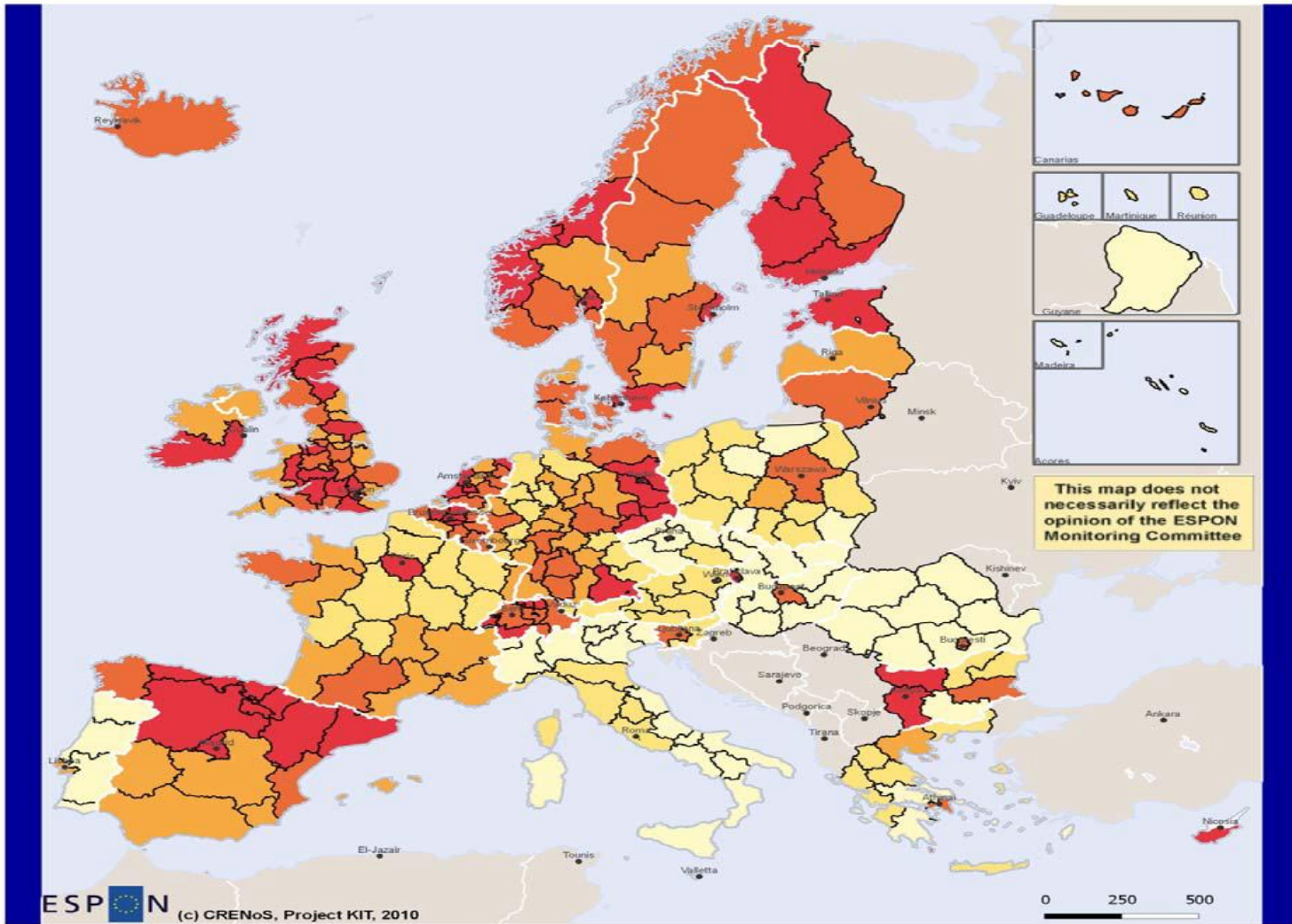UMR 7522

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RD Expenditure per 1000 POP, average 2006-2007, Millions of Euros

Legend

	no data
	0.000 – 0.057
	0.057 – 0.193
	0.193 – 0.397
	0.397 – 0.712
	0.712 – 2.630

(c) CRENoS, Project KIT, 2010

EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
Origin of data: Eurostat, Institut National de la Statistique et des Études Économiques (France), ISTAT Istituto Nazionale di Statistica (Italy)
Regional level: NUTS 2
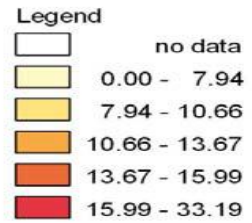
Tertiary education (% over population), 2005-2007
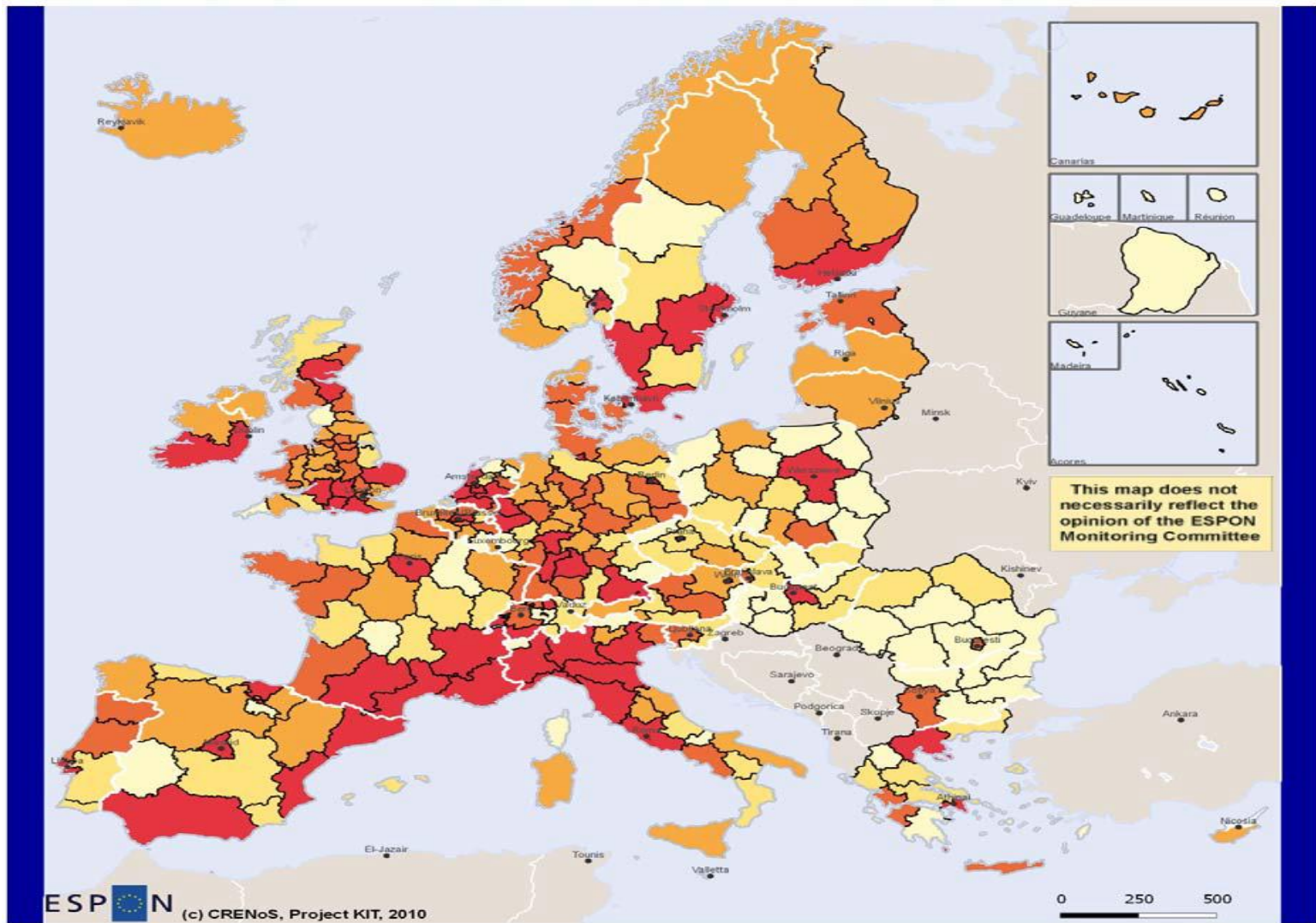
Legend

☐	no data
☐	0.00 – 7.94
☐	7.94 – 10.66
☐	10.66 – 13.67
☐	13.67 – 15.99
☐	15.99 – 33.19

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

ESPON (c) CRENoS, Project KIT, 2010

Number of participations in the 5FP, 1998-2002

Legend

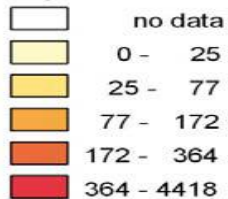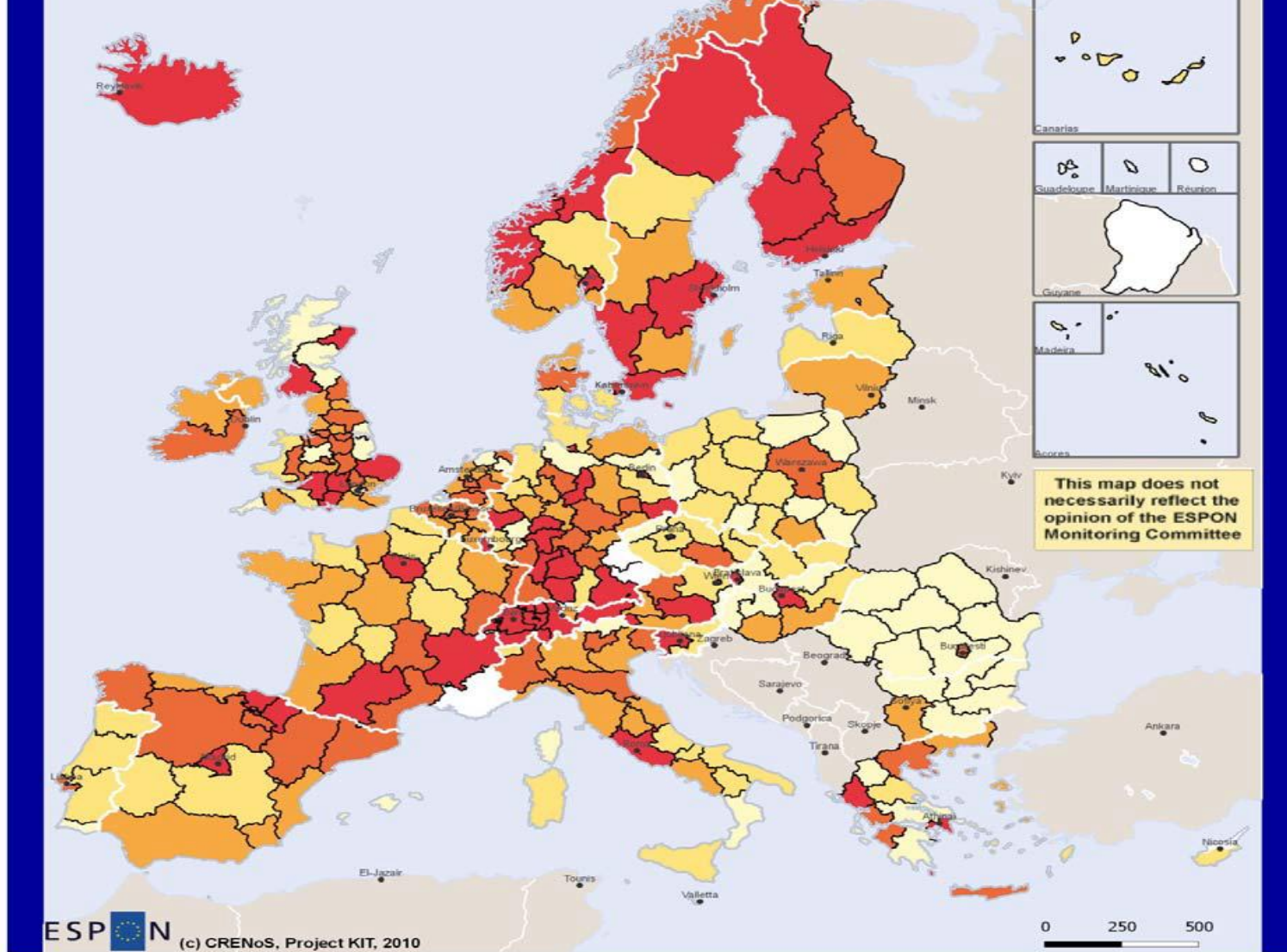|	
	no data
	0 – 25
	25 – 77
	77 – 172
	172 – 364
	364 – 4418

ESPON (c) CRENoS, Project KIT, 2010

EUROPEAN UNION
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(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
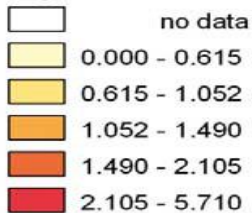Origin of data: Cordis, 1998-2002
Regional level: NUTS 2

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

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RD Personnel % of total employment, Average 2006-2007

Legend

	no data
	0.000 - 0.615
	0.615 - 1.052
	1.052 - 1.490
	1.490 - 2.105
	2.105 - 5.710

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

ESPON (c) CRENoS, Project KIT, 2010

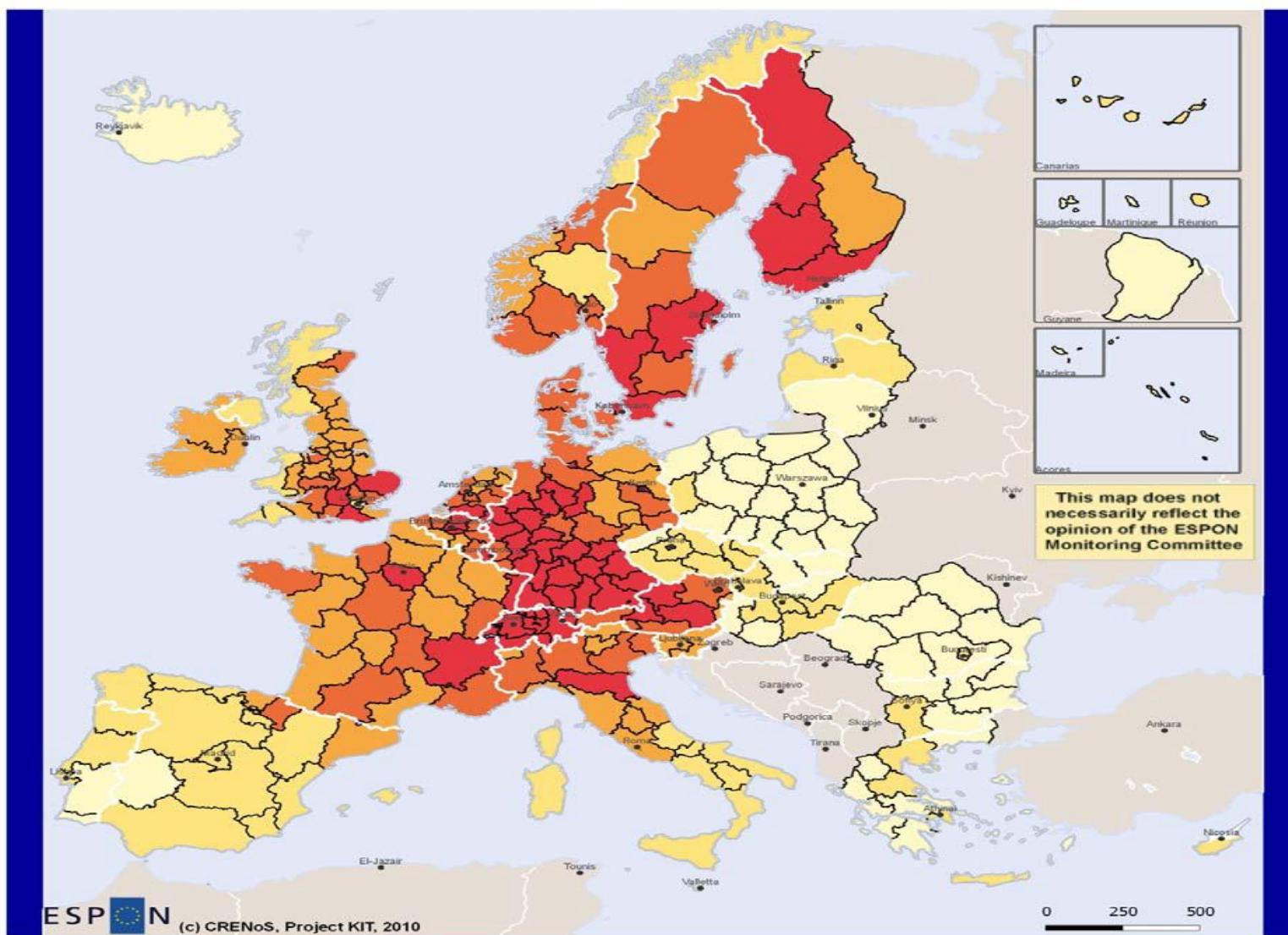EUROPEAN UNION
Part-financed by the European Regional Development Fund
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(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
Origin of data: Eurostat, Institut National de la Statistique et des Études
Économiques (France), ISTAT Istituto Nazionale di Statistica (Italy)
Regional level: NUTS 2

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Number of patents per 1000 POP, average 2005-2006

Legend
- no data
- 0.000 – 0.005
- 0.005 – 0.042
- 0.042 – 0.089
- 0.089 – 0.160
- 0.160 – 0.728

11
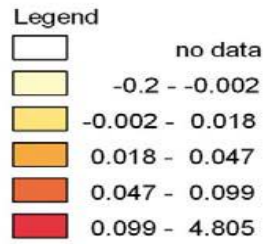
Number of patents, yearly rate of change, 2002-2006

Legend

☐	no data
☐	-0.2 – -0.002
☐	-0.002 – 0.018
☐	0.018 – 0.047
☐	0.047 – 0.099
■	0.099 – 4.805

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Example of synthetic indicators

- The KIT Espon project has calculated for each region (NUTS-2) its ranking in terms of research activity and human capital
- After crossing both dimensions, a typology is derived:
    - Regions ranking high in both research intensity and HC : « scientific regions »
    - Regions ranking high only on one of these dimensions
    - Regions ranking low in both dimensions

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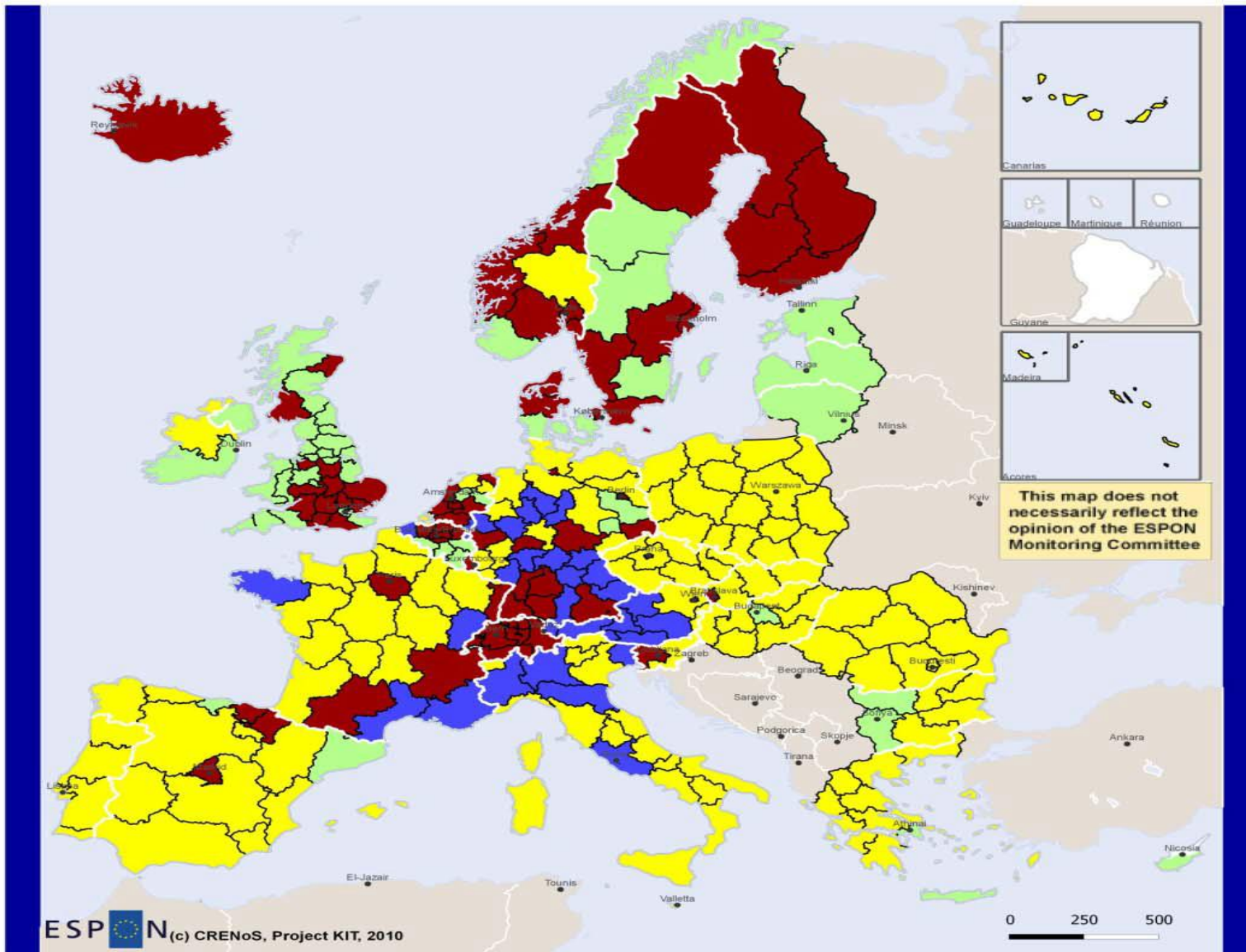
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This map does not necessarily reflect the opinion of the ESPON Monitoring Committee
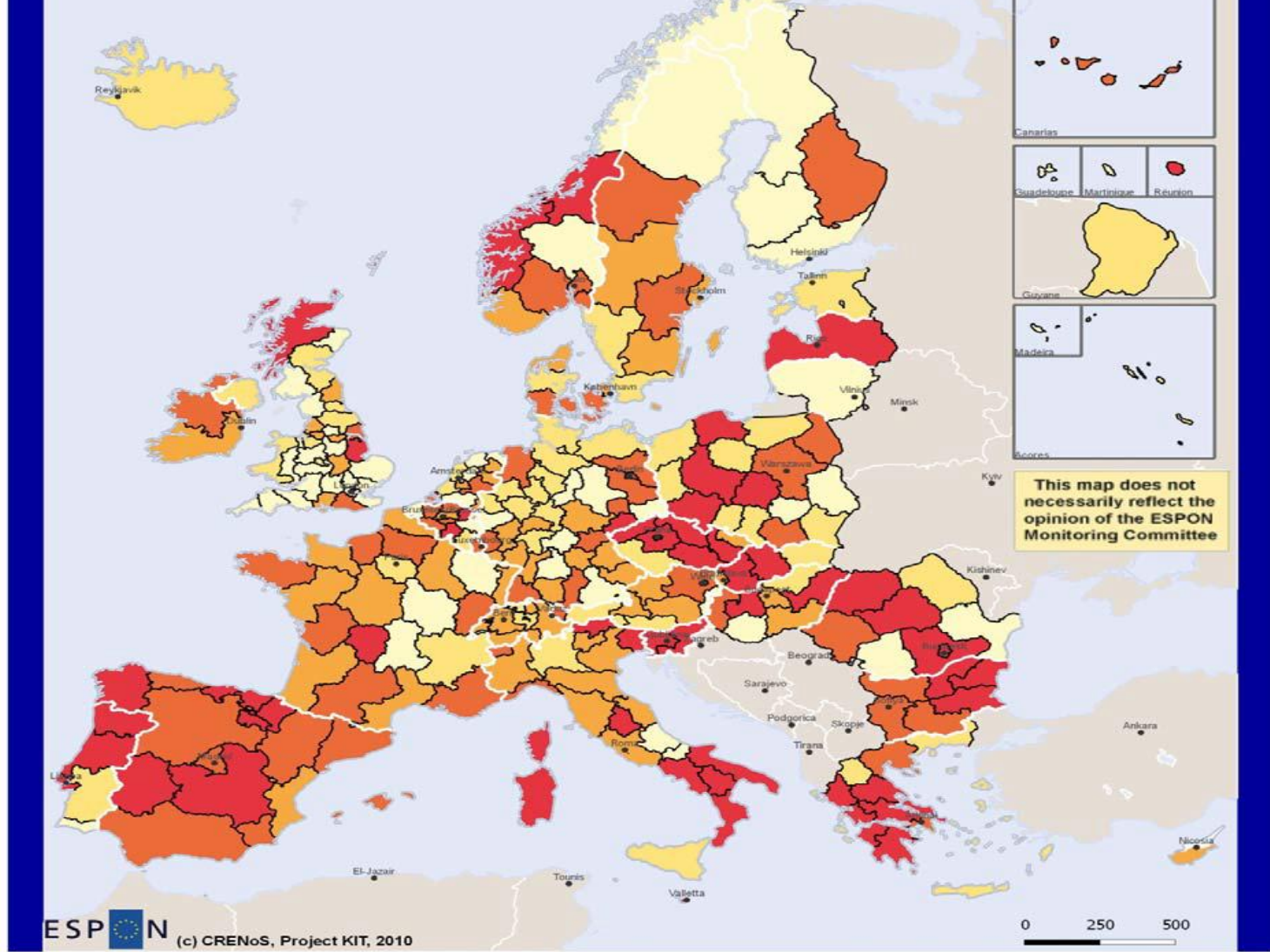
ESP●N (c) CRENoS, Project KIT, 2010

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(c) EuroGeographics Association for administrative boundaries
Source: CRENoS elaboration, 2010
Origin of data:Eurostat, OECD REGPAT database, ISTAT and
Institut National de la Statistique et des Études Économiques data, CORDIS data
Regional level: NUTS 2

0   250   500

Legend

☐ no data

■ Scientific regions

■ Human capital intensive regions

■ Research intensive regions

■ Regions witn no specialization in knowledge activities

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Chapter 4
National systems of innovation

Jean-Alain Héraud

Some definitions of NSI

- **Freeman 1987**

  The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies

- **Lundvall 1992**

  The elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge (…) and are either located within or rooted inside the borders of nation states.

- **Nelson 1993**

  The national institutions whose interactions determine the innovative performance (…) of national firms

- **Patel, Pavitt 1993**

  The national institutions, their incentive structures, and their competencies, that determine the rate and direction of technological learning in a country.

A more socio-political approach of innovation systems:

Public research and innovation policy stakeholders' arena

- ■ **Differing interests, perspectives and values**
- ■ **No dominant player?**
- ■ **Contested policies**
- ■ **Need for consensus?**

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The financial approach:
Flows of *financing* and *performance* of R&D
The case of France (2002)
Billion Euros

19,1	Firms	21,8
	0,7	
2,2		1,3
	2,4	
15,7	Administrations	12,7
	0,5	1,7
	Abroad	
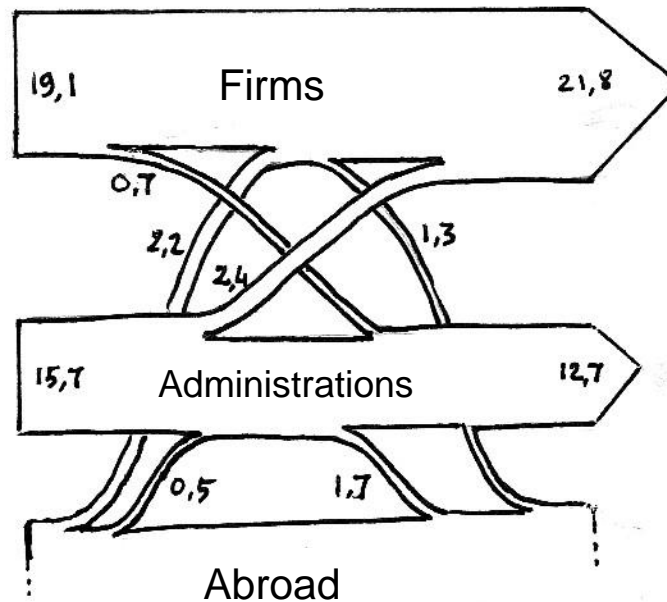
Total financing of national R&D expense: 34,8 G€ (2,28% GDP)
Total R&D performance: 34,5 G€ (2,26% GDP)

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Institutions and Functions
Research landscape; the case of Germany (2001)

Research type

[bn] €

Applied-oriented

Curiosity-oriented

Contract research for industry

Federal and state institutes 1,0

HGF 2,2

WGL 0,95

FhG 1,0

Universities 8,0

others 1,1 (z.B. AiF)

MPG 1,3

Industry 37,2 bn €

public   private

Financing
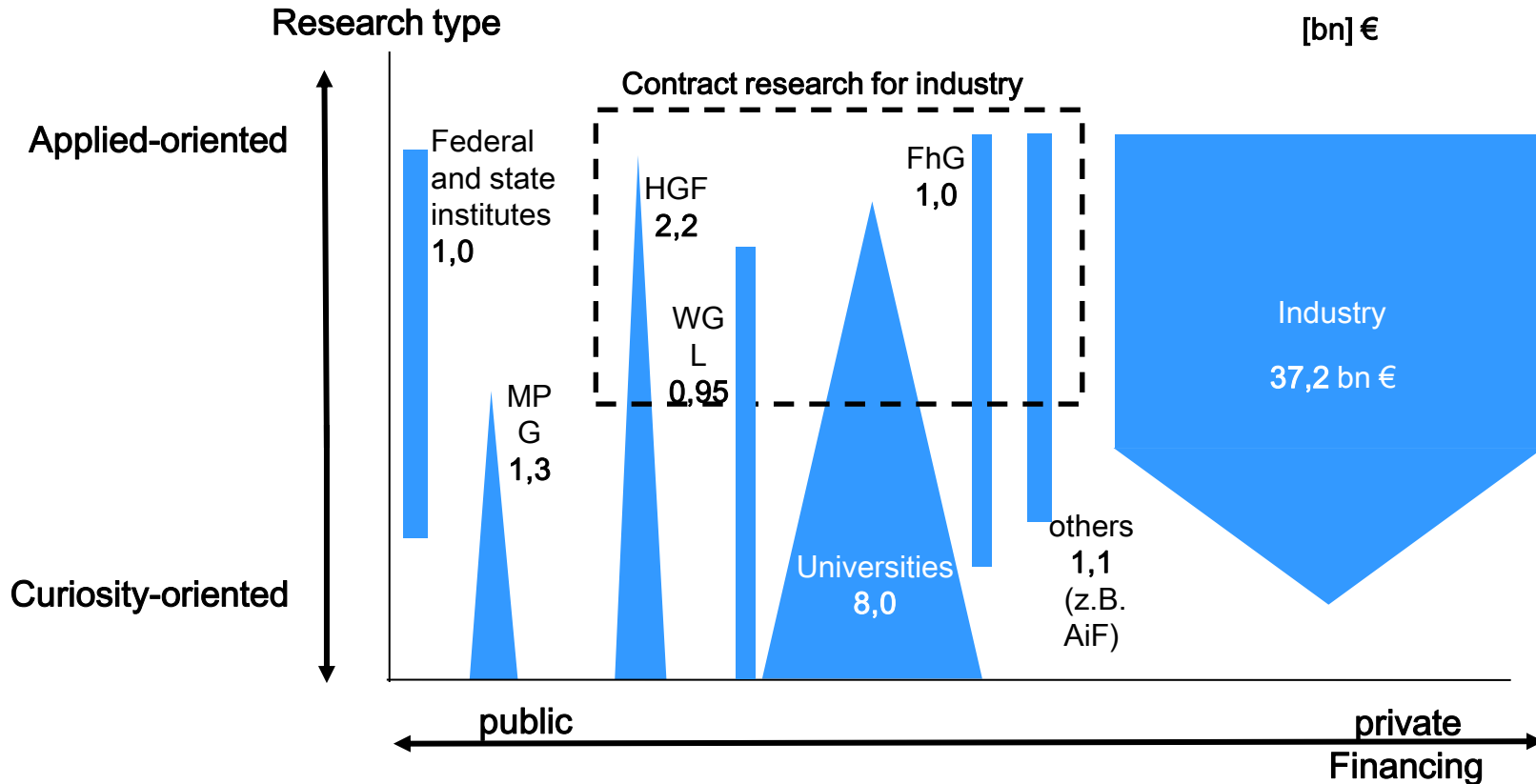
HGF	Hermann von Helmholtz-Gemeinschaft
WGL	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz
AIF	Arbeitsgemeinschaft industrieller Forschungsvereinigungen
MPG	Max-Planck-Gesellschaft

Source: Stefan KUHLMANN, FhG-ISI

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A possible measurement of R&D efficiency in national systems

Figure 6.1.21 US patents per unit of business R&D expenditure

EU-15: 0.24 (1992-1996), 0.33 (1997-2001)
US: 0.49 (1992-1996), 0.58 (1997-2001)
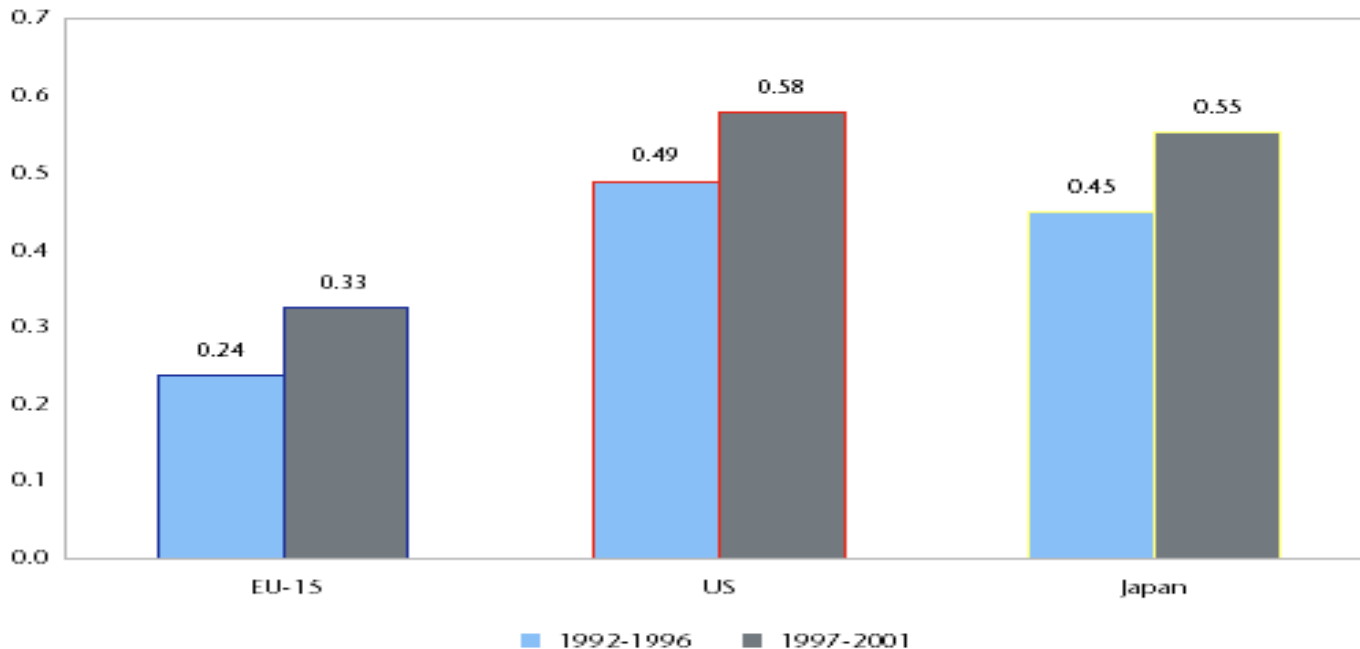Japan: 0.45 (1992-1996), 0.55 (1997-2001)

■ 1992-1996 ■ 1997-2001

Source: DG Research
Data: USPTO, data processed by Fraunhofer-ISI; OECD, Eurostat
Note: Business R&D (BERD) measured in million PPS at 1995 prices. Calculated using a two-year time lag between year of R&D expenditure and year of patenting.

Third European Report on S&T Indicators, 2003

Source: Third European Report

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Is EU-15 strong in science, but weak in technology ?

**Productions scientifiques et technologiques :
Part de l'Union Européenne dans le monde**

Source : OST 1998

- Production scientifique: 1990 = 30,2 ; 1995 = 32,6
- Dépôts de brevets EUR-PAT: 1990 = 48,4 ; 1996 = 43,1
- Dépôts de brevets US-PAT: 1990 = 23,1 ; 1996 = 17,8
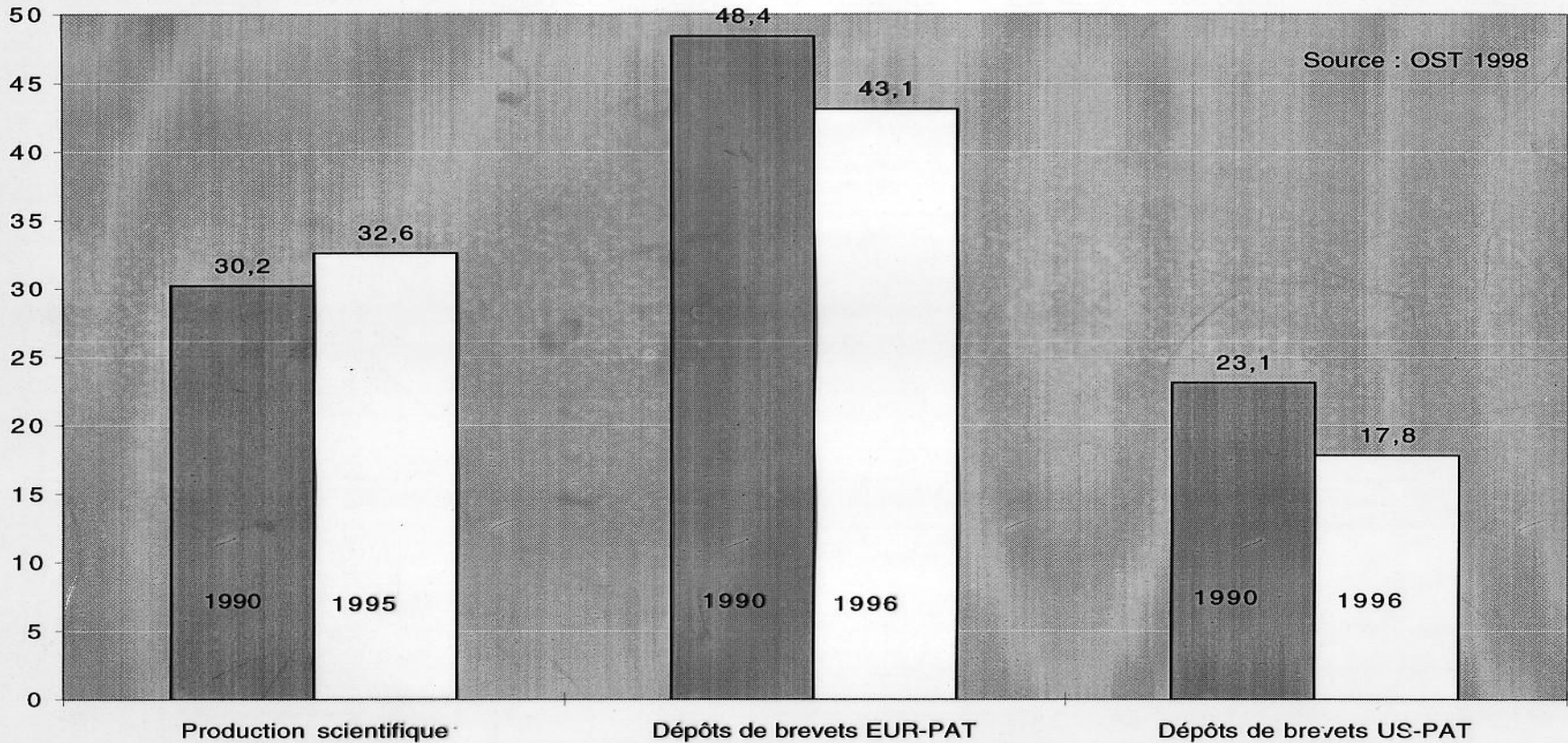
The European paradox: policy issue in the 2000's

The necessity to reorient European structures and policies :

- Understanding where we come from: the situation in the '90s:

  - Science indicators give a good image of Europe: a large share of the world publications, this share being non declining. But technology indicators are not good: declining share of world patents.

  - Europe is a stronghold for several economic activities, but less in the most promising ones than in traditional middle tech branches

- Conclusion in terms of innovation system:

  Europe has interesting assets (industrial and cognitive) but they are not efficiently linked. The science-technology-business chain is weak

The rise of European science, the emergence of Asia

Disciplines led by the EU, U.S., and Asia/Pacific

Who is in first Place in Publications in 2500 of the world's leading journals? Blank is US Leadership.	1981	1983	1985	1987	1989	1991	1993	1995	1997	1999	2001
Agricultural Science							EU	EU	EU	EU	EU
Biology & BioChem											
Chemistry	EU	EU	EU	EU	EU	EU	EU		EU	EU	EU
Clinical Medicine							EU	EU	EU		EU
Computer Science											
Ecology & Enviroment											
Engineering											EU
Geoscience									EU		EU
Immunology											
Materials Science							EU	EU	AP	AP	AP
Math							EU	EU	EU		EU
Microbiology							EU	EU	EU	EU	EU
Molecular Bio & Genetics											
Multidisciplinary	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU
Neuroscience											
Pharmacology	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU
Physics		EU			EU	EU	EU	EU	EU	EU	EU
Plant & Animal Science							EU	EU	EU	EU	EU
Psych & Psychiatry											
Space Science									EU		EU

Source: ISI (Thomson-Reuters)

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Thanks for your attention

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