Economics and Policy of Innovation

Academic year 2015/2016

Lecture 2: February 24th, 2016

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Measuring Innovation

(Chapter 6)

Outline

1. **Input indicators:**
   a. EUROSTAT data on Science and Technology
   b. R&D Scoreboard (European Commission)

2. **Output indicators: Patent** data (but also Trademarks, Bibliometrics…)

3. Analysis of **firm technological strategies**, at different levels (geographical, sectorial, firm size…)

http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/introduction — Introduction

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Science, technology and innovation

- Introduction
- Data
  - Main tables
  - Database
  - Methodology
  - Publications

Introduction

Science, technology and innovation are often considered as important drivers for economic development and growth.

EU Policy History

2000 – The European Council launched the 'Lisbon Strategy', aimed at transforming the EU by 2010 into 'the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion'.

2002 – In Barcelona, a further aim was added, namely to spend by 2010 at least 3 % of GDP on research, of which two thirds should be financed by the business sector.

2005 – The Lisbon Strategy was re-launched with the initiative 'Working together for growth and jobs'.

2006 – At a Council meeting in Brussels, it was recognised that Europe should invest more in knowledge and growth.

2006-07 – At the Spring European Councils, one of the four priority areas agreed upon by the Member States was more investment in knowledge and innovation.

2007 – The European Commission launched the Green Paper 'The European Research Area: New Perspectives', a 'broad institutional and public debate on what should be done to create a unified and attractive European Research Area'.

The following graph is an example of statistics on this theme.

Gross domestic expenditure on R&D (GERD)
Percentage of GDP

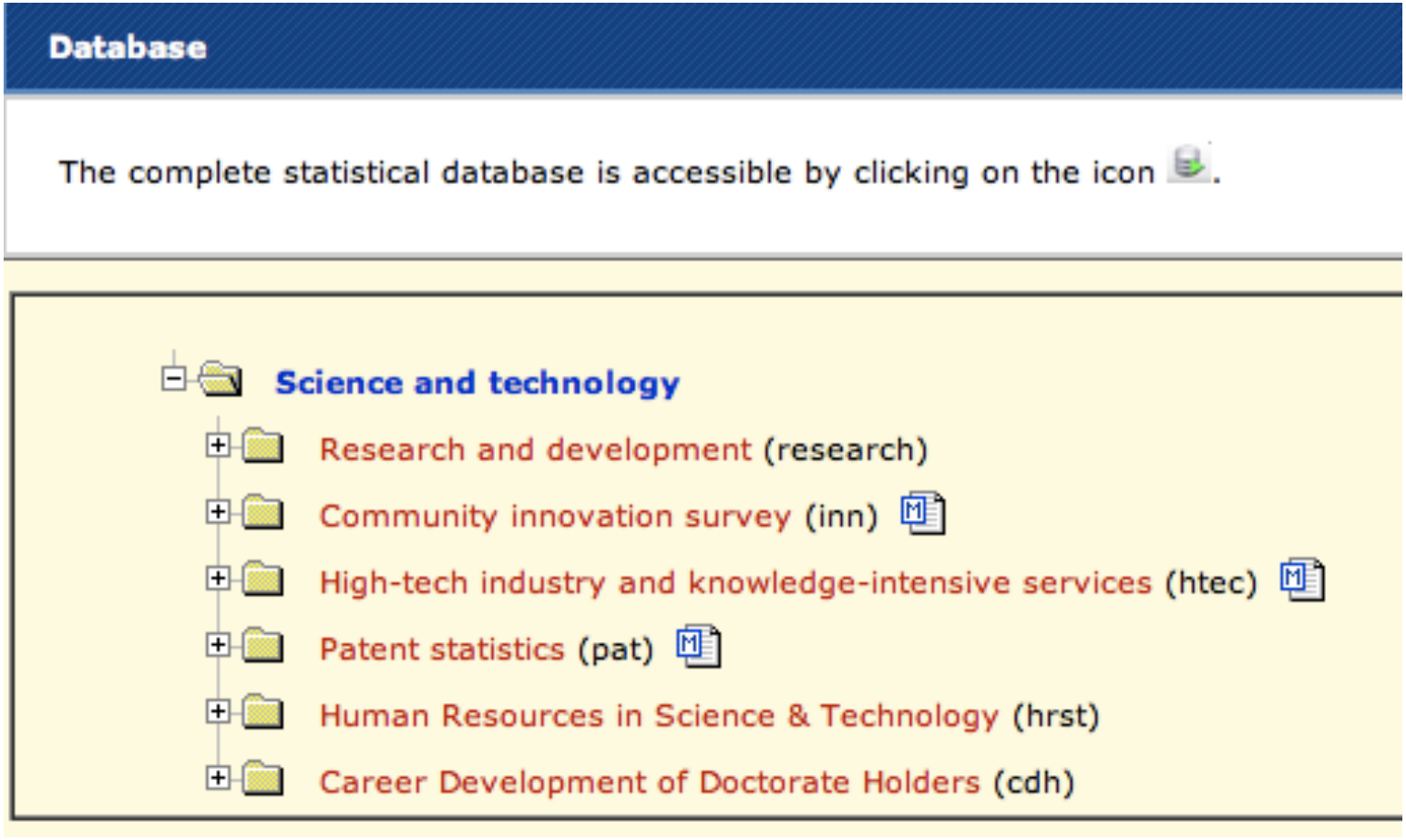
See also

- **Statistics Explained** Your guide to European statistics
- R&D industrial investment Scoreboard
- Information Society
- Research and methodology
- Education

Legislation

- Decision No 1608/2003/EC of the European Parliament and of the Council concerning the production and development of Community statistics on science and technology
- Commission Regulation No 753/2004 on statistics on science and technology
- Commission Regulation No 1450/2004, implementing Decision No 1608/2003/EC of the European Parliament and of the Council concerning the production and development of Community statistics on innovation
- Report COM (2007) 801 from the Commission to the Council and the European Parliament on the implementation of Decision No 1608/2003/EC of the European Parliament and of the Council

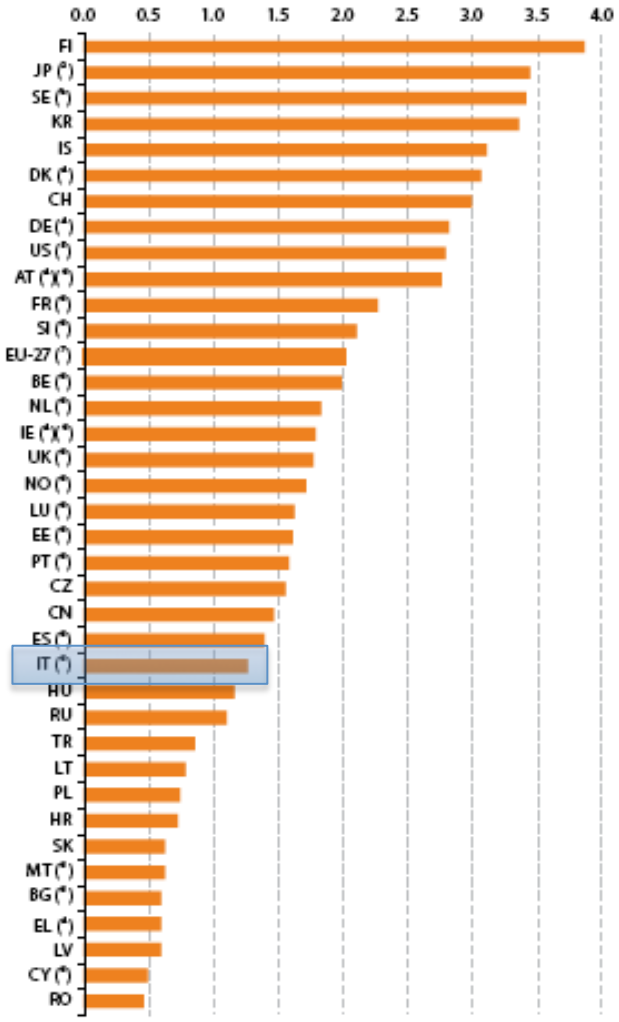
Database on Science, technology and innovation…



… with main categories

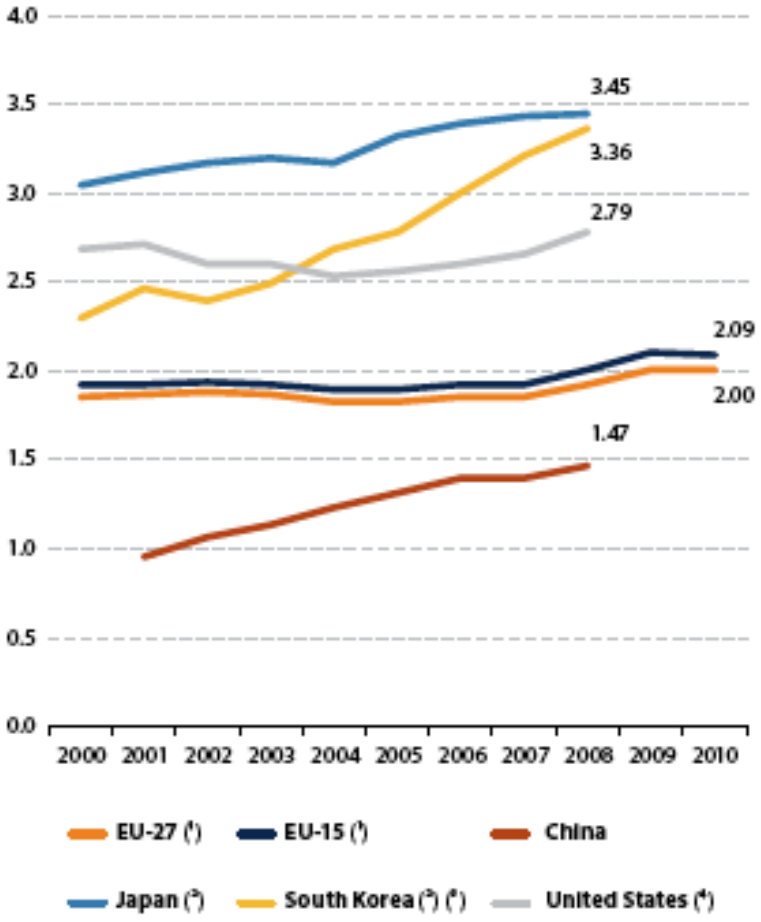
World R&D figures (1)

Figure 2.2: R&D intensity (R&D expenditure as % of GDP), 2010 (1)
(% of GDP)



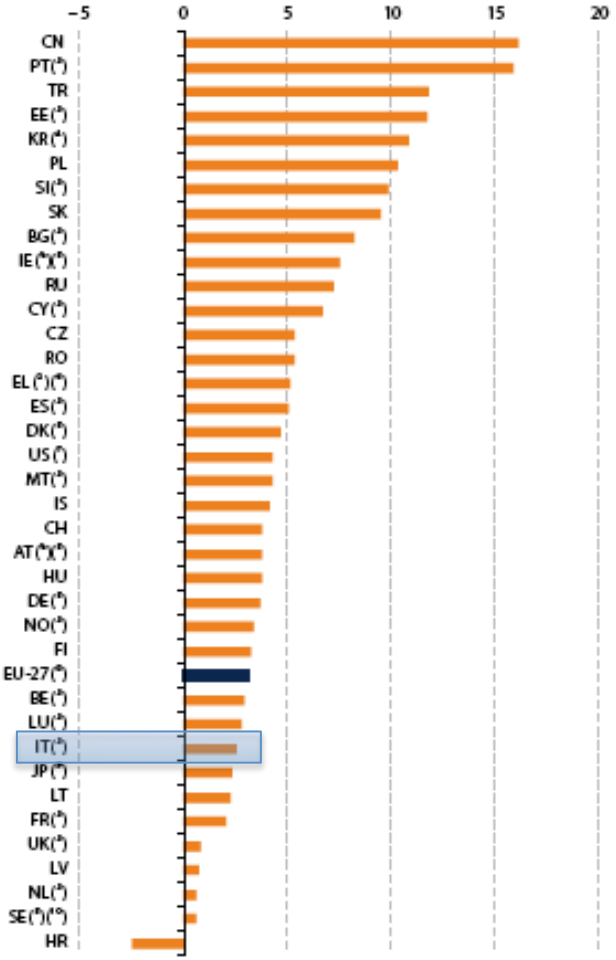
World R&D figures (2)

Figure 2.1: R&D intensity (R&D expenditure as % of GDP), EU-27, EU-15, China, Japan, South Korea and the United States, 2000–2010
(% of GDP)



World R&D figures (3)

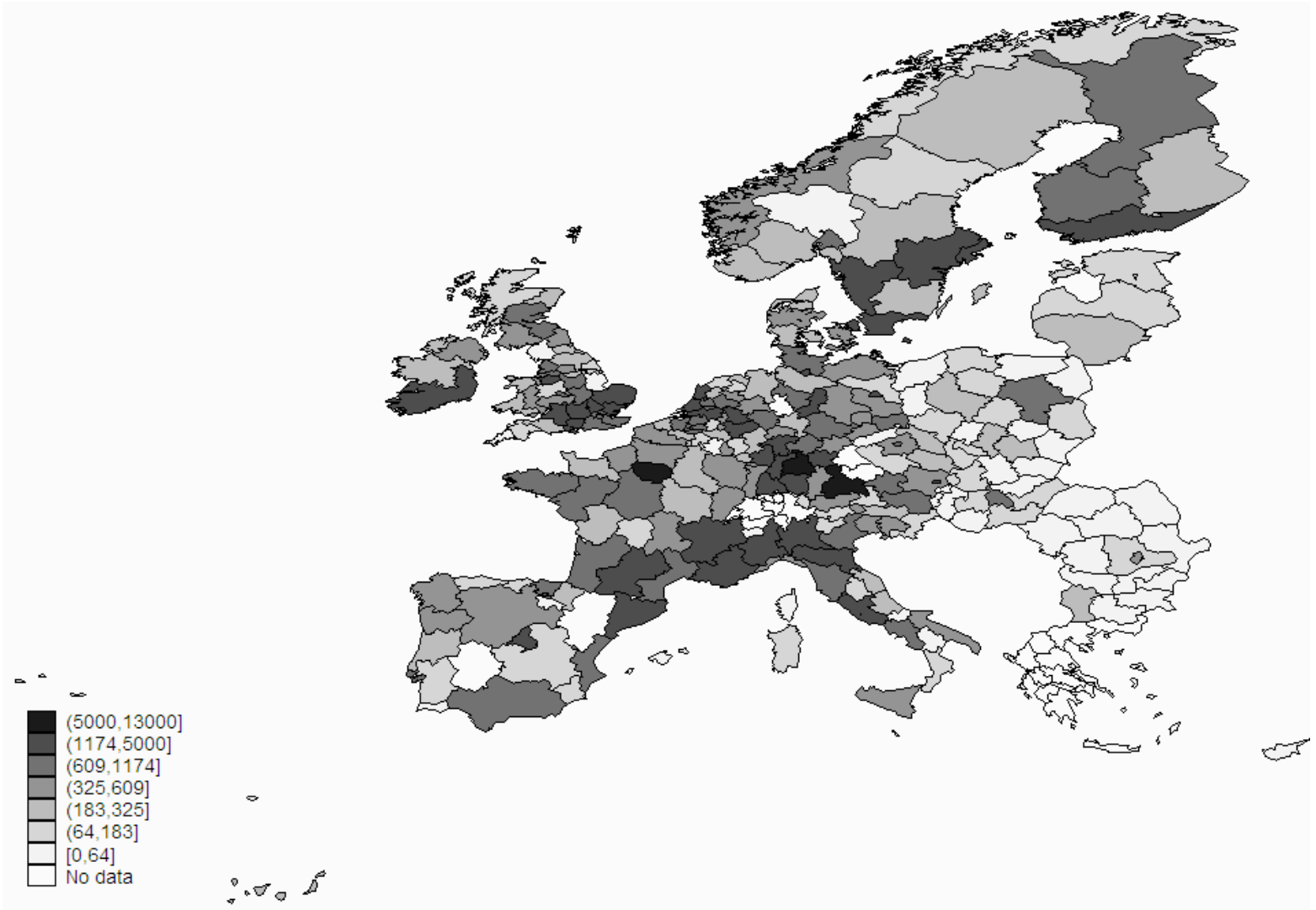
Figure 2.4: Average annual growth rate (AAGR) of R&D expenditure, 2005–2010 (1) (2)
(%)



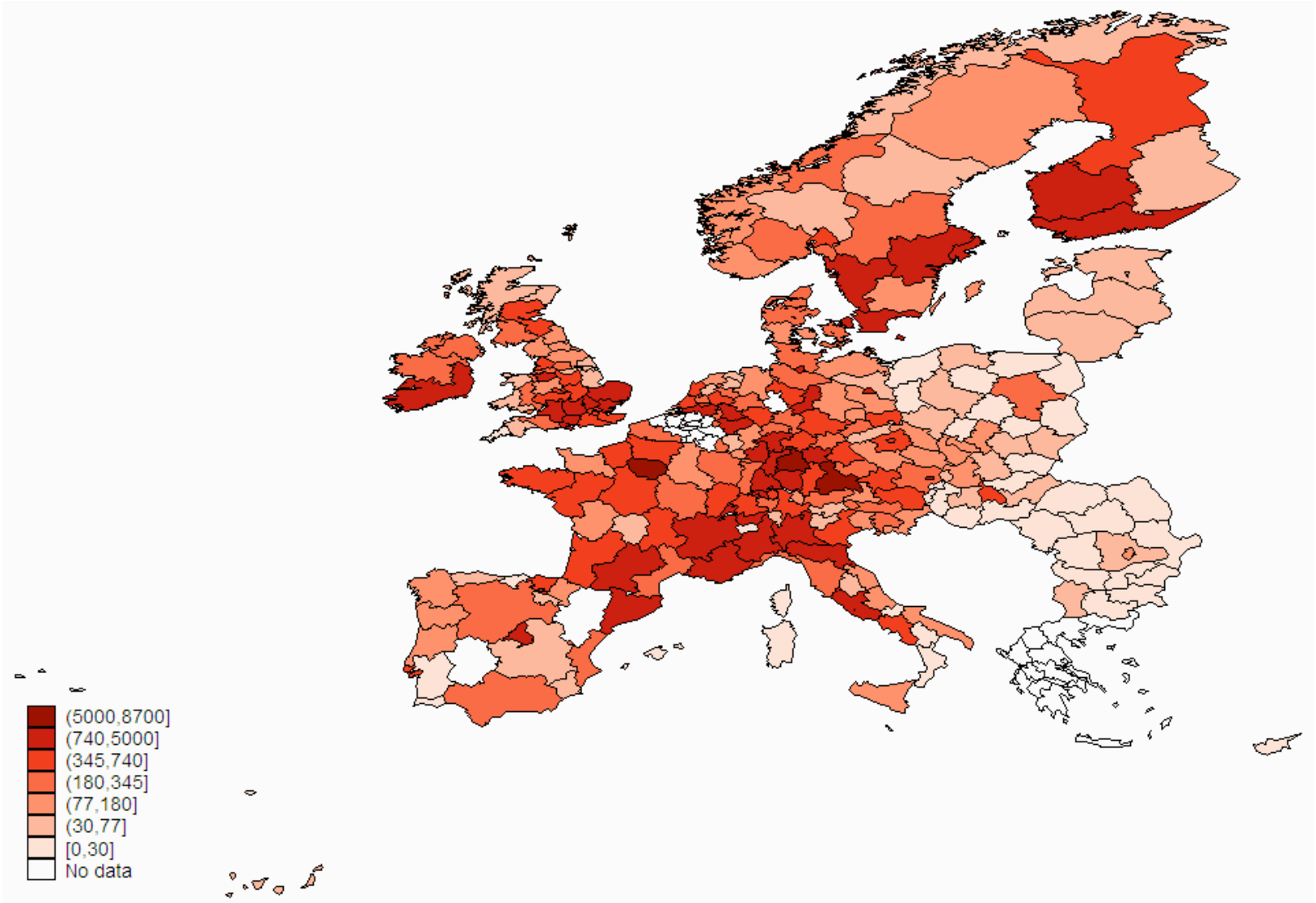
Breakdown of R&D

- Overall: **GERD** (*Gross R&D Expenditure), that is total R&D undertaken in a country (e.g. Italy)*
- *By sector of performance:*
  - *Private (**BERD**, Business R&D Expenditure)*
  - *Public (**GOVERD**, Government R&D Exp.)*
  - *University (**HERD**, Higher Education R&D Exp.)*
  - *No Profit*
- *By sector of funding: same 4 categories + "abroad" (the funder is not resident in Italy)*

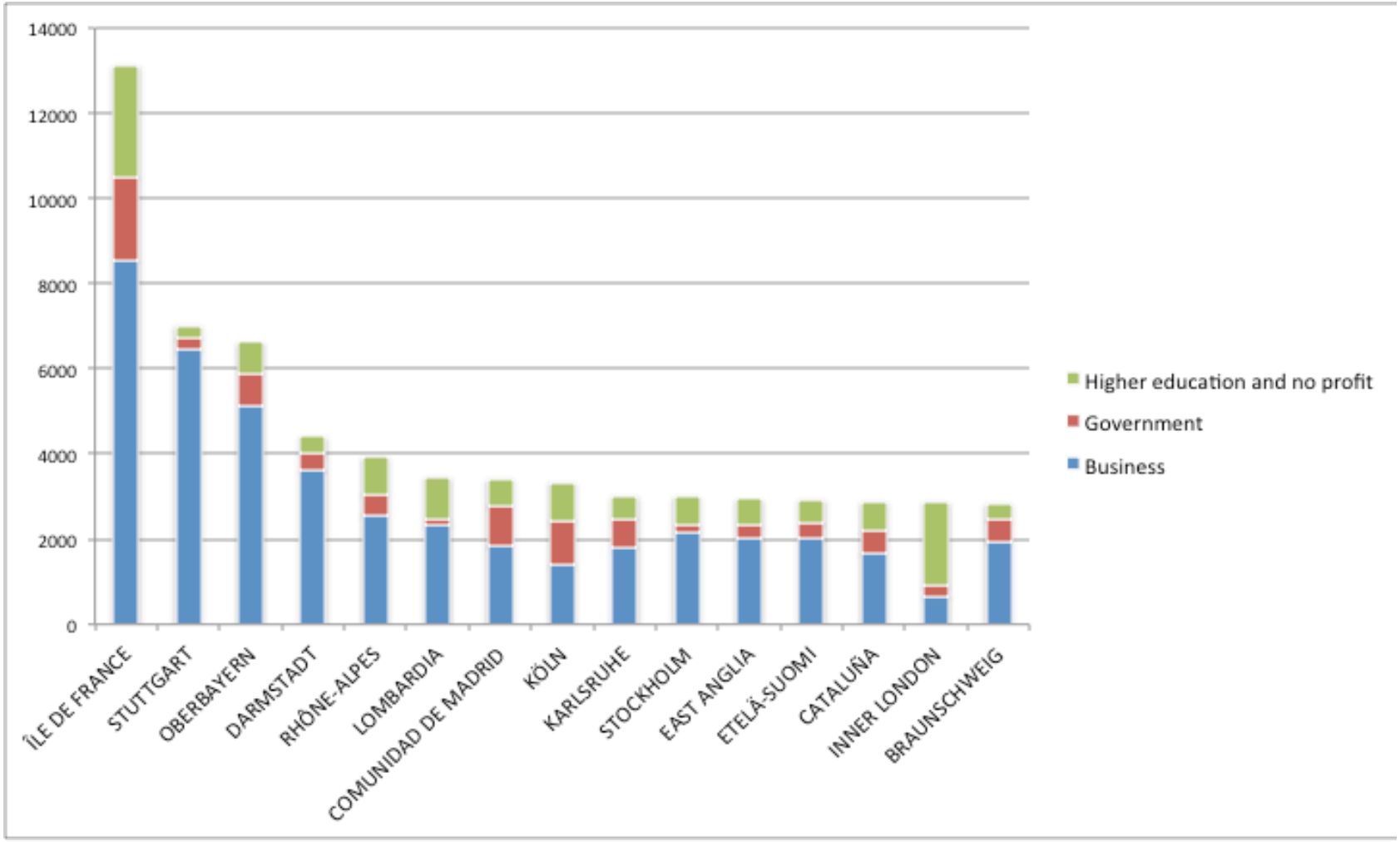
GERD in EU regions
(average 2000-2009)



BERD in EU regions
(average 2000-2009)



Differences between public and private R&D (BERD, GOVERD, HERD, year 2009)…



… and human capital variables

Top Regions	Htec_emp	Top Regions	Hrst
STUTTGART	20.4	ÎLE DE FRANCE	3370.64
BRAUNSCHWEIG	18.13	COMUNIDAD DE MADRID	1628.55
TÜBINGEN	16.95	LOMBARDIA	1599.55
KARLSRUHE	16.34	CATALUÑA	1409.09
KOZEP-DUNANTUL	15.13	RHÔNE-ALPES	1246.73
NIEDERBAYERN	14.67	ANDALUCÍA	1241.36
RHEINHESSEN-PFALZ	14.4	**OBERBAYERN**	1199.27
FREIBURG	14.38	OUTER LONDON	1145.73
OBERPFALZ	14.08	DÜSSELDORF	1125.36
UNTERFRANKEN	14.05	BERLIN	1044
SCHWABEN	13.51	KÖLN	1028.64
FRANCHE-COMTÉ	13.24	MAZOWIECKIE	1007.64
NYUGAT-DUNANTUL	13.06	***STUTTGART***	1006
OBERBAYERN	12.99	DARMSTADT	993.82
SEVEROVYCHOD	12.91	INNER LONDON	976.27
MITTELFRANKEN	12.8	LAZIO	950.91
PIEMONTE	12.13	ZUID-HOLLAND	913.64
ZAPADNE SLOVENSKO	11.67	PROVENCE-ALPES-CÔTE d'AZUR	885.27
KASSEL	11.62	COMUNIDAD VALENCIANA	842.73
JIHOZAPAD	11.57	NOORD-HOLLAND	785.64

Employees in High-tech sectors

Human Resources in Science and Technology (graduated and/or working in S&T)

Taxonomies

R&D intensity is also used to define the (OECD) technological classification, see at pages 155-158:

- High tech
- Medium-high tech
- Medium-low tech
- Low tech

Different approach in Pavitt (see at page 16) → we will study it later on.

Table 6.2 Classification of industries based on R&D intensity

	ISIC Rev 3	Direct R&D Intensity 1997	Acquired R&D intensity as % of direct R&D intensity, 1990
High technology Industries			
Aircraft and spacecraft	353	12.7	15
Pharmaceuticals	2423	11.3	8
Office, accounting and computing machinery	30	10.5	25
Radio, television and communications equipment	32	8.2	17
Medical, precision and optical instruments	33	7.9	29
Medium–high-technology industries			
Electrical machinery and apparatus	31	3.8	42
Motor vehicles and trailers	34	3.5	29
Chemicals	24 exc 2423	2.6	18
Railroad and transport eqpt. n.e.c.	352+359	2.8	88
Machinery and eqpt n.e.c.	29	1.9	104
Medium–low-technology industries			
Coke, refined petroleum products and nuclear fuel	23	0.8	30
Rubber and plastic products	25	0.9	127
Other non-metallic mineral products	26	0.9	285
Building and repairing of ships and boats	351	0.7	200
Basic metals	27	0.7	289
Fabricated metals products	28	0.6	133
Low-technology industries			
Manufacturing n.e.c. and recycling	36–37	0.4	n.a.
Wood, pulp, paper, paper products, printing and publishing	20–22	0.3	167
Food products, beverages and tobacco	15–16	0.4	267
Textiles, textile products, leather and footwear	17–19	0.3	250

OECD Technological classification

High-technology industries

Aircraft and spacecraft
Pharmaceuticals
Office, accounting and computing machinery
Radio, TV and communciations equipment
Medical, precision and optical instruments

Medium-low-technology industries

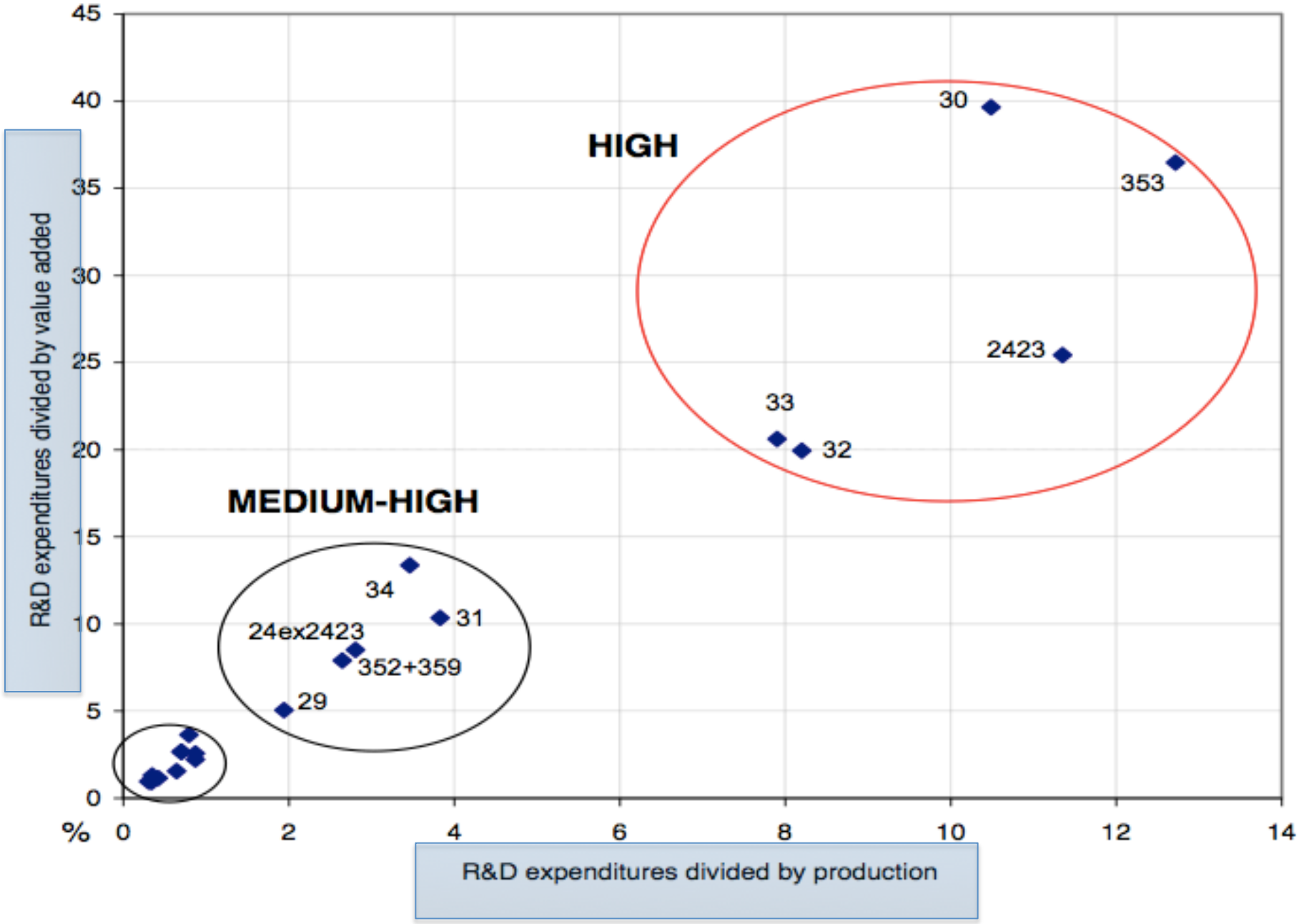
Building and repairing of ships and boats
Rubber and plastics products
Coke, refined petroleum products and nuclear fuel
Other non-metallic mineral products
Basic metals and fabricated metal products

Medium-high-technology industries

Electrical machinery and apparatus, n.e.c.
Motor vehicles, trailers and semi-trailers
Chemicals excluding pharmaceuticals
Railroad equipment and transport equipment, n.e.c.
Machinery and equipment, n.e.c.

Low-technology industries

Manufacturing, n.e.c.; Recycling
Wood, pulp, paper, paper products, printing and publishing
Food products, beverages and tobacco
Textiles, textile products, leather and footwear


45
40
35
30
25
20
15
10
5
0
%
0
2
4
6
8
10
12
14
R&D expenditures divided by value added
R&D expenditures divided by production
HIGH
30
353
2423
33
32
MEDIUM-HIGH
34
31
24ex2423
352+359
29

Methodological problems in the R&D survey

- It is confidential → almost no access to raw data
- Aggregated data do not fully explain economic phenomena…
- … so over the last years there has been a larger use of R&D data in firm annual reports

1b) The R&D Scoreboard (European Commission, JRC-IPTS)

- Annual publication with top EU and non-EU firms, which has performed the highest amount of R&D globally. They declare this value in their annual reports.
- First edition published in 2004, the last one (2015) is the 12th:

  http://iri.jrc.ec.europa.eu/scoreboard.html

World R&D ranking, 2010

World top 1400 Companies				R&D Investment
				2010
Rank	Company	ICB Sector	Country	€m
1	Roche	Pharmaceuticals (4577)	Switzerland	7.181,11
2	Pfizer	Pharmaceuticals (4577)	USA	7.016,61
3	Microsoft	Software (9537)	USA	6.740,81
4	Toyota Motor	Automobiles & parts (335)	Japan	6.666,69
5	Merck US	Pharmaceuticals (4577)	USA	6.403,88
6	Volkswagen	Automobiles & parts (335)	Germany	6.258,00
7	Samsung Electronics	Electronic equipment (2737)	South Korea	6.181,36
8	Novartis	Pharmaceuticals (4577)	Switzerland	6.022,97
9	General Motors	Automobiles & parts (335)	USA	5.189,60
10	Johnson & Johnson	Pharmaceuticals (4577)	USA	5.101,64
11	Nokia	Telecommunications equipment (9578)	Finland	4.938,00
12	Intel	Semiconductors (9576)	USA	4.901,87
13	Daimler	Automobiles & parts (335)	Germany	4.852,00
14	Sanofi-Aventis	Pharmaceuticals (4577)	France	4.390,00
15	Panasonic	Leisure goods (374)	Japan	4.383,25
16	GlaxoSmithKline	Pharmaceuticals (4577)	UK	4.378,96
17	Honda Motor	Automobiles & parts (335)	Japan	4.258,72
18	Siemens	Electrical components & equipment (2733)	Germany	4.241,00
19	Sony	Leisure goods (374)	Japan	3.970,55
20	Cisco Systems	Telecommunications equipment (9578)	USA	3.930,59
21	Robert Bosch	Automobiles & parts (335)	Germany	3.824,00
22	IBM	Computer services (9533)	USA	3.788,21
23	Ford Motor	Automobiles & parts (335)	USA	3.727,09

EU-27 R&D ranking, 2010

Rank	Company	ICB Sector	Country	2010 €m
			Top 1000 Companies	139.689,20
			number of companies for calculation	*1000*
1	Volkswagen	Automobiles & parts (335)	Germany	6.258,00
2	Nokia	Telecommunications equipment (9578)	Finland	4.938,00
3	Daimler	Automobiles & parts (335)	Germany	4.852,00
4	Sanofi-Aventis	Pharmaceuticals (4577)	France	4.390,00
5	GlaxoSmithKline	Pharmaceuticals (4577)	UK	4.378,96
6	Siemens	Electrical components & equipment (2733)	Germany	4.241,00
7	Robert Bosch	Automobiles & parts (335)	Germany	3.824,00
8	Bayer	Chemicals (135)	Germany	3.211,00
9	AstraZeneca	Pharmaceuticals (4577)	UK	3.204,55
10	EADS	Aerospace & defence (271)	The Netherlands	3.084,00
11	Ericsson	Telecommunications equipment (9578)	Sweden	3.022,42
12	BMW	Automobiles & parts (335)	Germany	2.773,00
13	Alcatel-Lucent	Telecommunications equipment (9578)	France	2.559,00
14	Boehringer Ingelheim	Pharmaceuticals (4577)	Germany	2.453,00
15	Peugeot (PSA)	Automobiles & parts (335)	France	2.402,00
16	Finmeccanica	Aerospace & defence (271)	Italy	1.967,00
17	Fiat	Automobiles & parts (335)	Italy	1.936,00
18	Volvo	Commercial vehicles & trucks (2753)	Sweden	1.799,06
19	SAP	Software (9537)	Germany	1.730,00
20	Renault	Automobiles & parts (335)	France	1.728,00
21	Philips Electronics	Leisure goods (374)	The Netherlands	1.697,00
22	STMicroelectronics	Semiconductors (9576)	The Netherlands	1.627,99
23	Continental	Automobiles & parts (335)	Germany	1.524,90

EU-27 R&D ranking, 2010, by sector (e.g. “food”)

Food producers (357)				number of companies for calculation	33
1	Unilever	30	UK		928,00
2	Danone	97	France		209,00
3	Kerry	122	Ireland		156,43
4	Vilmorin	167	France		117,40
5	Danisco	181	Denmark		109,50
6	KWS SAAT	203	Germany		92,44
7	FrieslandCampina	260	The Netherlands		61,00
8	CSM	309	The Netherlands		47,00
9	Sudzucker	369	Germany		35,30
10	Lantmannen	372	Sweden		35,15
11	Tate & Lyle	414	UK		29,18
12	Valio	430	Finland		27,30
13	Barilla	435	Italy		26,91
14	Wittington Investments	444	UK		25,68
15	Premier Foods	506	UK		19,96
16	Unibel	577	France		15,61

Italian R&D ranking, 2010

Italy				number of companies for calculation	55
1	Finmeccanica	16	Aerospace & defence (271)	7522	1.967,00
2	Fiat	17	Automobiles & parts (335)	3410	1.936,00
3	Telecom Italia	41	Fixed line telecommunications (653)	6420	698,00
4	Intesa Sanpaolo	83	Banks (835)	6511	252,00
5	UniCredit	88	Banks (835)	6511	233,28
6	Eni	91	Oil & gas producers (53)	1110	221,00
7	Pirelli	131	Automobiles & parts (335)	2511	150,00
8	Chiesi Farmaceutici	137	Pharmaceuticals (4577)	2441	146,00
9	PRADA	192	Personal goods (376)	1824	100,91
10	Enel	210	Electricity (753)	4011	89,00
11	Sorin	235	Health care equipment & services (453)	3310	75,04
12	Recordati	246	Pharmaceuticals (4577)	2441	68,84
13	IMMSI	257	Automobiles & parts (335)	3410	62,90
14	Prysmian	276	Electrical components & equipment (2733)	3162	56,00
15	Lottomatica	278	Travel & leisure (575)	9271	54,80
16	Italtel	297	Telecommunications equipment (9578)	3220	49,90
17	Fincantieri	330	Commercial vehicles & trucks (2753)	3550	44,37
18	Terna	338	Electricity (753)	4011	42,40
19	Danieli	339	Industrial machinery (2757)	2924	42,27
20	Avio	349	Aerospace & defence (271)	3530	40,61
21	De'Longhi	357	Household goods & home construction (372)	3663	37,70
22	Poste Italiane	381	Industrial transportation (277)	6412	33,71
23	Benetton	393	Personal goods (376)	1824	32,00
24	COFIDE	402	General industrials (272)	7487	30,22
25	IMA Industria Macchine Automatiche	404	Industrial machinery (2757)	2924	30,08
26	Barilla	435	Food producers (357)	1589	26,91
27	Datalogic	439	Electronic equipment (2737)	3210	25,97
28	Carraro	499	Automobiles & parts (335)	3430	20,59
29	DiaSorin	501	Pharmaceuticals (4577)	2441	20,47
30	Same Deutz-Fahr	505	Commercial vehicles & trucks (2753)	3550	19,97
31	Geox	574	Personal goods (376)	1930	15,69
32	Atlantia	586	Industrial transportation (277)	6340	15,26

2. Output: Patent data as a measure of Innovation

- Large use, because of:
  - Longitudinal data (many years)
  - Systematic collection of information
  - Data are (more or less) freely available

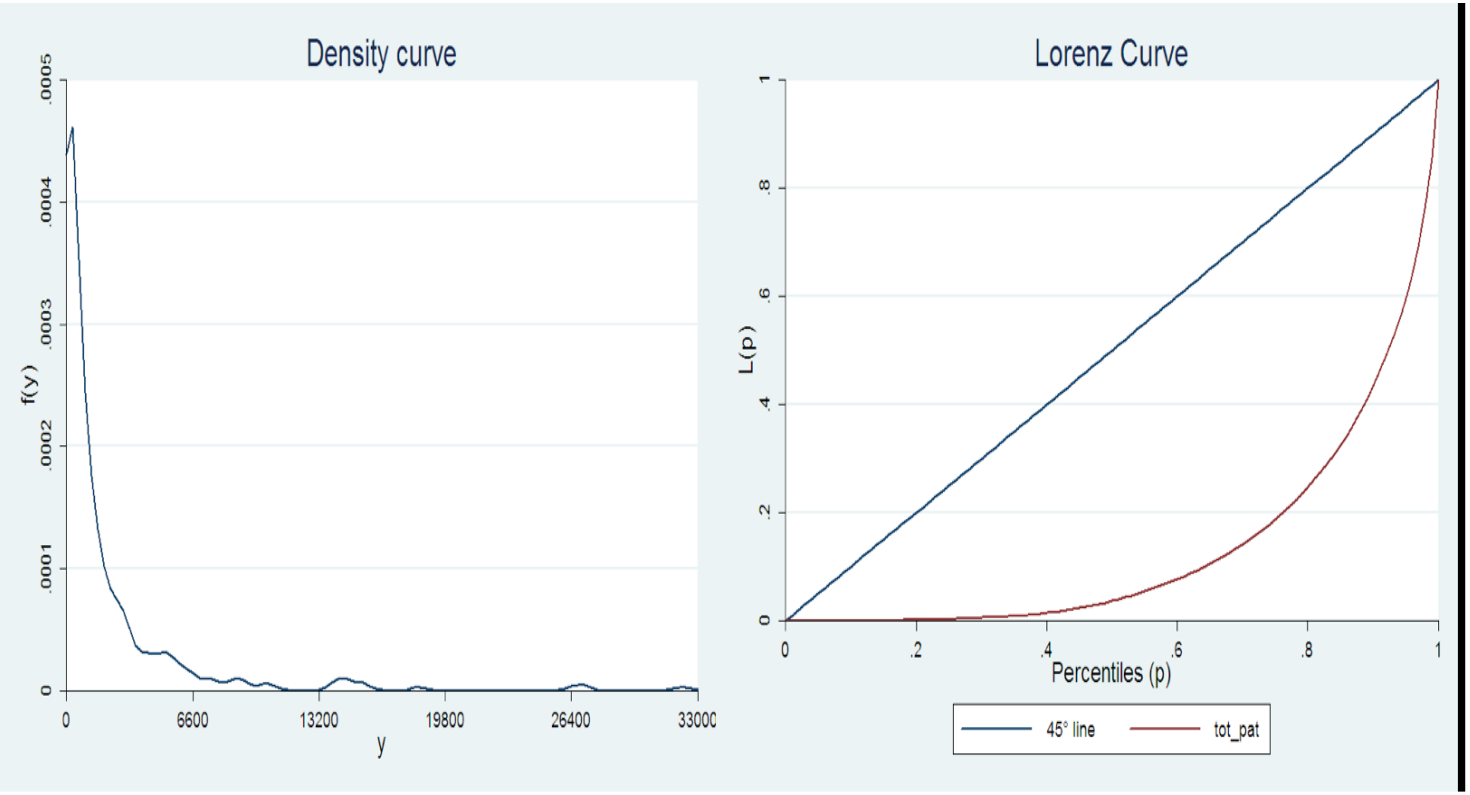
- Most important databases: PATSTAT, European Patent Office data, USPTO data, Japanese Patent Office etc.

Patent application: **request** to the patent office for a grant of patenting the innovation, as it is described and commented in the patent application form.

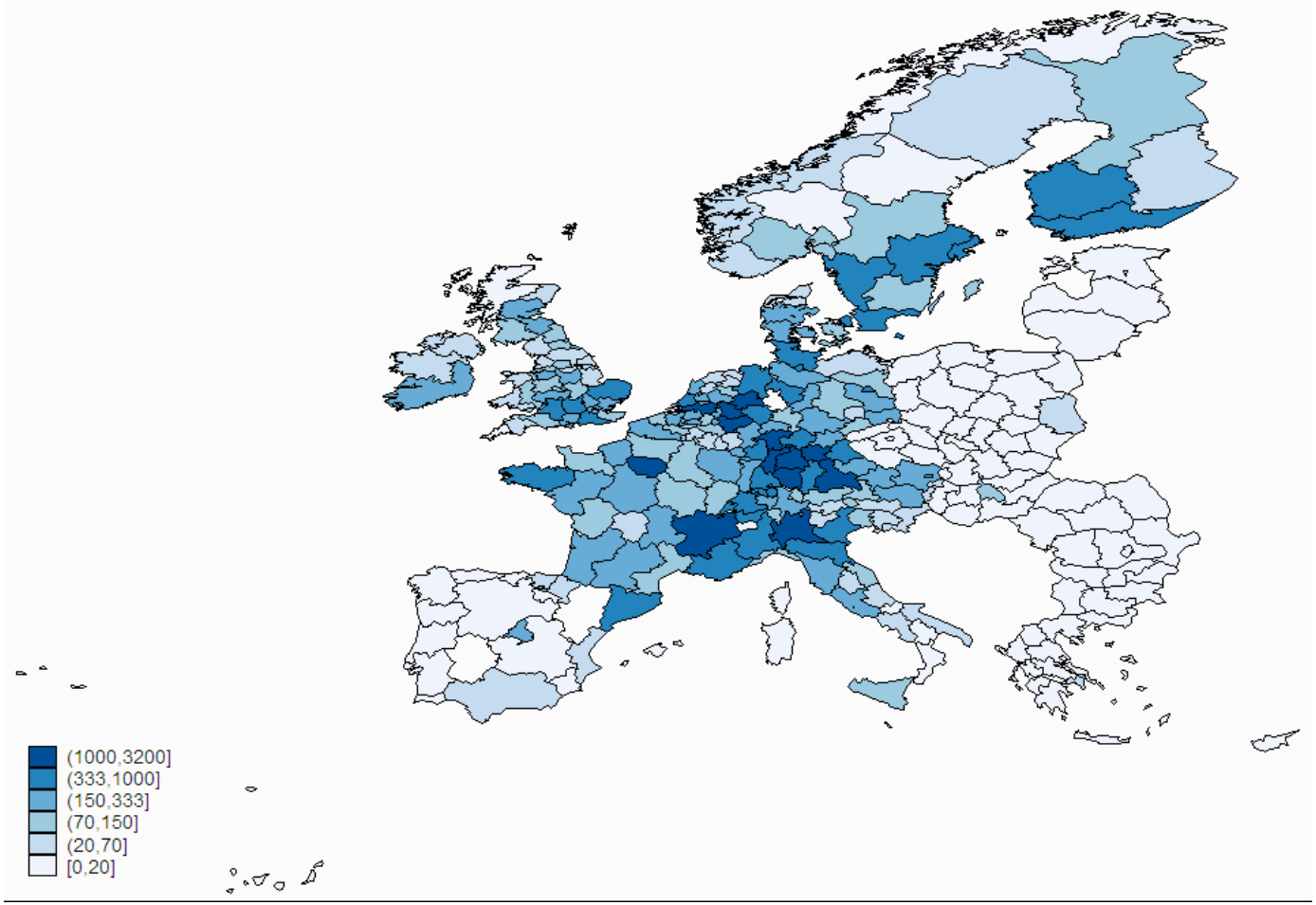
→ Many statistics regard patent applications only!

Patent grant: at the end of the application process, when the patent is issued because it complies with all requirements.

Uneven distribution of patent applications (2000-2010) **across** European **regions**



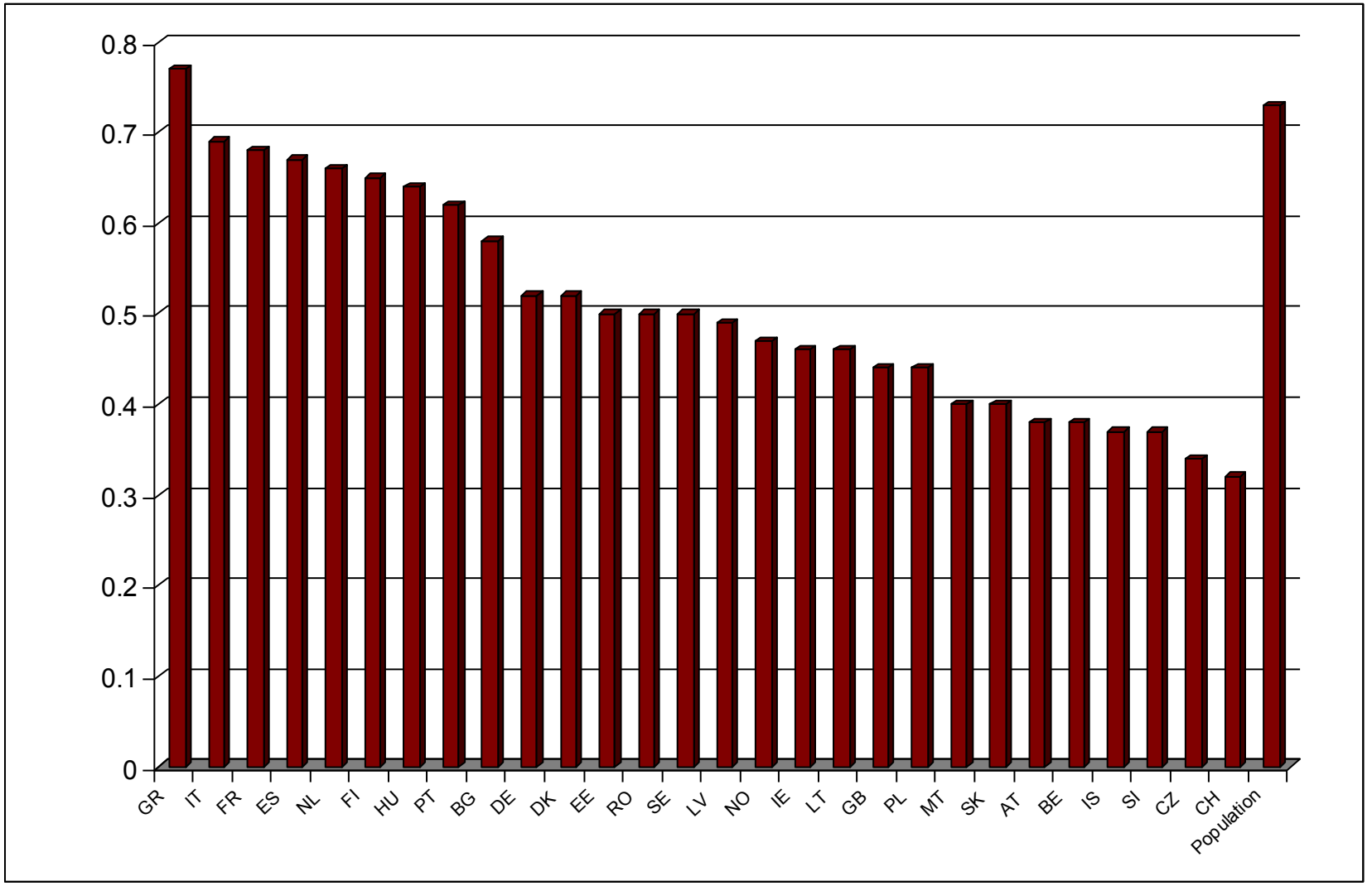
Uneven distribution of Total Patent Applications (average 2001-2010)



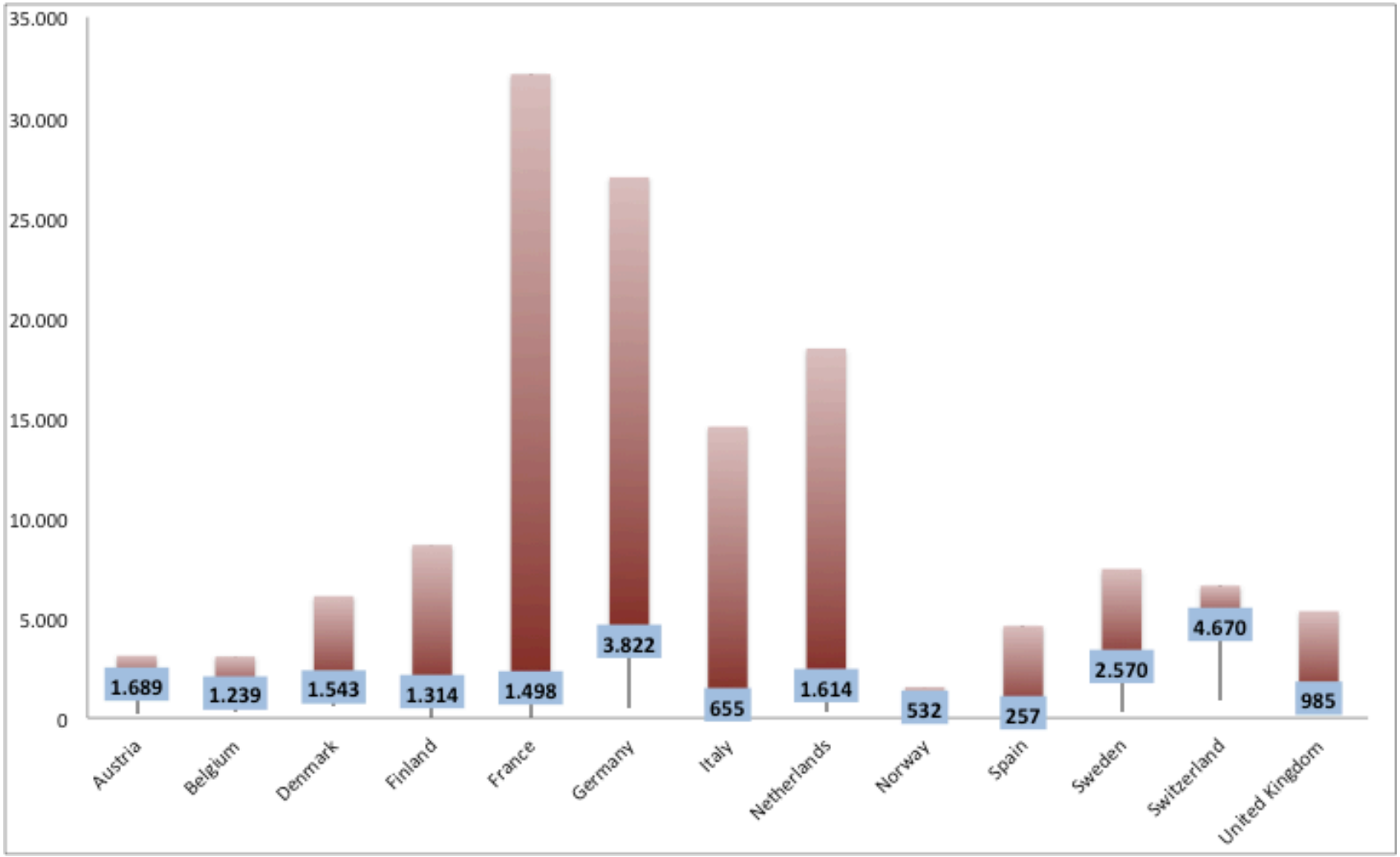
Concentration in top regions (total patent applications): one third of the total… and persisting

Region	Patent applications 1978-2011	Cumulated percentage of patent applications 1978-2011	Ranking 1978-2011	Patent applications 2000-2010	Cumulated percentage of patent applications 2000-2010	Ranking 2000-2010
ÎLE DE FRANCE	71.560	6%	1	32.152	5%	1
OBERBAYERN	53.514	11%	2	26.517	10%	3
STUTTGART	48.380	15%	3	26.998	14%	2
DARMSTADT	37.671	18%	4	15.606	17%	5
DÜSSELDORF	35.333	21%	5	15.338	19%	6
KÖLN	31.878	24%	6	14.271	22%	9
NOORD-BRABANT	30.303	26%	7	18.446	25%	4
RHÔNE-ALPES	28.721	29%	8	14.527	27%	8
LOMBARDIA	28.532	31%	9	14.544	29%	7
KARLSRUHE	26.547	33%	10	13.943	32%	10
Top regions total	392.439			192.342		
Overall total	**1.176.346**			**607.06**		

Uneven distribution of patent applications **within** European **countries**



Distance between top and least performing region, and median, in selected countries (total applications)



3) Technological strategies in Firm Annual Reports

- The R&D Scoreboard includes synthetic information on global R&D investment, together with some other economic variables. However, firm annual reports provide more information on firm technological strategies.
- Let's use one Italian top R&D performer as an example:

PLANET INSPIRED

Finmeccanica annual report, 2009

GROUP RESULTS AND FINANCIAL POSITION

Highlights

€ millions	2009	2008	Change
New orders	21,099	17,575	20%
Order backlog	45,143	42,937	5%
Revenues	18,176	15,037	21%
Adjusted EBITA (*)	1,587	1,305	22%
Net profit	718	621	16%
Adjusted net profit	700	664	5%
Net capital invested	9,612	9,513	1%
Net financial debt	3,070	3,383	(9%)
FOCF (*)	563	469	20%
ROS (*)	8.7%	8.7%	0 p.p.
ROI (*)	16.7%	21.4%	(4.7) p.p.
ROE (*)	11.0%	10.5%	0.5 p.p.
EVA (*)	290	376	(23%)
Research & development	1,982	1,809	10%
Workforce (no.)	73,056	73,398	(0.5%)

Finmeccanica annual report, 2009 (2)

Primary Finmeccanica Group Indicators by segment

The primary changes that marked the Group's performance compared with 31 December 2008 are described below. A deeper analysis can be found in the section covering the trends in each business segment.

€ millions

2009	New orders	Order backlog	Revenues	Adj. EBITA	ROS %	R&D	Workforce at 31 Dec. (no.)
Helicopters	3,205	9,786	3,480	371	10.7%	328	10,343
Defence and Security Electronics	8,215	12,280	6,718	698	10.4%	711	30,236
Aeronautics	3,725	8,850	2,641	241	9.1%	474	13,146
Space	1,145	1,611	909	47	5.2%	87	3,662
Defence Systems	1,228	4,010	1,195	130	10.9%	235	4,098
Energy	1,237	3,374	1,652	162	9.8%	36	3,477
Transportation	2,834	5,954	1,811	65	3.6%	110	7,295
Other Activities	113	172	410	(127)	n.a.	1	799
Eliminations	(603)	(894)	(640)				
	21,099	45,143	18,176	1,587	8.7%	1,982	73,056

Finmeccanica annual report, 2009 (3)

- We can find a description of its R&D activities:

In *Defence and Security Electronics,* R&D costs totalled €mil. 711 (roughly 36% of the Group total) and related in particular to:

- in the *avionics and electro-optical systems* segment: the continuation of development for the EFA programme and new electronic-scan radar systems for both surveillance and combat;
- in the *integrated communications networks and systems* segment: the continuation of development of TETRA technology and wideband data link products and software design radio;
- in the *radar and command and control systems* segment: the continuation of the 3D Kronos radar surveillance system and of the active one, upgrading of the current SATCAS products, the programme to develop capabilities and technologies for architectural design and construction of major systems for the integrated management of operations by armed ground forces (Combined Warfare Proposal - CWP).

Finally, in the *Helicopters* segment, R&D costs came to €mil. 328 (about 17% of the Group total) and mainly concerned the development of technologies primarily for military use (AW149) and of multi-role versions of the BA 609 convertiplane for national security.

- **Research and development costs:** the Group classifies under R&D all internal and external costs incurred relating to projects aimed at obtaining or employing new technologies, knowledge, materials, products and processes. These costs may be partly or entirely reimbursed by customers, funded by public institutions through grants or other incentives under law or, lastly, be borne by the Group. From an accounting standpoint, R&D costs can be categorised differently as indicated below:
  - if they are reimbursed by the customer pursuant to a contract, they are classified under "work in progress";
  - if they relate to research – or if they are at a stage at which it is not possible to demonstrate that the activity will generate future economic benefits – they are taken to profit or loss in the period incurred;
  - finally, if they relate to a development activity for which the technical feasibility, the capability and the willingness to see the project through to the end, as well as the existence of a potential market for generating future economic benefits can be shown, they are capitalised under "intangible assets". In the case in which a grant is given towards these expenses, the carrying value of the intangible assets is reduced by the amount received or to be received.

Finmeccanica annual report, 2009 (4)

- Finally, 13 report pages are dedicated to the description of research projects in which other firm subsidiaries are involved:
  - SELEX Sistemi Integrati
  - SELEX Galileo
  - SELEX Communications
  - MBDA (joint venture)
  - Thales Alenia Space (joint venture)
  - AgustaWestland
  - Elsag Datamat
  - Oto Melara, ecc.

Finmeccanica annual report, 2009 (5)

FINMECCANICA AND RESEARCH AND DEVELOPMENT

Once again in 2009 Finmeccanica initiated new Research and development (R&D) programmes featuring highly innovative content and continued programmes already under way, with an emphasis on containing risks, focusing on strategic objectives and on consolidating the results achieved. The gradual integration of the most recently acquired companies led to a more profound analysis of the synergies achievable within the Group, including in the area of R&D.

Aerospace, Defence and Security

In the Aerospace, Defence and Security sectors it is particularly clear that innovation must be planned along varying timeframes to ensure that the Group maintains its competitive position and creates new products.

The subdivision of R&D into the areas of technological research and development (*a*) and research and development applied to products (*b*) allows for proper planning and containment of risk by optimising the incorporation of new technologies in Group products so that they are able to be commercially successful and remain competitive over time.

a) Technological research and development

These are technological developments that are sometimes described as "basic", in that they are highly strategic and long-term, and that by nature require highly-qualified staff and specialised facilities.

Finmeccanica annual report, 2009 (6)

- *Seventh Framework Programme - Energy* (2007-2013).
  In 2009, Ansaldo Nucleare was awarded the LEADER project for preparing the detailed desig of the prototype of a lead cooled fast reactor system for generating power and burning minor actinides. This project is a follow-up to the nearly completed ELSY project of which Ansaldo Nucleare has always been the project coordinator, the goal of which was to develop the reference configuration for this technology.
- *Seventh Framework Programme - Transportation, including Aeronautics* (2007-2013).
  Group companies are providing committed, experienced participation in research in the aeronautics field, an area to which European funding has been allocated, particularly to the Clean Sky and SESAR Joint Technology Initiatives:
  - the Clean Sky Joint Technology Initiative seeks to develop the most suitable technologies for drastically reducing the environmental impact of aircraft. Finmeccanica is co-leader of two of the six ITD (integrated technology demonstrators): the Green Regional Aircraft (Alenia Aeronautica) and the Green Rotorcraft (AgustaWestland in cooperation with Eurocopter). Avio, SELEX Galileo and SELEX Sistemi Integrati are also involved, along with many other companies, research centres and Italian universities;
  - the SESAR Programme, instead, will allow the development of the new European ATM

Other international firm rankings (as a starting point)

- Fortune Global 500
- Forbes Global 2000
- Financial Times Emerging 500

Other international firm rankings (2)

- Fortune Global 500: top 500 world firms, according to turnover and profits.

Rank	Company Name	Revenues ($b)	Profits ($b)
1	 Royal Dutch Shell	481.7	26.6
2	 Wal-Mart Stores	469.2	17.0
3	 Exxon Mobil	449.9	44.9
4	 Sinopec Group	428.2	8.2
5	 China National Petroleum	408.6	18.2

Other international firm rankings (3)

- Forbes Global 2000: top 2000 global firms (composite indicator).

Rank ▲	Company	Country	Sales	Profits	Assets	Market Value
1	ICBC	China	$134,8 B	$37,8 B	$2.813,5 B	$237,3 B
2	China Construction Bank	China	$113,1 B	$30,6 B	$2.241 B	$202 B
3	JPMorgan Chase	United States	$108,2 B	$21,3 B	$2.359,1 B	$191,4 B
4	General Electric	United States	$147,4 B	$13,6 B	$685,3 B	$243,7 B
5	Exxon Mobil	United States	$420,7 B	$44,9 B	$333,8 B	$400,4 B

Other international firm rankings (4)

- FT Emerging (and not) 500: many variables…

Emerging rank 2013	Emerging rank 2012	Company	Country	Sector	Market value $m
1	1	PetroChina	China	Oil & gas producers	254,818.7
2	2	Industrial & Commercial Bank of China	China	Banks	230,420.5
3	3	China Construction Bank	China	Banks	203,395.9
4	6	Agricultural Bank of China	China	Banks	142,491.3
5	7	Bank of China	China	Banks	130,024.9
6	9	Ambev	Brazil	Beverages	129,570.3
7	4	Petrobras	Brazil	Oil & gas producers	113,177.0
8	10	Sinopec	China	Oil & gas producers	106,736.4
9	5	Gazprom	Russia	Oil & gas producers	101,420.6
10	8	Vale	Brazil	Mining	91,130.1

A focus on emerging firms (example of China shifting from purely manufacturing to innovation)

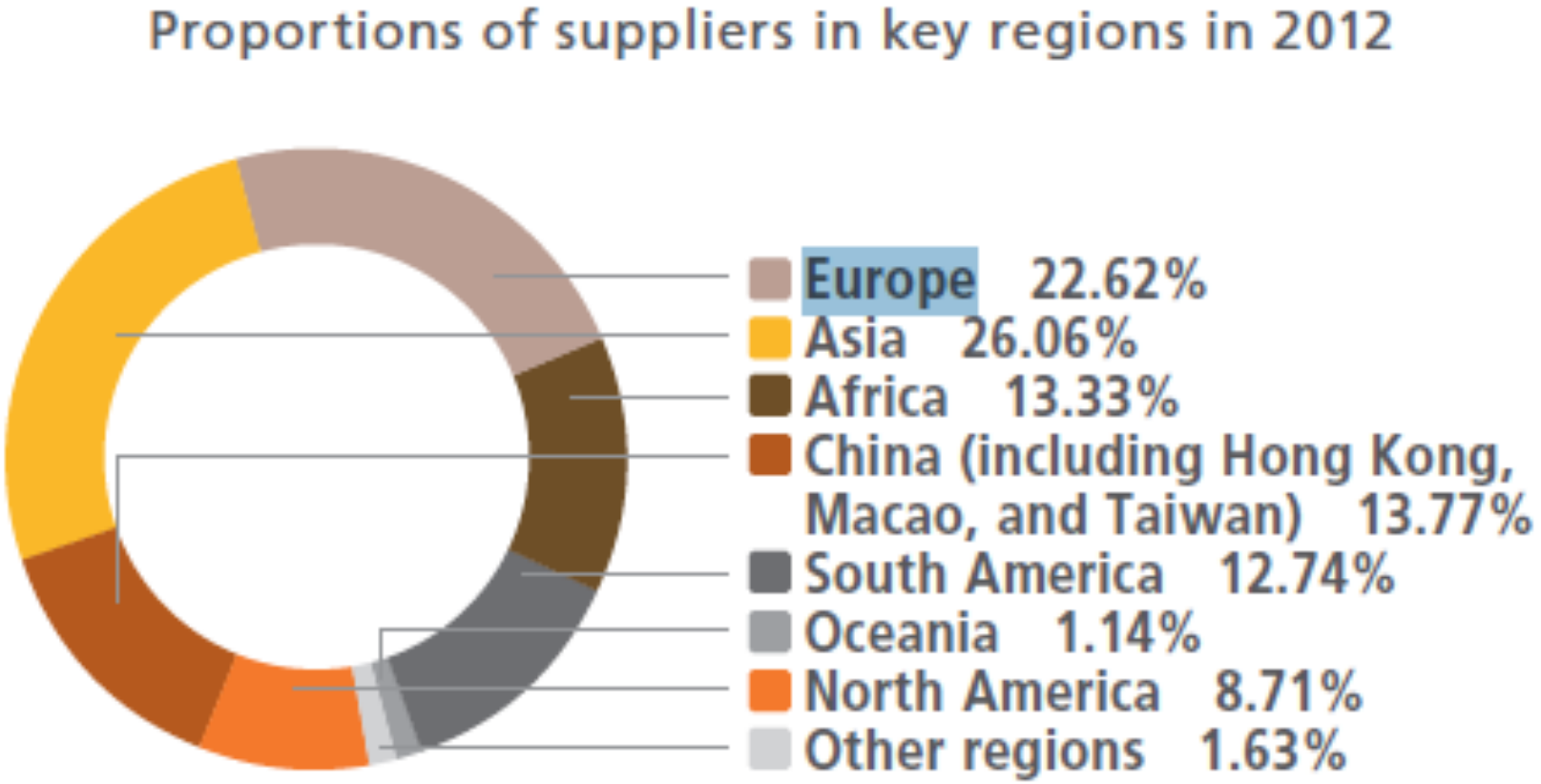
HUAWEI

A focus on emerging firms (2)

(b) Major subsidiaries

Subsidiaries	Place of Incorporation	Ownership Interests	
		2012	2011
Huawei Technologies Co., Ltd.	PRC	100%	100%
Shanghai Huawei Technologies Co., Ltd.	PRC	100%	100%
Beijing Huawei Digital Technologies Co., Ltd. (formerly "Huawei Digital Technologies Co., Ltd.")	PRC	100%	100%
Shenzhen Huawei Technologies Software Co., Ltd.	PRC	100%	100%
HUAWEI TECHNICAL SERVICE CO., LTD.	PRC	100%	100%
Huawei Machine Co., Ltd. (formerly "Imfocus Technologies Co., Ltd.")	PRC	100%	100%
HiSilicon Technologies Co., Limited	PRC	100%	100%
Huawei Device Co., Ltd.	PRC	100%	100%
Huawei Software Technologies Co., Ltd.	PRC	100%	100%
Huawei Tech. Investment Co., Limited	Hong Kong	100%	100%
Huawei Device (Hong Kong) Co., Limited	Hong Kong	100%	100%
Huawei Technologies Coöperatief U.A.	Netherlands	100%	100%
HUAWEI INTERNATIONAL PTE. LTD.	Singapore	100%	100%
PT. Huawei Tech Investment	Indonesia	100%	100%
HUAWEI DO BRASIL TELECOMUNICACOES LTDA	Brazil	100%	99.36%

A focus on emerging firms (3)



A focus on emerging firms (4)

Research and Development

Huawei has over 70,000 product and solution R&D employees, comprising more than 45% of our total workforce worldwide. We have set up 16 R&D centers in countries that include Germany, Sweden, the US, France, Italy, Russia, India, and China.