European Commission

EU R&D SCOREBOARD

The 2015 EU Industrial R&D Investment Scoreboard

Report EUR 27540 EN

Acknowledgements

The 2015 EU Industrial R&D Investment Scoreboard has been published within the context of the Industrial Research and Innovation Monitoring and Analysis (IRIMA) activities that are jointly carried out by the European Commission's Joint Research Centre (JRC) - Institute for Prospective Technological Studies (IPTS) and the Directorate General for Research and Innovation- Directorate A, Policy Development and Coordination.

IRIMA activities aim to improve the understanding of industrial R&D and Innovation in the EU and to identify medium and long-term policy implications.

The project was coordinated under the leadership of Alessandro Rainoldi (Head of JRC-IPTS Knowledge for Growth - KfG Unit) and Román Arjona Gracia (Head of DG RTD.A4 Analysis and monitoring of national research policies). This document was produced by Héctor Hernández, Fernando Hervás Soriano, Alexander Tübke, Antonio Vezzani, Mafini Dosso, Sara Amoroso, Nicola Grassano, Alexander Coad and Petros Gkotsis (KfG Unit) as the main authors. Marnix Surgeon and Roberto Martino from DG RTD.A made contributions to the design and review of this work.

Michael Tubbs from Innovomantex Ltd. greatly contributed to this work, reviewing the whole analytical work and the industrial findings.

Data have been collected by Bureau van Dijk Electronic Publishing GmbH under supervision by Petra Steiner, Annelies Lenaerts and Roberto Herrero Lorenzo.

Comments and inputs can be sent by email to: JRC-IPTS-IRI@ec.europa.eu

More information on IRIMA is available at: http://iri.jrc.ec.europa.eu/

European Commission - Joint Research Centre
Institute for Prospective Technological Studies
Edificio Expo; c/ Inca Garcilaso, N° 3
E-41092 Seville (Spain)
Tel.: +34 954488318, Fax: +34 954488300

IPTS e-mail: jrc-ipts-secretariat@ec.europa.eu

JRC98287

EUR 27540 EN

ISBN 978-92-79-53020-3 (pdf), ISBN 978-92-79-53021-0 (print)

ISSN 1831-9424 (online), ISSN 1018-5593 (print)

doi:10.2791/15792 (online), doi:10.2791/50785 (print)

Luxembourg: Publications Office of the European Union, 2015

EU R&D SCOREBOARD

The 2015 EU Industrial R&D Investment Scoreboard

Héctor Hernández, Fernando Hervás, Alexander Tübke, Antonio Vezzani, Mafini Dosso, Sara Amoroso, Nicola Grassano, Alexander Coad, Petros Gkotsis

2015

Contents

Summary

The "EU Industrial R&D Investment *Scoreboard*" (the *Scoreboard*), published annually since 2004, monitors top EU based R&D investing companies benchmarking them with top investors located in other parts of the world. The *Scoreboard* is part of the European Commission's monitoring activities to improve the understanding of trends in R&D investment by the business sector. In the context of the EU agenda for Jobs, Growth and Investment, the contribution

Highlights

- In 2014, the top world 2500 R&D *Scoreboard* companies raised their Research and Development investments by 6.8%, while net sales continued to grow at a significant lower pace (2.2%). The positive evolution of R&D investments confirms the crucial strategic role that knowledge generation plays for these companies in a context of global competition and increasingly accelerated technical change.

- Companies based in the EU showed an annual R&D investment growth rate of 3.3%, slightly improving the previous year's performance (2.5%). This reflects the mixed performance of medium- and high-tech sectors, e.g. good results by companies such as VW (11.7%), Ericsson (17.3%), AstraZeneca (21.4%), Bayer (13.2%), Total (42.6%) and Bosch (8.4%) have been offset by those of companies such as Nokia (-21.4%), Alstom (-29.5%), STMicroelectronics (-31.6%), GlaxoSmithKline (-10.5%), Royal Bank of Scotland (-31.5%) and Finmeccanica (-14.6%).

- Companies based in the US showed a stronger R&D investment growth rate (8.1%), driven by the good performance of its R&D-intensive ICT and health companies, which represent more than two thirds of US total R&D investment.

- The Chinese companies, from the 3rd largest country by number of companies in this edition, increased R&D investments by 23.6%, mostly due to the outstanding results shown in IT-hardware and software sectors. These same ICT sectors largely explained the strong R&D investment performance of companies based in Taiwan (12.4%) and South Korea (10.6%).

- An analysis of the health (biopharma and health equipment sectors) and ICT sectors shows a significant gap for the EU vis-à-vis the US in terms of R&D investment. However, the *Scoreboard* also shows there are a number of world-beating EU companies of substantial size in these sectors, e.g. Novo Nordisk, ASML and ARM. The gap is due to the fact that there are too few of them. Further investigation on an enlarged sample of top EU-1000 companies showed that there are a significant number of high-performance companies with the potential to further climb-up in the ranking of world top R&D investors (e.g. Dialog Semiconductor, Gameloft, Generix, Playtech and Wirecard).

- Companies in the ICT, Pharmaceuticals and Automobiles sectors continue to dominate the top 10 places in the world ranking. As in the previous edition, the top R&D investors are Volkswagen, Samsung, Microsoft, Intel and Novartis. The most significant changes at the top of the ranking in 2014 are the climb of Google to 6th place (from 9th), and of Pfizer to the 10th place (from 15th). Huawei (15th) and Apple (18th) accelerated in 2014 their race to the top, jumping 11 and 17 positions respectively. The slip down in the ranking of the EU based companies present in the top 50 is in part due to the depreciation of the euro which started in the second half of 2014.

- An analysis of the patent portfolios of the world's top R&D investors shows that EU and US based companies have the highest degrees of internationalisation of their inventive activities: 26% and 22% of their patent families are developed by inventors located outside the region. While the US appear to be the preferred location for health related inventions (pharma and biotech in particular), Europe is the most attractive place for the inventive activities of automobile companies.

of the business sector to reach the 3% objective for R&D intensity in the European economy is crucial. Evidence shows that most of the EU R&D gap with respect to main world competitors comes from an insufficient number of leading innovative companies in key high-tech sectors.

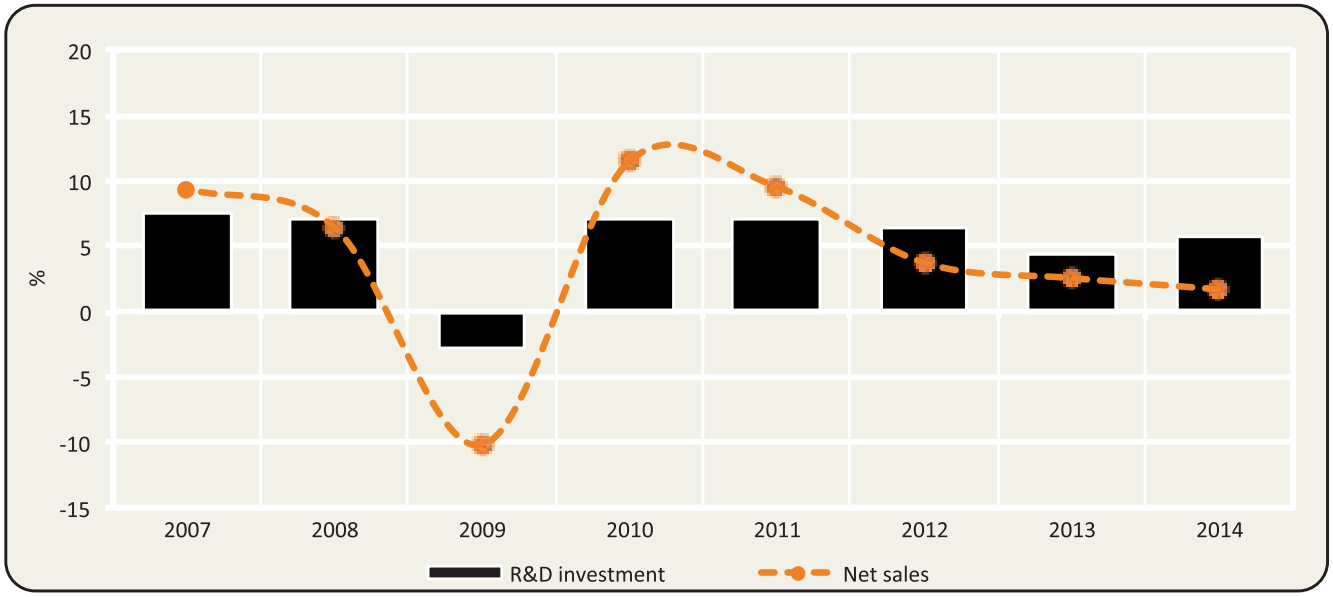
The *Scoreboard* relies on economic and financial information on the World's top 2500 companies that invested €607.2 billion in R&D –representing about 90% of the total expenditure on R&D by business worldwide. The data is collected from the latest available companies' accounts (i.e. for this year's edition usually the fiscal year 2014/15[1]). It complements official territorial statistics (such as BERD) in the study of important questions related to companies' innovation behaviour in a global context. It is a reliable, up-to-date benchmarking tool for comparisons between companies, sectors, and geographical areas, as well as to monitor and analyse emerging investment trends and patterns.

The 2015 *Scoreboard* sample contains 608 companies based in the EU, 829 companies based in the US, 360 in Japan and 703 from the rest of the world.

In 2014, the top world R&D investors increased their Research and Development investments by 6.8% to reach a figure of €607.2bn while net sales continued to grow at a significant lower pace (2.2%). This reaffirms the continuity of the robust growth trend of R&D investments observed since 2010 (see Figure S.1).

This positive evolution of R&D investments by the top world investors confirms the crucial strategic role that knowledge generation plays for these companies in a context of global competition and increasingly accelerated technological change. Capital expenditures continue to grow at a significantly lower rate (0.9%), although such investments still remain an important factor for many firm's productivity enhancement (companies in the sample devote in average 7% of their sales to capital investments, compared to the 3.4% devoted to R&D). However, capital investment is usually far less important for companies in R&D-intensive sectors such as biopharma and software. The number of employees for the world sample has increased by 1.5%, an improvement with respect to last year's stagnation (-0.1%). Figure S1 below shows the longer-term R&D trends for a subset of companies with available data for the past eight years.

Figure S.1 - One-year growth rate of R&D investment and net sales.



Note: Figures for the three variables have been computed on 1832 out of the 2500 companies for which data are available for the entire period 2007-2014

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

1 The latest available annual account is taken into account for each individual company. Due to differences in accounting practices, however, these refer to a range of dates from 2013 to the first half year of 2015 (see the methodological notes in the Annex).

In 2014, the 608 EU companies among the top world 2500 R&D investors increased R&D by 3.3%, slightly improving the previous year's performance (2.5%) in a context of sales stagnation (-1.0%) and return to positive profits (5.0%, compared to -6.6% in 2013).

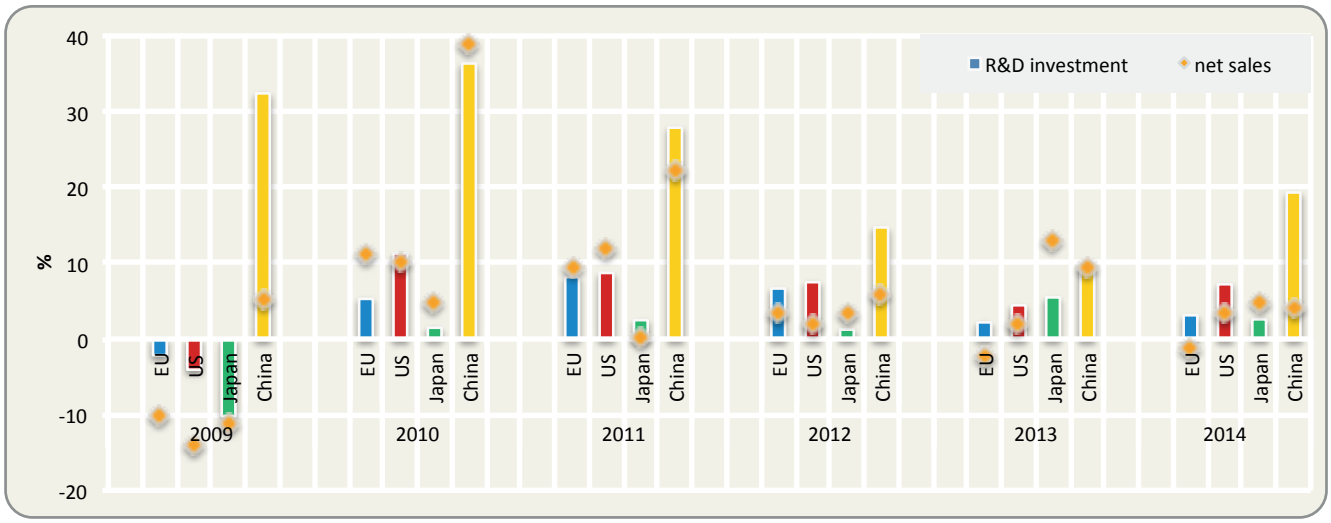
Companies based in the US showed the strongest R&D growth rate (8.1%, well above the growth of sales 3.6%, and despite a fall in profits of -0.8%), while Japanese companies increased R&D by 2.6%, despite a significant growth of net sales (4.3%) and profits (8.2%). The *Scoreboard* sample shows an increasing number of Chinese companies, now fourth group in terms of number of companies and total R&D investment. The Chinese companies increased R&D by 23.6% in 2014.

Figure S.2 shows the R&D and sales trends over the period 2009-2014 for a subset of companies based in the EU, US, Japan and China[2]. These four regions account for 86.5% of the total R&D investment made by the 2500 *Scoreboard* sample: EU 28.1%, US 38.2%, Japan 14.3% and China 5.9%.

Trends over the past 6 years show a hesitant recovery of companies based in the EU, especially in terms of net sales whereas their the US counterparts seem to have returned to the high R&D investment levels that obtained prior to the crisis.

Japanese companies, hardly affected by the crisis, show positive results in terms of R&D and net sales over the last two years, indicating continuing recovery after the earthquake of 2011. R&D investment by the Chinese companies rose significantly over the period 2008-2010 and remained at high levels in recent years. On the contrary, their net sales slowed down during the crisis, picked up again and then decelerated again in the past three years. However, please note that this refer only to 145 Chinese companies for which data were available over the 2009-2014 period compared to the 301 firms listed in this year's *Scoreboard*.

Figure S.2 - One-year growth rate of R&D investment and net sales, by main world region.



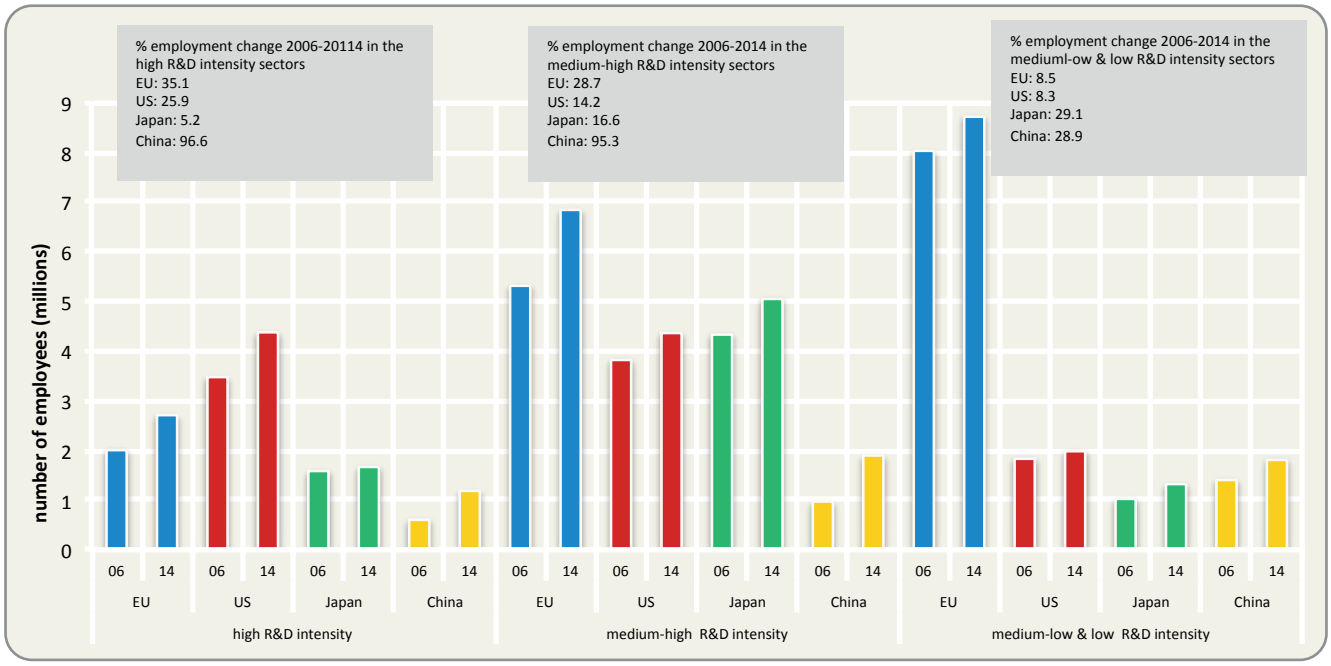
Note: Figures for the two variables have been computed on 516 EU, 667 US, 350 Japanese and 145 Chinese companies for which data are available for the entire period 2009-2014

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

2 Companies for which data are available for the whole 2009-2014 period.

In 2014, employment has increased for *Scoreboard* companies based in the EU (1.8%), US (1.4%), which represents an improvement with respect to the situation in 2013 (when the number of employees decreased by 3.1% in US based companies and by 0.6% in European ones). For the period 2006-2014, the employment increase observed for the set of companies for which data is available (23.1%), is led by increases in high R&D intensive sectors (33.8%) and medium-high sectors (26.3%), see figure S3.

Figure S3 - Employment figures in the *Scoreboard*, by sector group and main world region.



Notes: Sector groups as defined in Box S.1.
Figures displayed refer only to those companies (477 EU, 574 US, 336 Japanese, 184 Chinese) for which data are available for both years (2014 and 2006).
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Box S.1 - Grouping of industrial sectors according to R&D intensity (R&D as % of net sales)*.

High R&D intensity sectors include mainly Pharmaceuticals & biotechnology; Health care equipment & services; Technology hardware & equipment; Software & computer services, Aerospace & defence and Leisure Goods.

Medium-high R&D intensity sectors include mainly Electronics & electrical equipment; Automobiles & parts; Industrial engineering; Chemicals; Personal goods; Household goods; General industrials; Support services.

Medium-low R&D intensity sectors include mainly Food producers; Beverages; Travel & leisure; Media; Oil equipment; Electricity; Fixed line telecommunications.

Low R&D intensity sectors include mainly Oil & gas producers; Industrial metals; Construction & materials; Food & drug retailers; Transportation; Mining; Tobacco; Multi-utilities.

* This classification takes into account the R&D intensity of all companies aggregated by ICB 3-digit sectors: High above 5%; Medium-high between 2% and 5%; Medium-low between 1% and 2% and Low below 1%. Some sectors are adjusted to compensate for insufficient representativeness of the *Scoreboard* using the OECD definition of technology intensity for manufacturing sectors (ISIC REV 3. Technology intensity definition, OECD, 7 July, 2011.)

As in the previous *Scoreboard* edition, the top R&D investors are Volkswagen, Samsung, Microsoft, Intel and Novartis. The most significant changes at the top of the ranking in 2014 are the climb of Google to 6th place (from 9th), and Pfizer to 10th place (from 15th). Huawei (15th) and Apple (18th) accelerated in 2014 their race towards the top 10, jumping 11 and 17 positions, respectively.

Companies in the ICT, Pharmaceuticals and Automobiles sectors continue to dominate the top 10 of the ranking. The slip down in the ranking of the EU based companies present in the top 50 is in part due to the depreciation of the euro which started in the second half of 2014 (see Box I.1 for further detail).

Most of the top 100 companies showing a double-digit R&D increase are in the Pharmaceuticals & Biotechnology (10), ICT (9) and Automobiles & Parts (6) sectors. The companies showing the largest increase in R&D are Tata Motors, India (108.9 %); Facebook, US (88.4 %); Total, France (42.6 %); SK Hynix, South Korea (37.2 %) and Apple, US (35.0 %).

Among the top 100 companies, 21 have at least doubled their R&D since the beginning of the crisis in 2008 (3 companies based in the EU, 10 from the US and 8 from other countries). This group of companies is mainly from high R&D-intensive sectors (12) and from medium-high R&D intensive sectors (5). Many of these companies have also shown outstanding sales and employment performance in the period 2008-2014 (twelve doubled net sales and seven doubled employment).

In some cases the big changes in R&D observed over the last ten years are the result of different corporate policies such as mergers & acquisitions (M&As). Google and Oracle, with 122 and 65 deals respectively, illustrate this corporate behavior in the ICT sector. In terms of total value of the deals, pharmaceuticals companies dominate the ranking of M&As over the past eight years (Pfizer, Merck, Roche and Novartis).

EU and US based companies show a higher degree of internationalisation of their inventive activities, with 26% and 22% of their patent families developed by inventors located outside the region. The share of EU owned patent families developed by inventors located in the US (19%) is higher than the share of US patent families developed by inventors in the EU (10%).

The country distribution of patents filed by the world's top R&D investors is a good proxy for the location of companies' innovation activities. The analysis shows that 80% of patents were developed by inventors residing in the same world region as the parent company owning the rights.

Interesting regional and sector specificities have been found, both in the degree of internationalisation of companies' innovation activities and in the capacity of attracting R&D investments. Such differences reflect the industrial and technological specialisation of the world regions. The US appears to be the most attractive region of the world for the R&D investment for health related sectors, pharma and biotech in particular (Figure S.4). Europe is instead the preferred international location for the inventive activity of automobile companies (Figure S.5). This holds true for US based companies (28%) and particularly for those based in the rest of the world (71%).

Table S.4 - Mapping the international location of patenting activities (Pharmaceuticals & Biotech).

		Inventor location				
		EU	USA	Japan	RoW	Switzerland
Company's headquarter location	EU *(6,635)*	72.2%	21.6%	1.3%	3.9%	1.0%
	USA *(8,619)*	10.3%	81.2%	1.7%	5.0%	1.8%
	Japan *(1,342)*	5.8%	18.5%	67.8%	7.7%	0.21%
	RoW *(860)*	18.1%	30.5%	0.1%	50.3%	1.12%
	Switzerland *(2,897)*	31.0%	43.7%	2.6%	3.8%	18.8%

Note: Patent families are fractional counted in case of multiple inventors and/or multiple applicants. RoW does not include Switzerland as in other parts of the present report.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table S.5 - Mapping the international location of patenting activities (Automobiles and Parts).

		Inventor location				
		EU	USA	Japan	Asian Tigers	RoW
Company's headquarter location	EU *(14,609)*	84.9%	10.6%	1.2%	0.9%	2.4%
	USA *(7,172)*	28.1%	65.8%	0.8%	0.4%	4.8%
	Japan *(17,508)*	1.6%	7.8%	89.9%	0.0%	0.58%
	Asian Tigers *(2,520)*	0.2%	0.8%	0.4%	97.0%	1.54%
	RoW *(118)*	71.4%	5.3%			23.3%

Note: Patent families are fractional counted in case of multiple inventors and/or multiple applicants. RoW does not include the Asian Tigers and Switzerland as in other parts of the present report.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Companies in the high-tech sectors of Health and ICT showed a robust R&D growth in 2014 (Software 12.8%, Hardware 6.7%, pharma & biotech 7.2%). This has been driven mainly by the strong performance of US based high-tech companies, which continued to increase their share in the country's *Scoreboard* sample. The Pharma sector recovered in 2014 from the 2013 sluggish performance in both the US and the EU.

High R&D-intensive sectors showed a strong R&D investment performance worldwide, supported by robust sales growth. Companies based in the US and operating in ICT sectors continued to strongly increase their R&D investments, well above the growth rate of their competitors based in the EU and Japan: Software 13.1% versus 4.6% for EU and -5.7% for Japan, Hardware 7.0% versus -1.7% in EU and 1.3% in Japan. Companies located in the rest of the world showed outstanding performances in terms of R&D investment growth in ICT sectors (34.4% for Software and 16.7% for IT-hardware). These performances are mainly driven by companies based in China (47.3% and 24.8%) and South Korea (11.7% and 29.9%).

The R&D investment performance of the pharma and biotech sector in 2014 of companies based in the US (10.7%) and the EU (6.5%) is much better than that observed in 2013 (0.4% and 0.9% respectively). Pharma companies based in Japan showed an inverse trend: poor performance in 2014 (-1.0%) compared to the good performance in 2013 (9.3%).

These trends enhance US specialisation in high R&D intensive sectors and increase the gap with respect to its main competing companies in the EU and Japan. Meanwhile, companies based in China and South Korea are catching-up quickly.

US *Scoreboard* companies operating in high R&D-intensive sectors invest more than their EU counterparts, as illustrated in figure S.6. The most striking differences, both in terms of number of companies and overall R&D investment values, correspond to the Software, Internet and Computer Services, ICT Hardware, and to the health related sector of Biotechnology.

As shown in figure S.6 below, there is a significant gap for the EU vis-à-vis the US in terms of number of companies and R&D investment in high-tech sectors related to health and ICT. Nevertheless, the *Scoreboard* also shows a number of world-beating EU companies of substantial size in these sectors, as well as a significant number of high-performance companies showing the potential to further climb-up in the ranking of world top R&D investors.

There are a number of world-beating EU companies of substantial size in high-tech sectors related to health and ICT, such as Novo Nordisk (DK) in health, or ASML (NL) and ARM (UK) in ICT. Evidence from the EU enlarged *Scoreboard* sample shows a relevant number of high-performance R&D based innovators. Among these smaller R&D investors, five show particularly strong R&D intensity (above 10%) coupled with strong net sales growth (above 10% in the period 2005-2013), positive profits and well above sectoral labour productivity average: Dialog Semiconductor, Gameloft, Generix, Playtech and Wirecard. The challenge for Europe is to create the conditions needed to favour the sustained growth of such companies and the emergence and high growth of new ones.

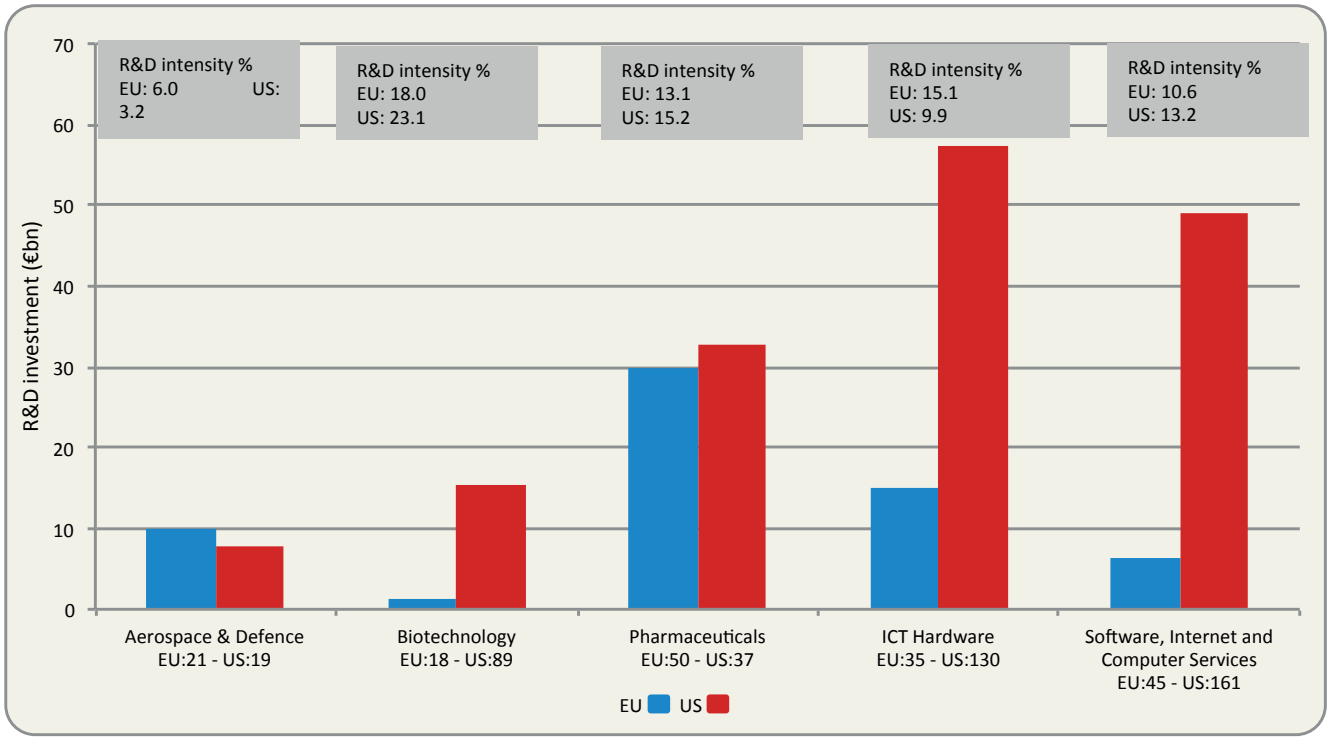
Overall, the R&D growth of EU companies outperform their US counterparts in medium-high tech sectors, however a mixed performance is shown in both regions.

In particular in the EU, a strong R&D performance of the EU Automobiles sector in 2014 (7.9%) has been offset by a negative one in Industrial Engineering (–4.1%, largely explained by the figures of the largest R&D investors in this sector Volvo -4.4% and Alstom – 59.5%), General Industrials (-2.1%) and Chemicals (-0.8%).

Interestingly, the R&D intensity of key medium-high tech sectors in the EU is generally higher than that of the US (see Figure

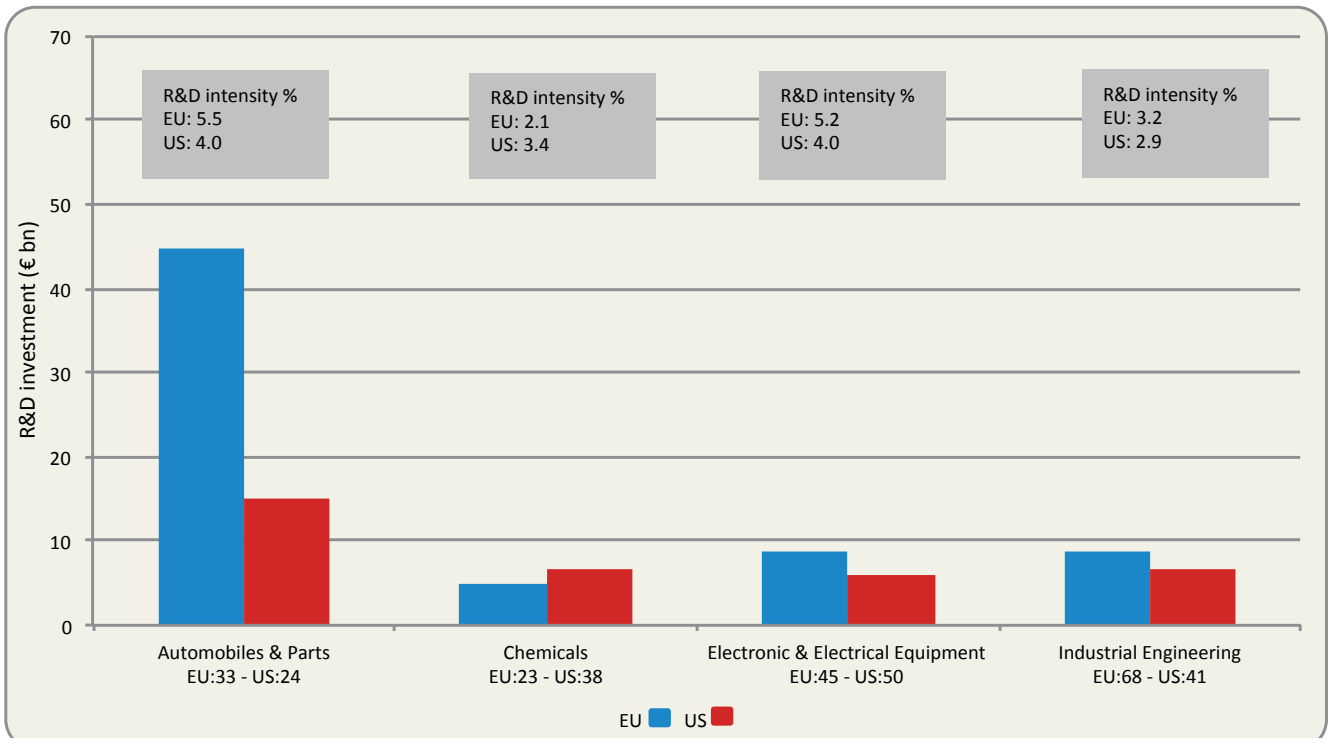
S.7). In this respect, the Automobiles and Electronic & Electrical Equipment sectors in the EU show an R&D intensity above the 5% threshold used for classifying a sector as high-tech (share of R&D over net sales): 5.5% and 5.2%, respectively. Also in terms of overall R&D investments the EU outperforms the US in the medium-high tech sectors (€76.2bn vs €46.9bn).

Figure S.6 - R&D investment and R&D intensity for selected high-tech sectors (EU vs US).



Note: Figures on the horizontal axis refer to the number of companies by region in each sector.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Figure S.7 R&D investment and R&D intensity for selected medium high-tech sectors (EU vs US).



Note: Figures on the horizontal axis refer to the number of companies by region in each sector.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Introduction

This 2015 edition of the "EU Industrial R&D Investment *Scoreboard*" (the *Scoreboard*)[3] comprises the **2500 companies investing the largest sums in R&D in the world** and an additional number of companies to cover the **top 1000 R&D investing companies based in the EU**[4]. In total, there are 2898 companies incorporated in the 2015 *Scoreboard*.

Companies' R&D rankings are based on information taken from the companies' latest published accounts. For most companies these correspond to calendar year 2014, but significant proportions have financial years ending on 31 March 2015 (Japanese companies in particular). There are few companies included with financial years ending as late as end June 2015 and a few for which only accounts to end 2013 were available.

In order to avoid double counting, The *Scoreboard* considers only data from parent or independent companies. Normally, these companies integrate into their consolidated accounts the data of their subsidiary companies. An analysis of the ownership structure of the parent companies included in the 2015 *Scoreboard* shows that they have more than 600.000 subsidiary companies (controlled companies with more than 50% ownership).

It should be noticed that the *Scoreboard* relies on disclosure of R&D investment in companies' published annual reports and accounts and that due to different national accounting and disclosure practices, companies of some countries are less likely than others to disclose R&D investment consistently. For these reasons, companies from some countries such as Southern or Eastern European countries might be under-represented while others such as the companies from the UK over-represented.

The *Scoreboard* collects key information to enable the assessment of the R&D and economic performance of companies. The main indicators, namely R&D investment, net sales, capital expenditures, operating profits and number of employees are collected following the same methodology, definitions and assumptions applied in previous editions. This ensures comparability so that the companies' economic and financial data can be analysed over a longer period of time.

The capacity of data collection is being improved by gathering information about the ownership structure of the *Scoreboard* parent companies and the main indicators for their subsidiaries. In 2015, we have collected available indicators reported by the more than 600.000 subsidiary companies involved in this *Scoreboard* edition. This allows a better characterisation of companies, in particular regarding the sectoral and geographic distribution of their research and production activities and the related patterns of growth and employment.

In particular, the analysis of key indicators on the parent companies and their subsidiaries allows the reassignment of companies to countries where they show their actual economic activity, thus improving our analyses at country and world region levels. For example, in this report, a significant number of companies have been reassigned to China as a result of the examination of companies headquartered in Cayman Island and Bermuda (see details in chapter 5).

Companies' behaviour and performance can be analysed over longer time periods using our history database that contains information on the top R&D companies since 2003. This enables benchmarking analyses of companies across sectors and countries, for example the identification of companies showing outstanding economic or innovation results and the analysis of the main factors underlying such successful dynamics.

The data have been collected by Bureau van Dijk Electronic Publishing GmbH, following the same approach and methodology applied since the first *Scoreboard* edition in 2004. For background information please see Annex 1.

3 The EU Industrial R&D Investment *Scoreboard* is published annually by the European Commission (JRC-IPTS/DG RTD) as part of its Industrial Research and Innovation Monitoring and Analysis activity (IRIMA).

4 In this report, the term EU company refers to companies whose ultimate parent has its registered office in a Member State of the EU. Likewise, non-EU company applies when the ultimate parent company is located outside the EU (see also the glossary and definitions in Annex 2 as well as the handling of parent companies and subsidiaries).

Report structure

Chapter 1 presents the worldwide trends of industrial R&D. It provides an overview of the main indicators for the top 2500 companies ranked by level of R&D investment and the main changes that took place over the last year. An analysis of the main indicators of the company data aggregated by world regions is included together with the performance of companies over the past 10 years.

The performance of individual companies among the top R&D investors is provided in chapter 2. The list of the top world 100 R&D companies is examined highlighting those companies showing remarkable R&D and economic results and improvement in the R&D ranking over the last 12 years.

Chapter 3 presents an analysis of the main R&D and economic indicators of companies aggregated by industrial sector, with comparisons of EU companies and their main worldwide counterparts.

Results of an analysis aimed at identifying companies that presented outstanding economic and R&D performance over the past 10 years is shown in chapter 4. The analysis includes a discussion of corporate characteristics that likely contributed to the high performance of these companies.

Chapter 5 deals with the international distribution of companies' economic and innovation activities. The objective is to obtain a first estimate of the actual distribution of jobs, value-added and knowledge across countries and regions.

Chapter 6 discusses the trends on R&D and economic performance of the companies included in the extended sample comprising the top 1000 R&D investors based in the EU. This includes the results of an exercise aiming to extend the coverage of R&D investing companies in member states previously thought to be under-represented in the *Scoreboard*.

Annex 1 provides background and methodological information about how the *Scoreboard* is prepared. The methodological approach of the *Scoreboard*, its scope and the limitations are described in Annex 2. The sector and country composition of the EU 1000 sample is found in Annex 3. A supplementary list of companies reporting R&D investment is presented in Annex 4. The access to the full dataset is shown in Annex 5.

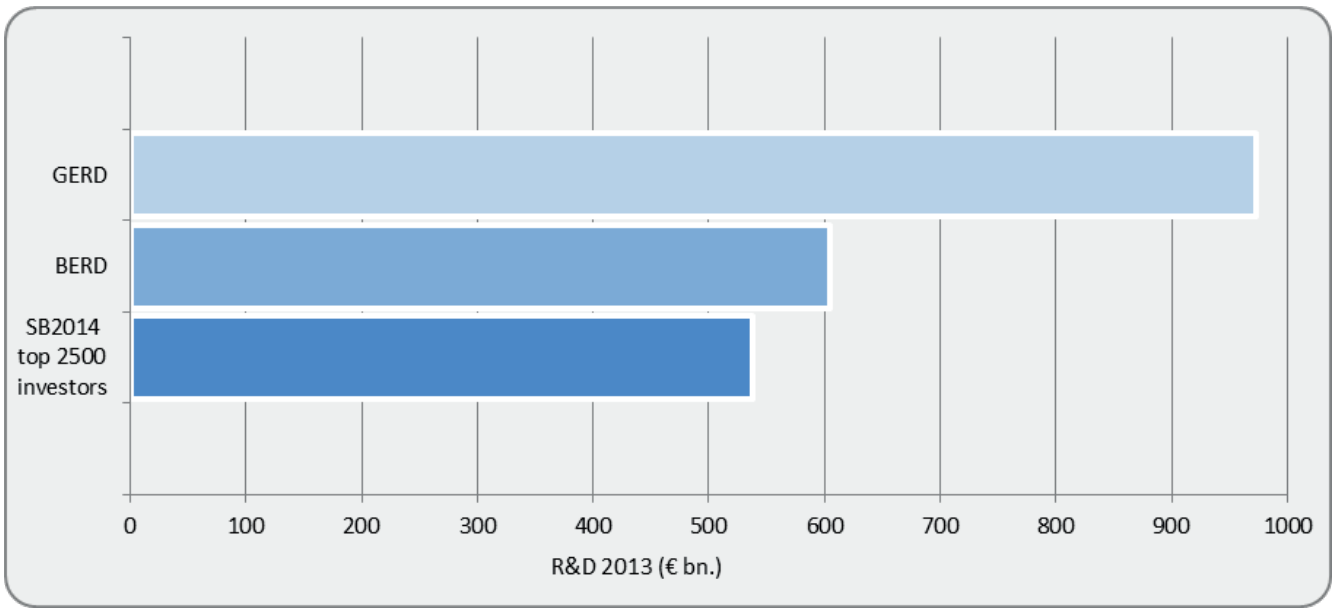
The complete data set is freely accessible online at: http://iri.jrc.ec.europa.eu/scoreboard15.html

Description of the company dataset

This edition of the *Scoreboard* contains data on the world's top 2500 companies ranked by their investments in R&D. These companies each invested more than €17.9 million in 2014/15, accounting together for €607.2 billion.

The amount of R&D investment by these 2500 companies is equivalent to more than 55% of the total expenditure on R&D worldwide (GERD) and about 90% of the R&D expenditure financed by the business sector worldwide (BERD). This is illustrated in figure I.1 where the latest 2013 territorial statistics are compared with the corresponding figures of the 2014 *Scoreboard* (2014 *Scoreboard* €538.3bn; GERD €973.6bn; BERD €604.9bn).

Figure I.1 – Comparison of R&D figures of the *Scoreboard* and territorial statistics.



Note: Total R&D expenditure (GERD) and total business R&D expenditure (BERD) funded by the business sector in 2013.
Sources: Latest figures reported by Eurostat (30 March 2015) including most countries reporting R&D.
The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The dataset is complemented with additional companies in order to cover the top 1000 R&D investing companies based in the EU, all of them having invested more than R&D €5.5 million in 2014. This additional sample is analysed separately in chapter 6.

The main methodological limitations are summarised in Box I.1 (see further description of the dataset in Annex 2).

Companies' distribution by country, industry and size classes

The 2015 *Scoreboard* comprises companies with headquarters in 44 countries of which 19 are member states of the EU. The sample includes companies based in the EU (608), the US (829), Japan (360) and other countries (703) including China (301), Taiwan (114), South Korea (80), Switzerland (55), Canada (27), Israel (27), India (26) and a further 16 countries. See Table I.1 and Figure I.4.

A wide range of manufacturing and services sectors is represented in the *Scoreboard*, including 41 industries[5] with a special focus on the most innovative ones such as ICT, health, transport and engineering related industries. See number of EU and non-EU companies in Table I.2 and the top 3 companies by level of R&D investment for the main industries in Table I.3.

The distribution of the 2500 sample by groups of companies in terms of number of employees is shown in Table I.4.

Table I.1 – Distribution of companies by country.

Number of companies by country			
EU		**non-EU**	
Germany	136	US	829
UK	135	Japan	360
France	86	China	301
Sweden	42	Taiwan	114
The Netherlands	42	South Korea	80
Italy	32	Switzerland	55
Denmark	25	Canada	27
Finland	22	Israel	27
Ireland	20	India	26
Spain	17	Australia	16
Belgium	16	Norway	10
Austria	14	Brazil	9
Luxembourg	7	Singapore	9
Portugal	5	Turkey	9
Greece	3	Malaysia	5
Czech Republic	2	Russia	3
Slovenia	2	New Zealand	2
Hungary	1	Saudi Arabia	2
Malta	1	Further 7 countries	8
Total	**608**	**Total**	**1892**

Note: 2500 companies with R&D investment above €18.0 million.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

5 Sectors classified according to the Industry Classification Benchmark (3 digits level of aggregation).

Table I.2 – Distribution of companies by industrial sector.

Number of companies in the 10 most numerous industries			
EU		**non-EU**	
Pharma & Biotech	70	Tech Hardware & Equip.	281
Industrial Engineering	68	Pharma & Biotech	246
Soft. & Computer Services	46	Soft. & Computer Services	229
Electronic & Electric Equip.	45	Electronic & Electric Equip.	184
Automobiles & Parts	35	Industrial Engineering	133
Tech Hardware & Equip.	35	Automobiles & Parts	120
Chemicals	24	Chemicals	109
Banks	23	Health Care Equip. & Services	80
Aerospace & Defence	21	General Industrials	76
General Industrials	21	Construction & Materials	53

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table I.3 – Top 3 companies for the main industries included in the 2015 *Scoreboard*.

Pharmaceuticals & Biotech.		**Automobiles & Parts**		**Technology Hardware & Equip.**	
NOVARTIS	Switzerland	VOLKSWAGEN	Germany	INTEL	US
ROCHE	Switzerland	TOYOTA MOTOR	Japan	CISCO SYSTEMS	US
JOHNSON & JOHNSON	US	GENERAL MOTORS	US	APPLE	US
Software & Computer Services		**Electronic & Electrical Equipment**		**Industrial Engineering**	
MICROSOFT	US	SAMSUNG	South Korea	VOLVO	Sweden
GOOGLE	US	SIEMENS	Germany	CATERPILLAR	US
ORACLE	US	HITACHI	Japan	ABB	Switzerland
Chemicals		**Aerospace & Defence**		**General Industrials**	
BASF	Germany	AIRBUS	The Netherlands	GENERAL ELECTRIC	US
DUPONT	US	BOEING	US	TOSHIBA	Japan
MONSANTO	US	UNITED TECHNOLOGIES	US	PHILIPS	The Netherlands
Leisure Goods		**Health Care Equipment & Services**		**Oil & Gas Producers**	
SONY	Japan	MEDTRONIC PLC	Ireland	PETROCHINA	China
PANASONIC	Japan	BAXTER INTERNATIONAL	US	TOTAL	France
LG ELECTRONICS	South Korea	BOSTON SCIENTIFIC	US	ROYAL DUTCH SHELL	UK

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table I.4 - Distribution of companies in the 2015 *Scoreboard* by size class.

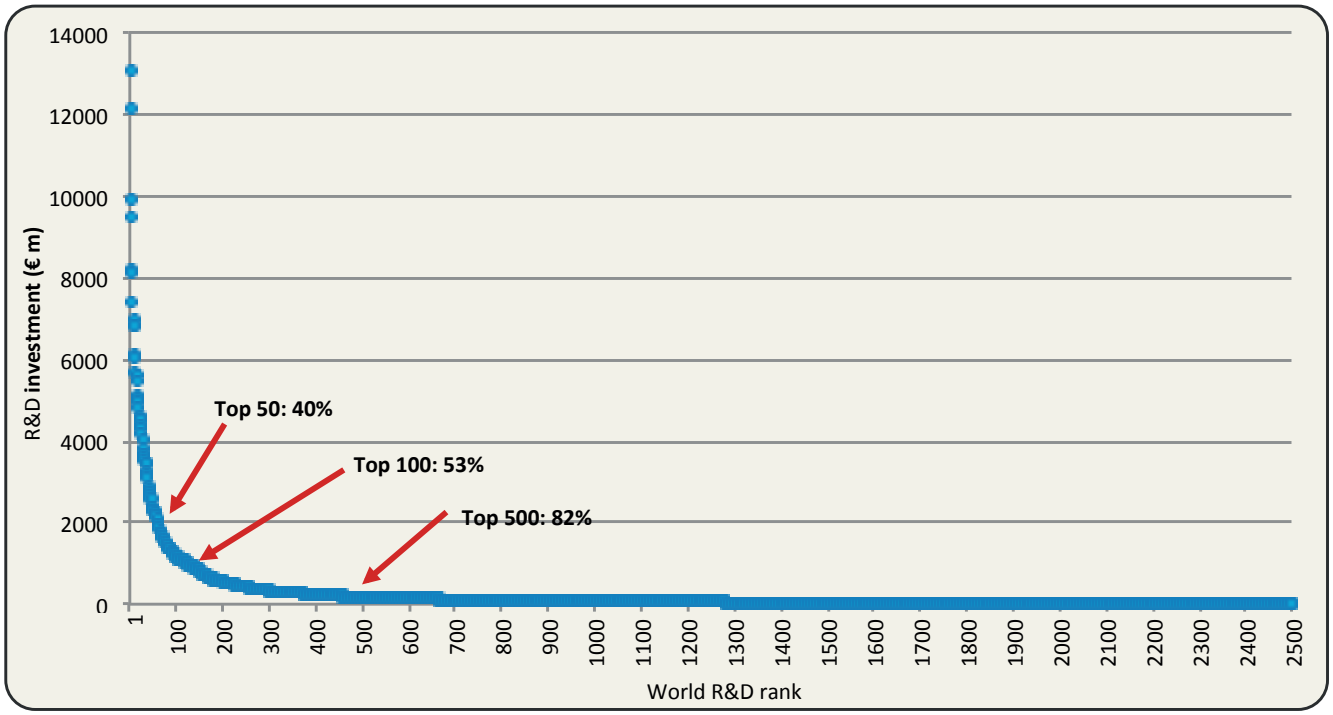
Number of employees	Number of companies	R&D per company (€m)	Net sales per company (€m)	R&D intensity (%)
Less than 250(SMEs)	142	39.1	799.8	4.8
251-1000	241	42.1	215.7	19.5
1001-5000	572	63.5	911.9	7
5001-10000	381	142.1	2793.2	5.1
More than 10000	866	517.2	16740.6	3.1

Note: Figures have been computed on 2202 out of the 2500 companies for which data on employment 2014 are available.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Concentration of the R&D investment by company, sector and country

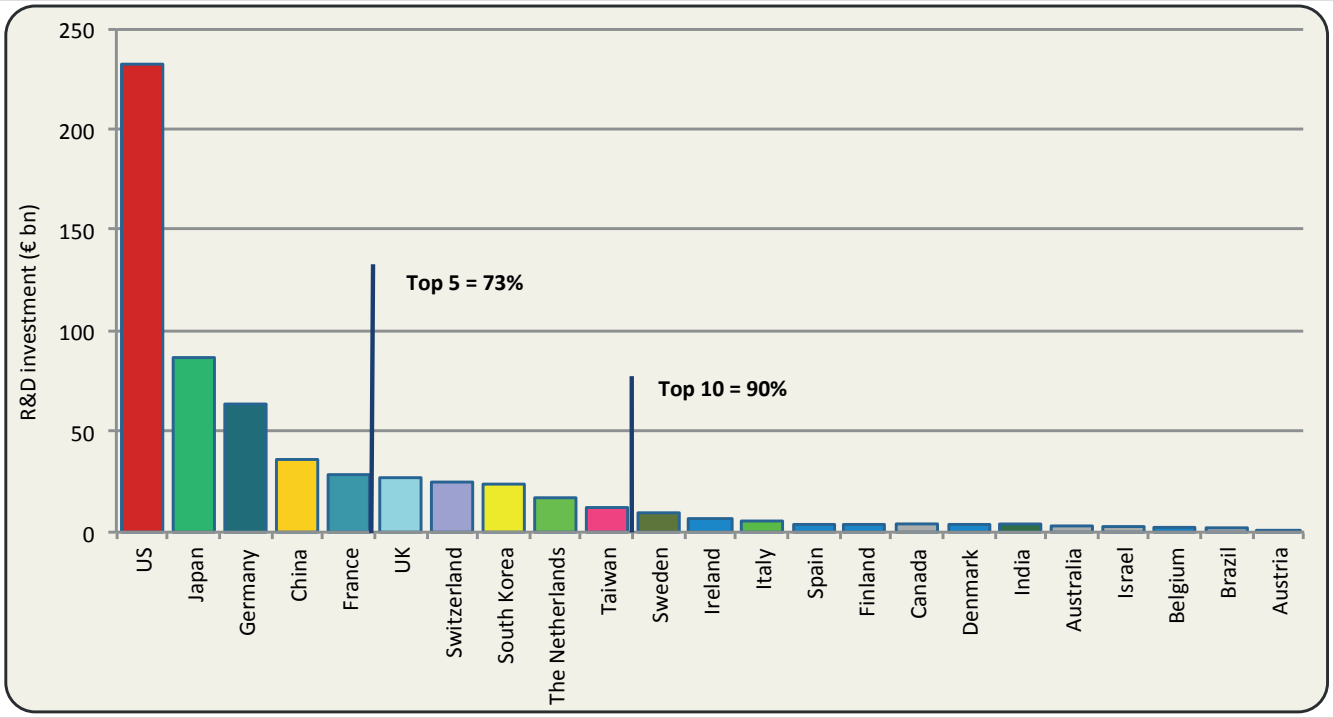
Industrial R&D is highly concentrated. A small subset of companies, industries and countries account for a large share of the total R&D investment of the 2500 sample. For example, the top 100 companies account for 53.2%, the companies based in the three largest countries (US, Japan and Germany) account for 62.8% and the four largest industries (Pharmaceuticals & Biotechnology, Automobiles & Parts, Technology Hardware & Equipment, Software & Computer Services) account for 59.8% of the total R&D investment. This is illustrated in Figures I.2 and I.3.

Figure I.2 – Companies of the 2015 *Scoreboard* ranked by R&D.



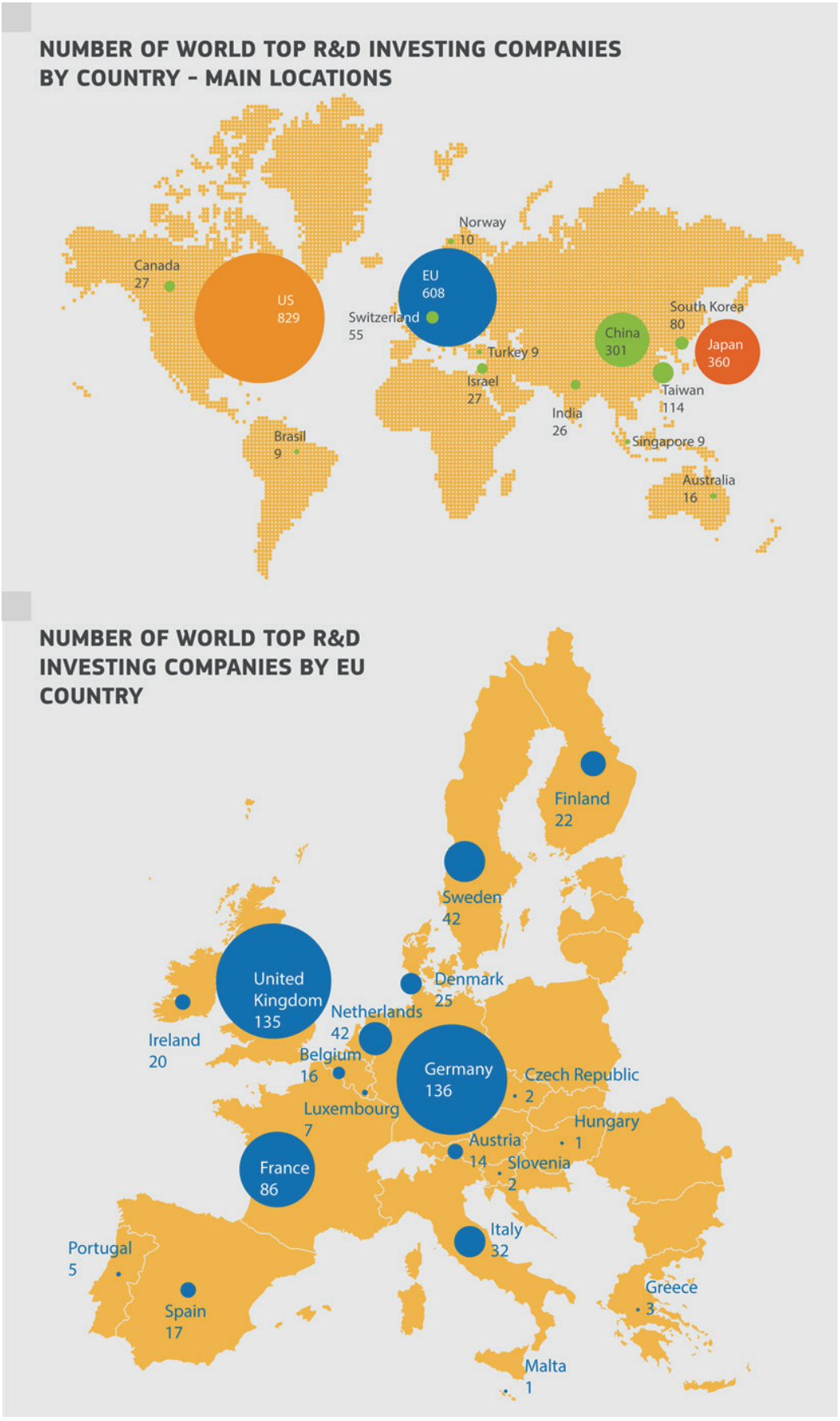
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure I.3 – R&D investment of the 2015 *Scoreboard* aggregated by country.



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure I.4 Distribution of the 2500 companies in the 2015 *Scoreboard* by country.



Note: The world map only includes countries with 9 or more companies.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Box I.1 Methodological caveats.

Users of *Scoreboard* data should take into account the methodological limitations summarised here, especially when performing comparative analyses (full description of methodology is found in Annex 2):

A typical problem arises when comparing data from different currency areas. The *Scoreboard* data are nominal and expressed in Euros with all foreign currencies converted at the exchange rate of the year-end closing date (31.12.2014). The variation in the exchange rates from the previous year directly affects the ranking of companies, favouring those based in countries whose currency has appreciated with respect to the other currencies. In this reporting period, the exchange rate of the Euro depreciated by 12.3% against the US dollar and by 7.1 % against the pound sterling. The Japanese Yen remained practically unchanged.

The growth rate of the different indicators for companies operating in markets with different currencies is affected in a different manner. In fact, companies' consolidated accounts have to include the gains and/or losses due to the appreciation and/or depreciation of their investments abroad. The result is an 'apparent' rate of growth of the given indicator that understates or overstates the actual rate of change. For example, this year the R&D growth rate of companies based in the Euro area with R&D investments in the US is partly overstated because the 'gains' of their overseas investments due to the depreciation of the Euro against the US dollar (from $1.38 to $1.21). Conversely, the R&D growth rate of US companies is partly understated due to the 'losses' of their investments in the Euro area. Similar effects of understating or overstating figures would happen for other indicators, e.g. for net sales.

When analysing data aggregated by country or sector, be aware that in many cases, the aggregate indicator depends on the figures of a few firms. This is due, either to the country's or sector's small number of firms in the *Scoreboard* or to the indicator being dominated by a few large firms.

The different editions of the *Scoreboard* are not directly comparable because of the year-on-year change in the composition of the sample of companies, i.e. due to newcomers and leavers. Every *Scoreboard* comprises data for several financial years allowing analysis of trends for the same sample of companies.

In most cases, the companies' accounts do not include information on the place where R&D is actually performed; consequently the approach taken in the *Scoreboard* is to attribute each company's total R&D investment to the country in which the company has its registered office or shows its main economic activity. This should be borne in mind when interpreting the *Scoreboard's* country classification and analyses.

Growth in R&D can either be organic, the outcome of acquisitions or a combination of the two. Consequently, mergers, acquisitions and demergers may sometimes underlie sudden changes in specific companies' R&D growth rates and/or positions in the rankings.

Other important factors to take into account include the difference in the various countries' (or sectors') business cycles which may have a significant impact on companies' investment decisions, and the initial adoption or stricter application of the International Financial Reporting Standards (IFRS)[6].

6 Since 2005, the European Union requires all listed companies in the EU to prepare their consolidated financial statements according to IFRS (see: EC Regulation No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002R1606:EN:HTML).

1 Worldwide trends in corporate R&D

This chapter provides an overview of the main trends for R&D and economic indicators of the world 2500 companies that each invested more than €18.0 million in R&D in 2014/15[7]. It includes analysis of the performance of companies aggregated according to the location of their registered offices in the main world regions. *The 2500 companies are grouped into four main sets: the top 608 companies from the EU, 829 companies from the US, 360 from Japan and 703 companies from other countries (RoW group). 'Other countries' includes companies from China (301), Taiwan (114), South Korea (80), Switzerland (55) and companies based in a further 19 countries.*

As in the previous year, the average growth rate of companies' R&D investments in 2014 was significantly higher than the growth rate of their revenues.

R&D investments and economic results in 2014 show important variations across world regions, countries and industries. As observed in recent years, this reflects a continued weak and uneven recovery of the global economy and persistent market uncertainties. Box 1.1 below summarises the economic background in 2014 and early 2015 in which global R&D companies have been operating.

Key findings

- The top 2500 *Scoreboard* companies invested €607.2bn in R&D, 6.8% more in 2014 than in 2013, following the increase of 5.0 % in the year before. The net sales of the 2500 companies were €17 972.6bn and increased much less than R&D, at 2.5 %, the same net sales increase as in 2013. *The lower increase in companies' sales was driven by falls in the prices of oil & gas and metals.*

- The 608 EU companies increased R&D investment by 3.3% to €170.9bn while decreasing net sales by 1.0 %. The 829 US companies invested €232.2bn in R&D, a higher increase respect to the previous year (8.1 %) but a lower increase in net sales (3.6%). The 360 Japanese companies showed a different performance, increasing R&D by 2.6% to €86.6bn but with a higher increase in net sales of 4.3%.

- As in the previous period, companies outside of the EU, the US and Japan (the RoW group) showed the best performance in terms of R&D (13.1%) while increasing net sales by 3.7 %. The largest increases in R&D investment in this group were reported by companies based in China (23.6 %), Taiwan (12.4 %) and South Korea (10.6 %).

- The Chinese companies, the 3rd largest country by number of companies (301) in this edition (but the 4th largest by amount of R&D), showed outstanding results in the IT-hardware and software sectors. For example, Baidu, Lenovo, Tencent, Huawei and ZTE had double-digit R&D and net sales growth.

- Trends over the past 9 years show a hesitant recovery of companies based in the EU, especially in terms of net sales whereas their the US counterparts seem to have returned to the high R&D investment levels that obtained prior to the crisis. Japanese companies, hardly affected by the crisis, show positive results in terms of R&D, net sales and profitability over the last two years, indicating continuing recovery after the earthquake of 2011.

7 Due to data availability some companies may be missed, please see methodological limitations in Annex 2.

Box 1.1 Economic background for the *Scoreboard* companies in 2014.

The economic situation tends to be dominated by the performance of the largest economies. The top five (US, China, Japan, Germany and the UK) account for almost 51% of world GDP with the top ten (which adds in France, Brazil, Italy, Russia & India) contributing just over 65%*. Brazil, Russia and India have few R&D companies in the *Scoreboard*.

These are main trends and factors affecting the major economies:

- The US and UK economies were the fastest growing Western ones, helped by the early use of QE (quantitative easing). The US Fed ended its five year QE programme in October 2014 and since then there has been speculation about when the first US interest rate rise would occur (but it had still not happened as of October 2015). The prospect of early rate rises in the US and UK have meant that both the dollar and sterling have remained strong.

- Japan unleashed a massive QE programme in April 2013 and this has led to a weak yen but with inflation still remaining worryingly low. The ECB launched its QE programme in March 2015, later than the US, UK and Japan. In autumn 2015, Eurozone growth was still substantially lower than in the US or UK and unemployment was running at around twice US/UK levels. The continuing QE programme has resulted in the euro falling against both the dollar and sterling.

- China's growth rate has been slowing and probably more than the official statistics suggest since the country's growth rate supposedly continued to hit its target in Q1 2015 despite slowing industrial production and a slumping property market**. The slowing Chinese economy has been affecting Western companies' growth, the lower demand for metals and falling metals prices being a related effect of this in 2014 and 2015. Of the other BRICs, Brazil is already in recession and Russia is suffering from the drop in oil and commodity prices.

- Oil prices were around $100 per barrel in mid-2014 but then started to fall and reached $50 at the end of the year. They have remained in the range $45 to $60 throughout 2015. This has benefited fuel using industries such as airlines and road transport but has provided a strong headwind for oil companies and engineering companies supplying the equipment for oil exploration and production activities.

These trends have had some significant effects in the table of the top 50 global R&D investors by amount of R&D. The stronger dollar means that many US companies have moved up a few places in the global rankings from last year whereas the weaker yen has seen many Japanese (and, to a lesser extent, Eurozone companies) moving down. And most companies with substantial sales to BRIC countries and to the oil & gas sector have experienced slowing growth.

*Statistics Times.com
**The Economist

Source: Innovomantex Ltd.

1.1 Indicator changes over the last year

The main economic and financial indicators for the year 2014 for the set of 2500 companies are summarised in Table 1.1.

- The positive trends on R&D investment continued in 2014 for the fourth consecutive year. The 2500 *Scoreboard* companies invested €607.2 billion in R&D, 6.8 % more than in 2013, following the increase of 5.0% in the year before. Seventy three per cent of the companies showed positive R&D growth in 2013.

- For the third consecutive year, the net sales of the 2500 companies increased less than R&D, at 2.2 %, a similar net sales increase as in the previous period. Company results in terms of operating profits improved significantly compared with the previous year: 82% of companies made profits - a much larger proportion than the 18% of companies that reported losses - but slightly down on the 83% reported last year.

- Company investment in fixed capital remained unchanged, compared with the previous year's increase of 2.8 %. Capital expenditure as a percentage of net sales (7.1 %) remained practically the same as that of the previous year.

- The number of employees of the 2500 companies in the *Scoreboard* increased by 1.5 %.

Table 1.1 - Overall performance of the 2500 companies in the 2015 *Scoreboard*.

Factor	Top 100 R&D investors	world 2500
R&D in 2014, € bn	323.4	607.2
One-year change, %	6.4	6.8
CAGR 3yr, %	6.1	6.1
Net Sales, € bn	5 125.6	17 972.6
One-year change, %	2.5	2.2
CAGR 3yr, %	4	2.9
R&D intensity, %	6.3	3.4
Operating profits, € bn	591.4	1 735.4
One-year change , %	-1.7	0.5
Profitability, %	11.5	9.7
Capex, € bn	346.7	1 131.2
One-year change , %	0.8	-0.1
Capex / net sales, %	7	7.1
Employees, million	12.1	51.2
One-year change, %	-1.2	1.5

Note: Profitability equals to Operating profits as percentage of sales.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

1.2 R&D trends by world region

Figure 1.1 and table 1.2 summarise the companies' indicators aggregated by main world region and table 1.3 shows the main indicators for countries included in the RoW group.

The R&D investment of the 608 EU companies continued to grow in 2014 at a significant pace, 3.3%, compared with 2.5 % in 2013. As also observed last year, the net sales of the EU companies decreased slightly by 1.0%. This was driven by falls in the prices of oil & gas and mining products which form a larger proportion of EU companies' sales than in other regions. *The overall R&D and, to a smaller extent, the net sales of the EU group are largely driven by the performance of German companies that account respectively for 36.8% and 26.8% of the EU's total R&D and net sales. The 136 German companies in the EU-608 group increased R&D by 6.3% and net sales by 3.0%. These results reflect to a large extent the performance of the German companies in the Automobiles & Parts sector (+7.8% in R&D and +6.2 % in net sales). This sector accounts for 53% of the R&D and 34% of the net sales of the group of German companies.* The other two largest member states of the EU showed a modest performance; companies based in the UK increased R&D by 0.3 % and decreased sales by 5.4% and those based in France increased R&D by 0.5% and decreased net sales by 1.5%. The UK's sales decrease was largely due to the fall in oil & gas and metals prices.

The group of US companies increased R&D investment (8.1 %) at a higher rate than the world's average and increased net sales by 3.6 %. *The R&D growth of the US companies was led by companies in high R&D-intensive sectors. Most of the largest US companies in Pharmaceuticals & Biotechnology and Software & Computer Services had double-digit R&D growth. Also some large companies in the Technology Hardware & Equipment sector such as Apple and Qualcomm showed high R&D growth (35.0% and 10.3% respectively).*

Japanese companies underperformed EU and US firms, in terms of R&D (2.6 %) but showed a larger net sales growth (4.3 %). *As in the case of German companies, the average performance of Japanese companies is strongly dependent on the results of the Automobiles & Parts sector, accounting for 28.5 % of total Japanese R&D, which showed an increase of 6.6% in R&D and 7.8% in net sales.*

Companies based outside of the EU, US and Japan (the RoW group) continued to increase substantially their R&D investment (13.1 %) and also net sales, at a more moderate rate but above the world average's (3.7 %). *The largest increase in R&D investment was reported by the 301 companies based in China (23.6 %). In the Chinese group of companies, outstanding performance was shown by the largest R&D investor, Huawei that increased R&D by 33.8 % and by R&D increases in high tech sectors such as Software and Computer Services (47.3 %) and Technology Hardware & Equipment (24.8%).*

Other countries in the RoW group whose companies have showed large increases in R&D are Taiwan (12.4 %) and South Korea (10.6 %). The companies based in Switzerland, now the second largest R&D investor in this group, showed a modest increase in R&D (2.7 %). Swiss R&D is dominated by Novartis and Roche

Compared with last year's *Scoreboard*, the EU and Japanese companies' share of total R&D investment decreased by 2.0 and 1.5 percentage points respectively (from 30.1% to 28.1% and 15.8% to 14.3%). On the contrary, the R&D share of US companies increased by 2.2 percentage points and that of the other countries group by 1.4 percentage points.

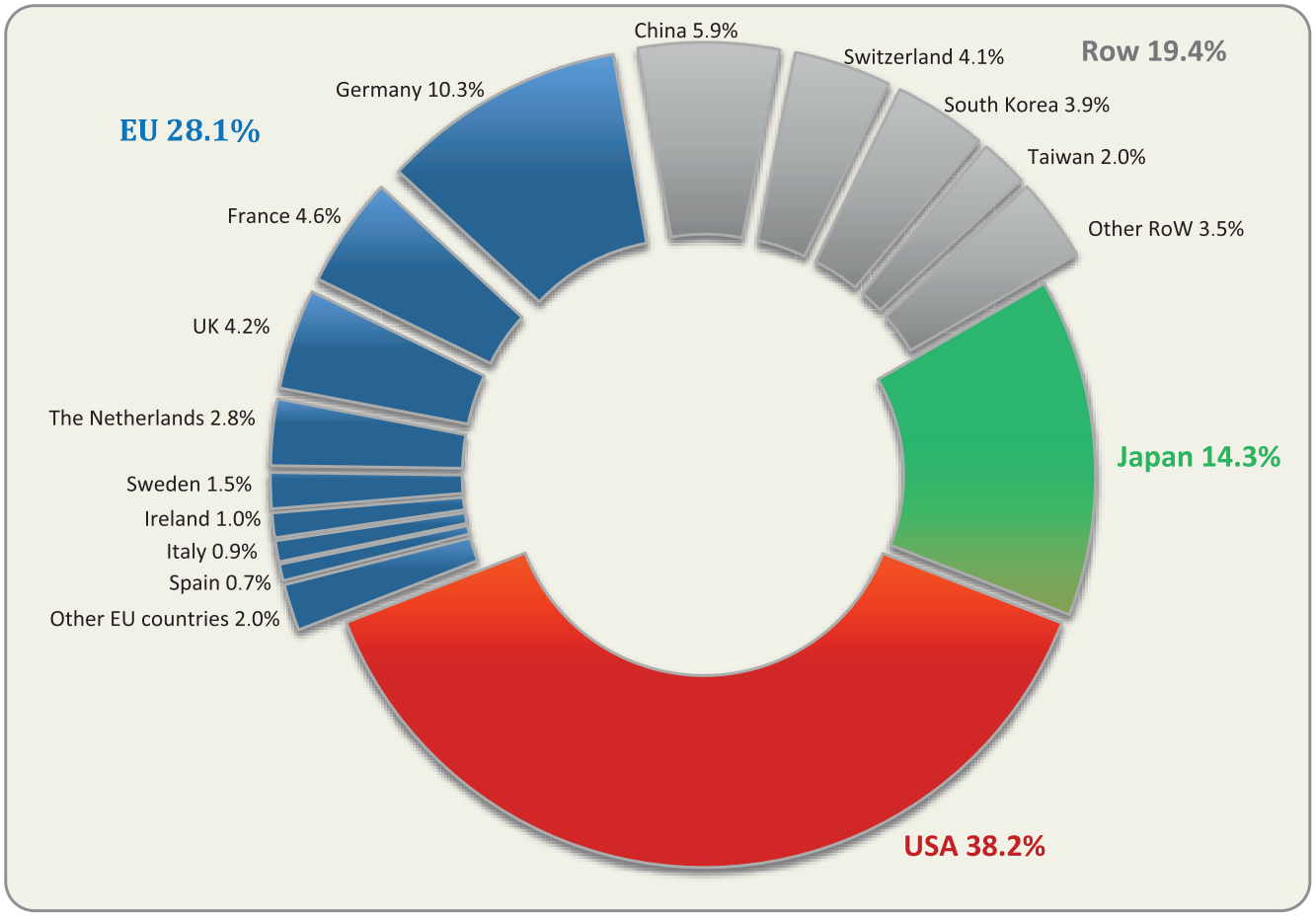
The average R&D intensity of companies based in the EU, the US and other countries increased by 0.2 percentage points due to the higher growth of R&D investments compared with the growth rate of net sales. The R&D intensity for companies based in Japan remained practically unchanged. *US R&D intensity is substantially larger than that of all regions because of its concentration in high technology sectors.*

In 2014, average company capital expenditure decreased for the second consecutive year for EU and Japanese companies (-5.1% and -2.1% respectively). Companies based in the US continued to increase capital expenditure at a significant pace (5.7%) whereas those based in the RoW group increased it slightly (0.8%).

Companies based in the EU showed a significant increase in operating profits (5.0%) reversing the negative trend of the previous years. The opposite happened for the companies based in the RoW group (-4.7%) and for the US companies (-0.8%). The Japanese companies showed for the second consecutive a significant increase in profits (8.2%). *The higher profits from Japanese companies are due mostly to the largest R&D investing sector, Automobiles & Parts (12 %) and also IT-Hardware (21 %).* The profitability (operating profits as percentage of net sales) changed according to the difference between the growth rate of sales and profits. Consequently, the average profitability of the EU and Japanese companies increased (to 8.3% and 6.5% respectively) and those based in the US and the RoW group slightly decreased (to 13.5% and 9.8% respectively). The ratio of sales to employees' number was highest for the US and RoW groups where profitability was also higher.

As underlined in previous *Scoreboard* reports, most of the differences in R&D intensity and profitability between regions and countries are related to differences in sector mix. The US is by far the strongest region in the group of high R&D intensity sectors including pharmaceuticals, health, software, and technology hardware whereas the EU and Japan are stronger in medium R&D intensity sectors such as the automotive sector (see chapter 3).

Figure 1.1 - R&D investment by the top 2500 companies, by main world region (% of total €607.2bn).



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 1.2 - Overall performance of the 2500 companies in the 2015 *Scoreboard*.

Factor	EU	USA	Japan	RoW
No. of companies	608	829	360	703
R&D in 2014, € bn	170.9	232.2	86.6	117.5
World R&D share, %	28.1	38.2	14.3	19.4
One year change, %	3.3	8.1	2.6	13.1
CAGR 3yr, %	4.2	6.9	3.1	10.5
Net Sales, € bn	6 042.8	4 397.6	2 644.5	4 887.7
One year change, %	-1.0	3.6	4.3	3.7
CAGR 3yr, %	0.0	2.6	6.8	5.3
R&D intensity, %	2.8	5.2	3.3	2.4
Operating Profit, € bn	491.9	593.8	172.9	476.9
One year change, %	5.0	-0.8	8.2	-4.7
Profitability, %	8.3	13.5	6.5	9.8
Capex, € bn	324.2	283	160.4	363.6
One year change, %	-5.1	5.7	-2.1	0.8
Capex intensity, %	6.8	6.5	6.1	8.6
Employees, million	19.7	11.6	8.3	11.6
One year change, %	1.9	1.4	-0.9	3.1

Note: Profitability equals to Operating profits as percentage of sales.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 1.3 - Performance of companies based in the largest countries of the RoW group.

Factor	China	Switzerland	South Korea	Taiwan
No. of companies	301	55	80	114
R&D in 2014, € bn	36.1	24.9	23.8	12.2
World R&D share, %	5.9	4.1	3.9	2.0
One year change, %	23.6	2.7	10.6	12.4
CAGR 3yr, %	17.8	3.6	13.3	9.8
Net Sales, € bn	1894.7	346.7	936	478.4
One year change, %	5.9	1.0	-0.6	5.7
CAGR 3yr, %	7.4	2.1	4.4	3.5
R&D intensity, %	1.9	7.2	2.5	2.6
Operating Profit, € bn	129.6	52.9	54.4	31.6
One year change, %	-2.1	-5.5	-16.1	28.6
Profitability, %	6.8	15.3	5.8	6.6
Employees, million	6.77	1.27	n.a.	0.55
One year change, %	4.6	1.0	13.8	-1.0

Notes: Profitability equals to Operating profits as percentage of sales.
Many South Korean companies do not report number of employees.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

1.2.1 Long-term performance of companies by world region

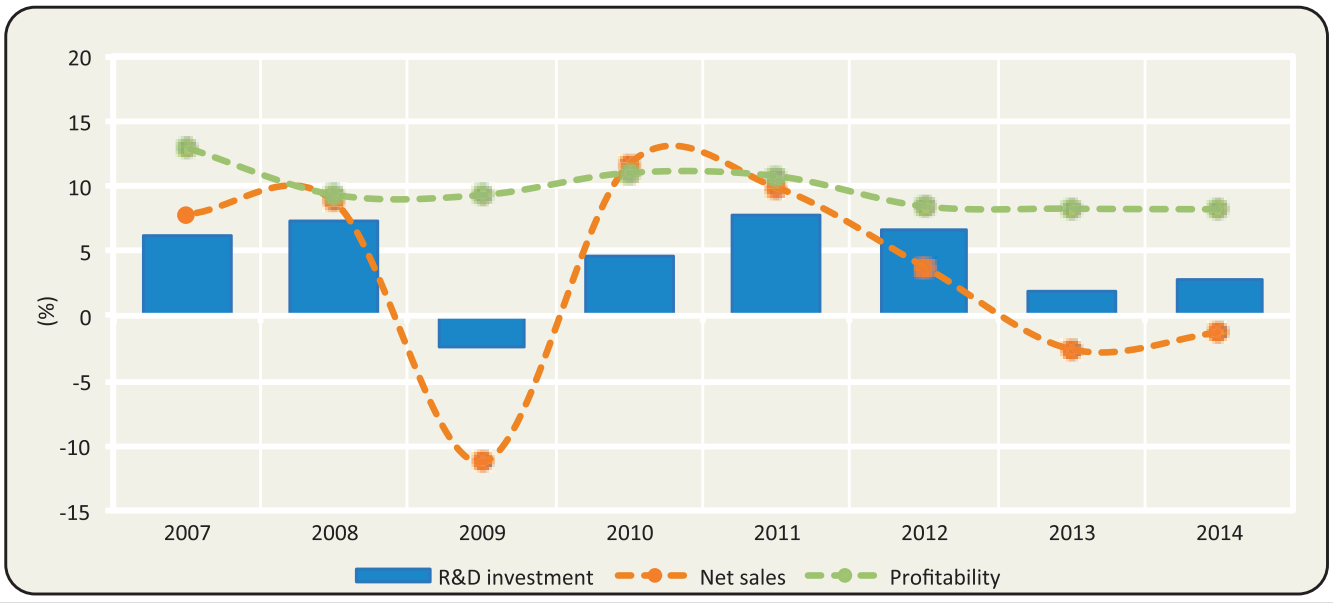
The annual growth rates of R&D investment and net sales and the profitability of companies based in the EU, the US, Japan and China are provided respectively in figures 1.2, 1.3, 1.4 and 1.5 for the period 2006-2014. These figures are based on our history database comprising R&D and economic indicators over the whole 2006-2014 period for 1509 companies (EU 457, US 611, Japan 345 and China 94).

Figure 1.6 shows the R&D and net sales trends for the companies based in the rest of the world, focussing on the largest R&D countries in this group (Switzerland, South Korea and Taiwan).

The trends observed in these figures show the behaviour of these companies including the effects of the crisis that began in 2008. The following points are observed:

- Companies based in the EU this year reversed the negative trends of the last three years, showing a modest recovery of R&D investment and diminishing the losses in net sales observed in the previous period. The profitability of the EU companies also shows a slight increase over the last year.
- The US companies continued to show significant R&D investment growth, similar to the level prior to the crisis and show a relative recover of net sales growth, but this was still well below the level of R&D growth. The US-based companies continued to show the high level of profitability that has been stable since recovery from the crisis in 2010. The profitability of the US companies is now close to 15% and much higher than their Japanese and EU counterparts in the range 6% to 9%.
- Japanese companies, hit hard by the crisis in 2008-2009 and by the earthquake in 2011, continued their recovery, in R&D and especially in net sales, observed in the past period but at a more moderate pace. The profitability of Japanese companies also continued to recover in 2014 but remained at low levels, especially compared with that of the US companies.
- R&D investment by the Chinese companies rose significantly over the period 2008-2010 and remained at high levels in recent years. On the contrary, their net sales slowed down during the crisis, picked up again and then decelerated again in the past three years. The profitability of the Chinese companies is lower than that of their US and EU counterparts and shows a smooth decreasing trend over the whole 2006-2014 period. Chinese profitability is slightly lower than that of the Japanese companies in 2014, significantly lower than the EU and much lower than the US. However, we have data for only 94 Chinese companies over the whole period compared to the 301 firms listed in this year's *Scoreboard*.

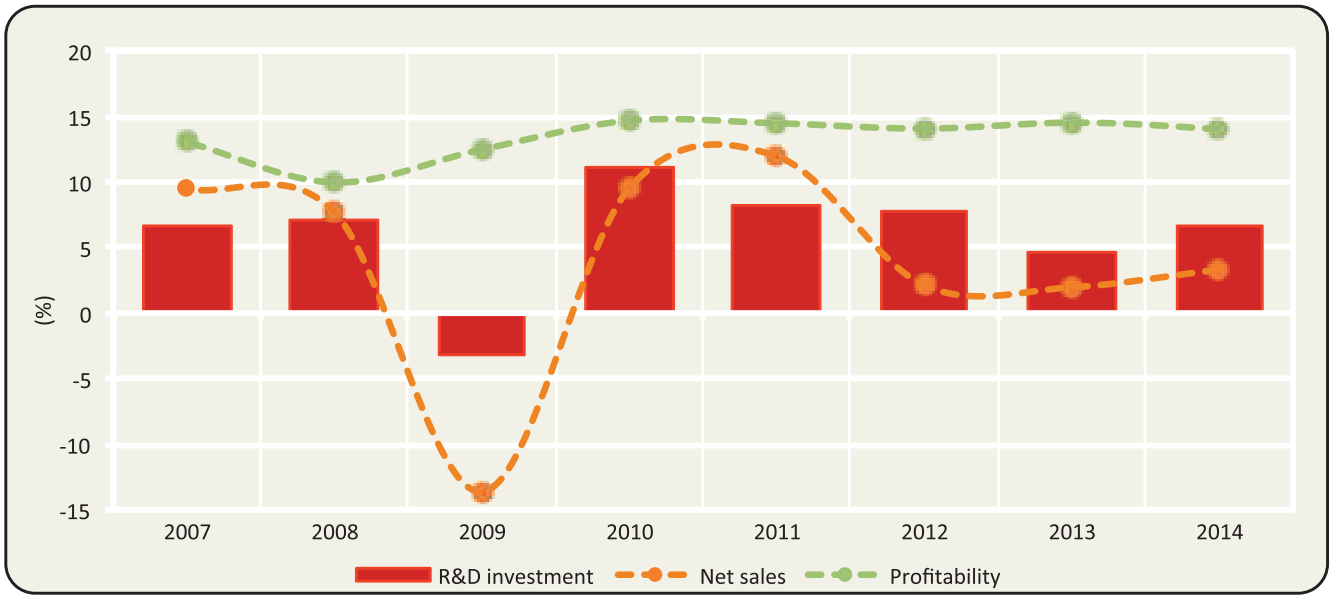
Figure 1.2 - One-year growth rate of R&D investment and net sales and yearly level of profitability for the EU companies.



Note: Figures for the three variables have been computed on 457 out of the 608 EU companies for which data are available for the entire period 2007-2014

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

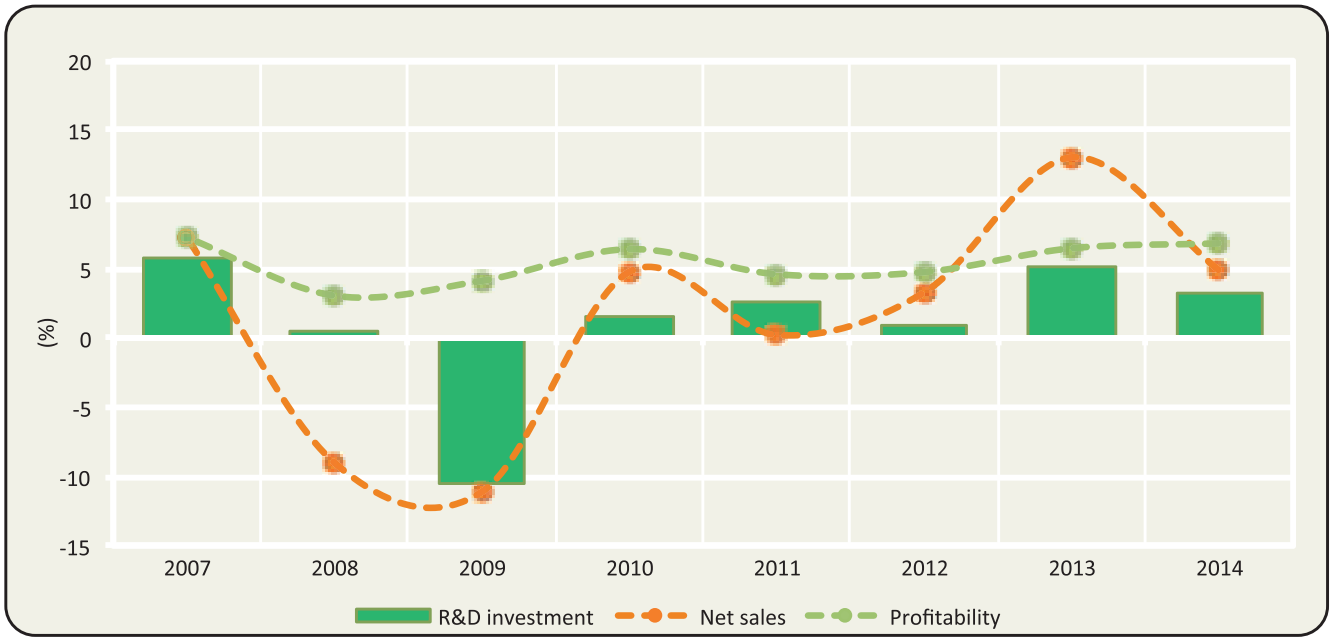
Figure 1.3 - One-year growth rate of R&D investment and net sales and yearly level of profitability for the US companies.



Note: Figures for the three variables have been computed on 611 out of the 829 US companies for which data are available for the entire period 2007-2014

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

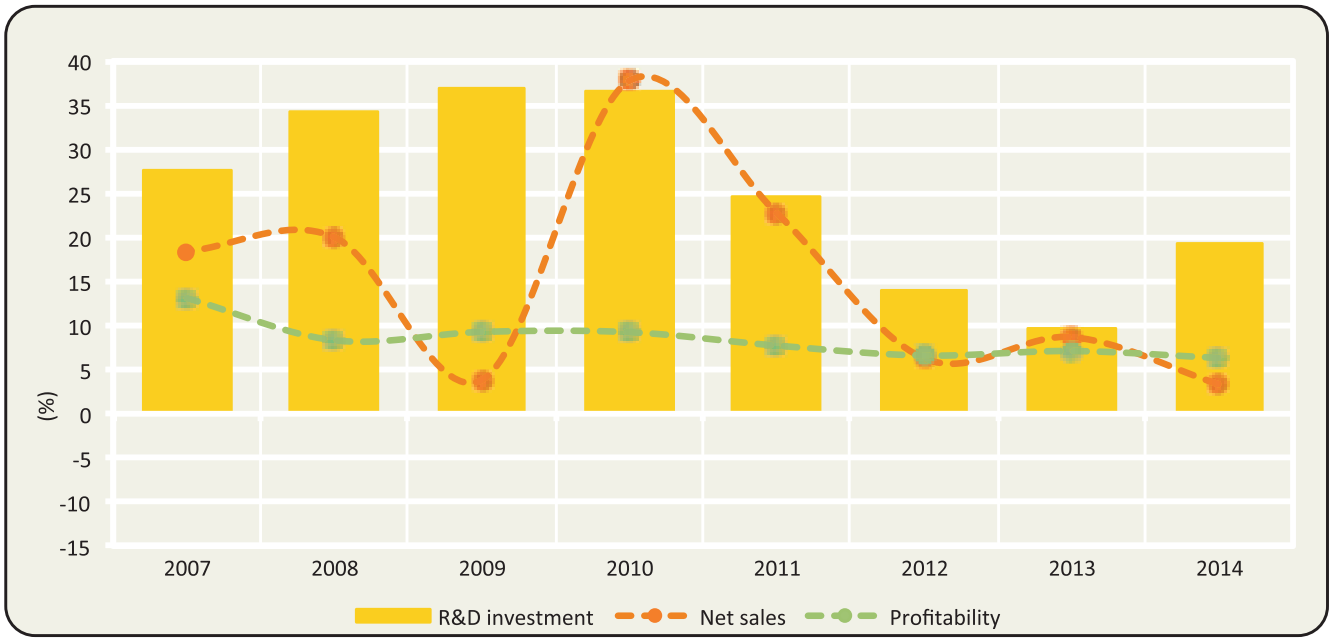
Figure 1.4 - One-year growth rate of R&D investment and net sales and yearly level of profitability for the Japanese companies.



Note: Figures for the three variables have been computed on 345 out of the 360 Japanese companies for which data are available for the entire period 2007-2014

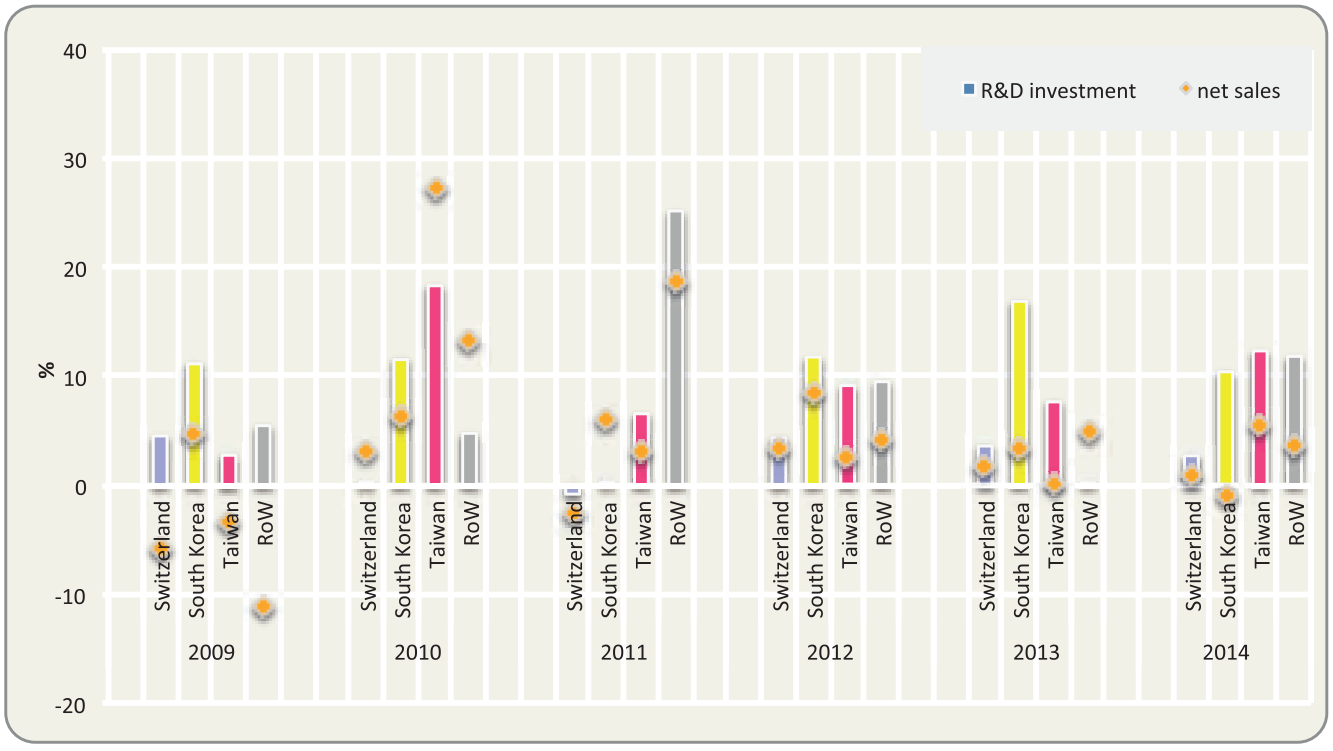
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 1.5 - One-year growth rate of R&D investment and net sales and yearly level of profitability for the Chinese companies.



Note: Figures for the three variables have been computed on 94 out of the 301 Chinese companies for which data are available for the entire period 2007-2014. Please note the different scale respect to the 3 previous charts.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 1.6 - One-year growth rate of R&D investment and net sales, by main world region.



Note: Figures for the two variables have been computed on 53 Swiss, 61 South Korean, 105 Taiwanese and 105 RoW companies for which data are available for the entire period 2009-2014. The RoW group in this chart does not include companies located in China, Switzerland, South Korea and Taiwan. Please note the different time scale respect to the 4 previous charts.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

1.2.2 R&D trends by world regions and sector groups

Trends in R&D over the long-term are presented in figure 1.7 for the main world regions. The figures refer to a set of 1920 companies that reported R&D over the whole period 2006-2014 (EU-481, US-645, Japan-349 and RoW group-445). The R&D data are broken down into groups of industrial sectors with characteristic R&D intensities (see definition in Box 1.2).

The following points can be observed regarding the overall R&D changes in the period 2006-2014 (figure 1.7):

- The world 1920 companies increased R&D by 50.9 % (EU-481 41.3 %; US-645 58.7 %; Japan-349 8.7 % and RoW group-445 131.5 %).
- For the 481 EU companies, the main R&D increases were in low R&D-intensive sectors (61.0 %) and medium-high sectors (44.4 %).
- For the 645 US companies, the main R&D increases were in medium-low R&D-intensive sectors (97.3 %, but these represent a small proportion of total R&D) and high sectors (67.3 %).
- For the 349 Japanese companies, the main R&D increases were in medium-high R&D-intensive sectors (14.8 %) and medium-low sectors (3.1 %).
- For the 445 companies based in the rest of the world, the main R&D increases were in low R&D-intensive sectors (169.7 %) and medium-high sectors (141.6 %).
- The proportion of high to medium R&D has increased for the US but decreased for both the EU and Japan.

Box 1.2 - Grouping of industrial sectors according to R&D intensity (R&D as % of net sales)*.

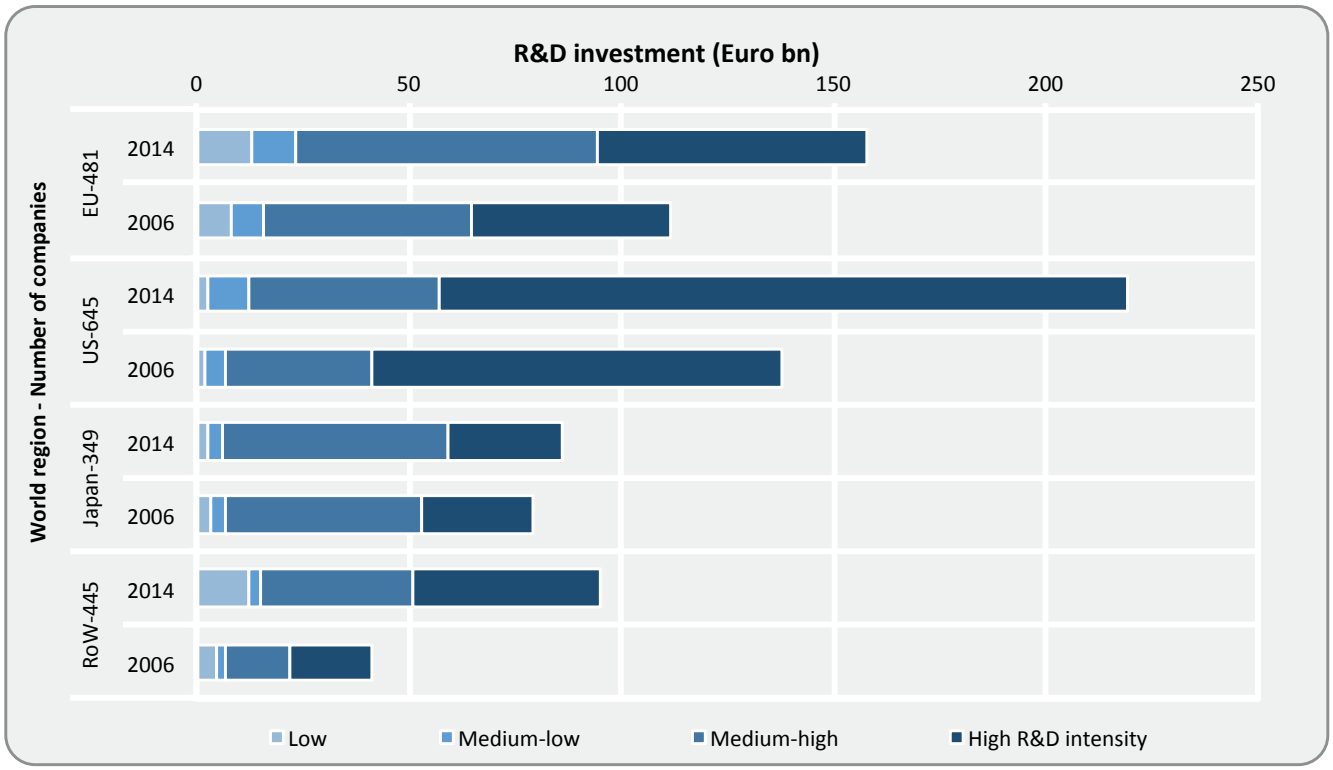
High R&D intensity sectors include mainly Pharmaceuticals & biotechnology; Health care equipment & services; Technology hardware & equipment; Software & computer services, Aerospace & defence and Leisure Goods.

Medium-high R&D intensity sectors include mainly Electronics & electrical equipment; Automobiles & parts; Industrial engineering; Chemicals; Personal goods; Household goods; General industrials; Support services.

Medium-high R&D intensity sectors include mainly Electronics & electrical equipment; Automobiles & parts; Industrial engineering; Chemicals; Personal goods; Household goods; General industrials; Support services.

** This classification takes into account the R&D intensity of all companies aggregated by ICB 3-digit sectors: High above 5%; Medium-high between 2% and 5%; Medium-low between 1% and 2% and Low below 1%. Some sectors are adjusted to compensate for insufficient representativeness of the Scoreboard using the OECD definition of technology intensity for manufacturing sectors (ISIC REV 3. Technology intensity definition, OECD, 7 July, 2011.)*

Figure 1.7 - R&D investment trends for the *Scoreboard* companies in the main world regions.



Note: figures displayed refer only to those companies for which data are available for both years (2014 and 2006).
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

1.2.3 Employment trends by regions and sector groups

Among the 2500 sample in this year's *Scoreboard,* 2202 companies reported employee figures. In total these companies employed 51.2 million people in 2014, 1.5% more than the previous year. The distribution of employees by region was 19.7 million in the 584 companies based in the EU, 11.6 million in the 810 US companies, 8.3 million in the 357 Japanese companies and 11.6 million in the 451 companies from other countries.

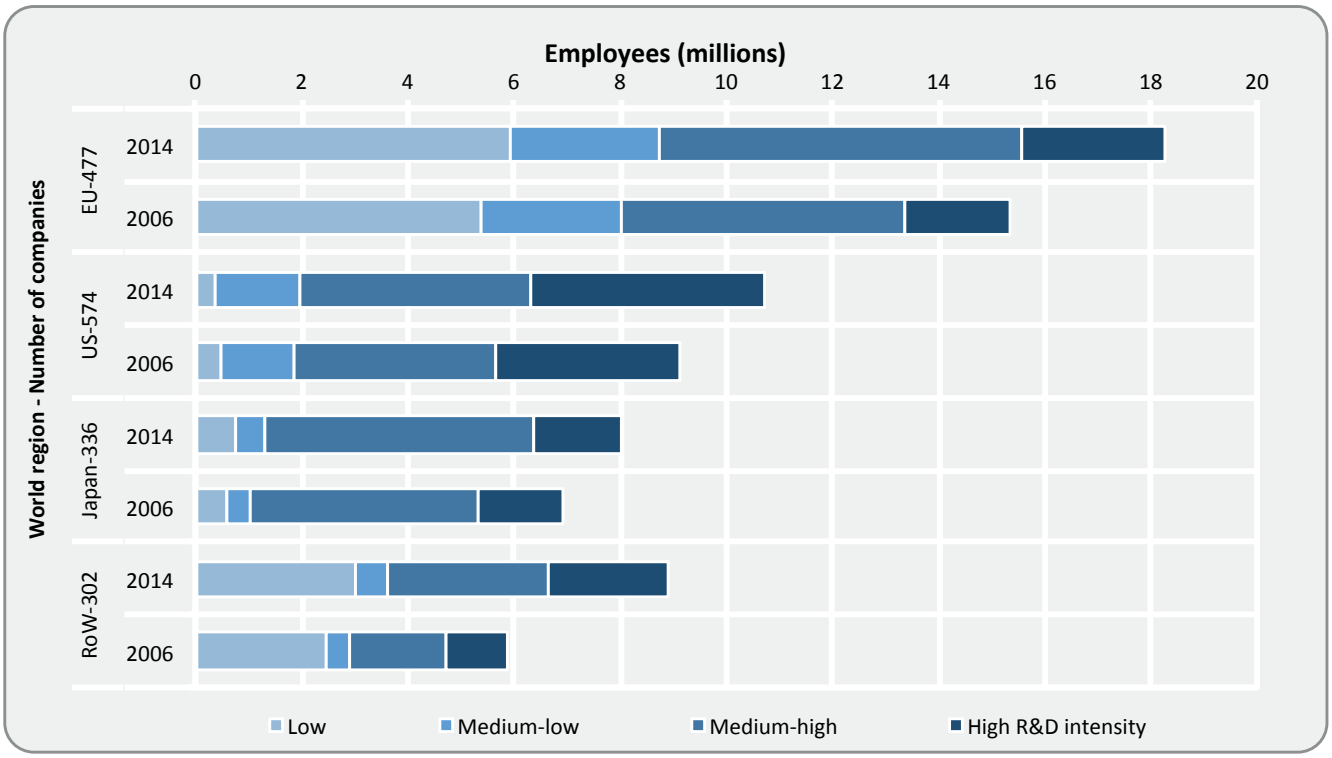
Trends on employment over the long-term are presented in figure 1.8 for the main world regions. The figures refer to a set of 1689 companies that reported number of employees over the whole period 2006-2014 (EU-477, US-574, Japan-336 and RoW group-302) and are broken down into groups of industrial sectors with characteristic R&D intensities (see definition in Box 1.2).

The following points can be observed regarding the changes in number of employees in the period 2006-2014 (figure 1.8):

- Overall worldwide employment increased by 23.1% from 2006 to 2014 led by increases in high R&D-intensive sectors (33.8%) and medium-high sectors (26.3%).
- For the EU companies, the overall employment growth was 19.0%, increasing by 35.1% in high R&D-intensive sectors, by 28.7% in medium-high and by 10.5% in low sectors.
- For the US companies, the overall employment growth (17.5 %) greatly varies by sector group: a strong increase for high R&D-intensive sectors (25.9 %) and a sharp decrease in low sectors (-23.8 %).
- For the Japanese companies, the overall employment increase of 15.8 % corresponded to an increase of 29.9 % in medium-low R&D-intensive sectors and of 28.5 % in low sectors.
- The ratio of employment in high to medium-high R&D intensity sectors for companies based in Japan fell from 37% to 33%, rose slightly for EU companies, from 38 % to 40%, and significantly increased for US companies from 91 % to 100 %.

It is important to remember that data reported by the *Scoreboard* companies do not inform about the actual geographic distribution of the number of employees. A detailed geographic analysis should take into account the location of subsidiaries of the parent *Scoreboard* companies (see analysis of the location of companies' economic and innovation activities in chapter 5).

Figure 1.8 - Employment trends by the *Scoreboard* companies for main world regions.



Note: figures displayed refer only to those companies for which data are available for both years (2014 and 2006).
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

2 Top R&D investing companies

This chapter describes the performance of individual companies, with a focus on the results of top R&D investors, highlighting those companies that show considerable changes in economic performance, in particular from an R&D viewpoint.

The world's top 100 R&D companies are analysed, highlighting those presenting important changes from the previous year and those showing the best performance in terms of R&D and economic growth over the last 10 years.

The group of top R&D investors includes major industrial players in key sectors such as IT hardware & software, pharmaceuticals and automobiles & parts. Key technological and market trends explain to a large extent changes observed in the *Scoreboard* indicators for these companies. Examples of such developments are illustrated in Box 2.1

The R&D ranking of the top 50 companies is presented in figure 2.1 and table 2.2 shows changes in such ranking since the first *Scoreboard* in 2004.

Key findings

- For the second consecutive year, the four top R&D investors remain the same: Volkswagen from Germany in the 1st place, Samsung Electronics from South Korea in the 2nd position, and Microsoft and Intel from the US in the 3rd and 4th places. The other companies in the top-ten are Novartis and Roche from Switzerland, Toyota from Japan, Google, Johnson & Johnson and Pfizer from the US.

- In 2014, among the top 100 companies, accounting for 53.3% of the total R&D investment, 71 increased R&D investment (vs. 62 in 2013), including 35 companies with double-digit R&D growth; of the 29 that decreased R&D, 6 decreased it by a double digit percentage. Regarding net sales, 71 companies reported an increase (vs. 68 in 2013), including 16 companies with double-digit sales growth.

- The top 100 group includes:

  - 29 EU companies of which 20 have increased R&D (11 by more than 10%),

  - 37 US companies of which 26 increased R&D (13 by more than 10%),

  - 16 from Japan of which 9 increased R&D (2 by more than 10%) and

  - 18 companies from other countries of which 16 increased R&D (9 by more than 10%).

- The 5 companies showing the largest increase in R&D are Tata Motors, India (108.9 % - but most of this R&D is at its UK subsidiary, Jaguar Land Rover); Facebook, US (88.4 %); Total, France (42.6 %); SK Hynix, South Korea (37.2 %) and Apple, US (35.0 %). The 5 showing the largest decrease in R&D are Otsuka, Japan (-30.6%); Nokia, Finland (-21.4 %); Eli Lilly, US (-18.2 %); Finmeccanica, Italy (-14.6 %) and General Electric, US (-10.9 %).

- Among the top 100 group, since the beginning of the crisis in 2008, 21 companies have at least doubled their R&D investment (3 companies based in the EU, 10 from the US and 8 from other countries). This group of companies is mainly from high R&D-intensive sectors (13); 12 of them have increased net sales by more than 100% (7 from the US and 5 from other countries) and 7 companies increased employment by more than 100% (6 based in the US and 1 from other non-EU countries). Many of these companies have made substantial acquisitions.

2.1 General trends

In the 2015 *Scoreboard* 123 companies have an R&D investment of more than € 1.0bn (37 from the EU and 47 from the US) while 58 have R&D exceeding € 2.0bn (18 from the EU and 24 from the US).

The top 10 companies each invested more than €5.0bn in R&D and account for 14.7% of the total R&D investment by the 2500 *Scoreboard* companies.

The four top R&D investors are the same as in last year's *Scoreboard*: In the 1st place the German company Volkswagen (€13.1bn), from South Korea in the 2nd position Samsung Electronics (€12.2bn) and from the US in the 3rd and 4th places Microsoft (€9.9bn) and Intel (€9.5bn). The other companies

in the top-ten are from Switzerland Novartis (€8.2bn) and Roche (€7.4bn), from Japan Toyota Motor (€6.9bn), from the US Google (€8.1bn), Johnson & Johnson (€7.0bn), and Pfizer (€6.8bn).

The top 100 companies invested €323.4 billion, accounting for 53.3% of the total R&D investment and 28.5% of the total net sales by all the 2500 *Scoreboard* companies. The EU has 29 companies among the top 100 R&D investors, two companies less than it had in the 2014 *Scoreboard*. The US has 37 companies, two more than it had last year and Japan has 16, one company less than in last year's *Scoreboard*. A new company from the rest of the world entered the group of top R&D investors (Tata Motors of India, jumping from place 104 to 49).

The EU companies in the top 100 are mainly from the Automobiles & Parts (7), Pharmaceuticals & Biotechnology (5) and ICT sectors (3). The US companies are mainly from the ICT (13), Pharmaceuticals & Biotechnology (10), and Chemicals (3) sectors. The Japanese companies operate mainly in the Automobiles & Parts (4) and Pharmaceuticals (4) sectors.

Seventy-one companies in the top 100 have shown positive R&D investment growth. Among them, 35 companies had double-digit R&D growth, and of these, 9 companies also showed double-digit growth in net sales.

Most of the top 100 companies showing double-digit R&D increases are in the Pharmaceuticals & Biotechnology (10), ICT (9) and Automobiles & Parts (6) sectors. The companies showing the largest increase in R&D are Tata Motors, India (108.9 %); Facebook, US (88.4 %); Total, France (42.6 %); SK Hynix, South Korea (37.2 %) and Apple, US (35.0 %).

Other companies among the top 100 group have shown double-digit growth in both R&D and net sales, e.g. Gilead Sciences, Biogen and eBay from the US; Taiwan Semiconductor (Taiwan) and Huawei from China.

Twenty-nine companies in the top 100 have experienced a decrease in R&D investment. Among these, four companies decreased R&D investments and net sales by more than 10 %. The companies with the largest decrease in R&D are Otsuka, Japan (-30.6%); Nokia, Finland (-21.4 %); Eli Lilly, US (-18.2 %); Finmeccanica, Italy (-14.6 %) and General Electric, US (-10.9 %).

The R&D intensity of companies in the top 100, as in the previous year, increased slightly due to a higher R&D growth (6.4%) than net sales growth (2.5%). *The EU and non-EU companies in the top 100 have the same average R&D intensity (6.3 %).*

Box 2.1 - Key technological trends concerning the top R&D investors.

Major technological trends can be classified into four groups:

1. **ICT (information & communication technologies).** These are IT hardware (e.g. more capable semiconductor chips following Moore's Law), software & artificial intelligence and fast communications (optical and wireless). The internet-of-things (IoT) is just one example that uses all these three components of ICT.

2. **New materials and micro-electromechanical devices** made from them. Examples are new battery materials, compound semiconductor devices, nanotechnology, graphene, advanced polymers (which are replacing metals in many applications), micro-sensors & actuators. Just one example of how nanotechnology is starting to affect our everyday lives are the nanocrystal/quantum dot ultra-high definition TV screens now being launched by companies such as Samsung and LG.

3. **Biotechnology and particularly therapeutic biotech** is rapidly developing. Biotech includes genomics (genome sequencing, gene editing), monoclonal antibodies (the basis of many new drugs), drugs capable of fighting antibiotic-resistant infections, anti-viral drugs (for HIV, HepC etc.), regenerative medicine (stem cells etc.) and cancer immunotherapy. Biotech is also important outside medicine in areas such as improved animal/plant genetics and industrial biotech processes. The launch of Gilead Sciences' 8-12 week cure for HepC was a major event of 2014.

4. **System advances** include integration of the above three, for example advanced robotics (involving ICT & new materials), advanced implantable medical devices, driverless cars, additive manufacturing (3D printing) and renewable energy (such as highly efficient concentrated photovoltaic solar cells).

Out of the top 22 R&D companies in the 2015 *Scoreboard*, 15 are deeply involved in ICT or biotech with the other seven coming from the automotive sector. The increasing size of the R&D budgets of the fast-growing companies central to these key technologies are clearly apparent from some major changes apparent in the 2015 *Scoreboard* rankings.

These include ICT companies in online advertising and social media such as Google which is now #6 in the global ranking compared to #36 just four years ago, Facebook is #55 compared to #295 in 2011 and eBay is #59 compared to #114 in 2011. And in Biotech, Gilead Sciences is this year at #47 compared to #115 in 2011 with Celgene at #59 vs. #113 in 2011.

We will take two examples of recent developments to illustrate the rapid progress that is being made – from system advances and biotech.

Google is using the cash from its dominant position in online advertising to develop new businesses such as advanced robotics (through its subsidiary Boston Dynamics), home automation/IoT (through NEST) and self-driving cars which it is already testing in substantial numbers on public roads. Apple also has a massive cash pile and is reported to be working on a self-driving car. These two ICT companies are now seen as a major potential threat by conventional automotive firms. Driverless cars are far from the only example where humans could be replaced by intelligent devices. Experts can foresee surgeonless operations using further development of robotic surgery systems such as Intuitive Surgical's *Da Vinci* system (which currently has a surgeon at the 'joystick' controls and screen). Hundreds of *Da Vinci* systems have been installed in hospitals worldwide.

One of the major biotech events of early 2015 was the May 2015 ASCO conference (American Society of Clinical Oncology). The focus of interest at ASCO was cancer immunotherapy, the science of training the immune system to recognise and kill cancer cells. Immunotherapy drugs are now being approved to treat cancers like advanced melanoma and lung cancer. The leading company in this field is Bristol-Myers Squibb (with three approved immunotherapy treatments) followed by Merck (with two) but other companies such as AstraZeneca have several immunotherapy drugs in their pipelines. The next few years are likely to see many more immunotherapy drugs approved for use against an ever-widening range of cancers.

Source: Innovomantex Ltd.

2.2 R&D changes driven by Mergers and Acquisitions (M&As) and Foreign Direct Investments (FDIs)

Changes in in-house company R&D are usually the results of organic growth or of the need to trim costs in difficult times. But in some cases big changes in R&D are the result of different corporate policies such as mergers & acquisitions (M&As) or demergers, when a company sharpens its focus by selling or spinning off one or more divisions, or investment in new assets (greenfield FDI).

For example, in the pharmaceutical sector, many companies access specialized R&D by acquiring smaller biotech companies via M&A to further diversify their portfolio of biopharmaceutical innovations or to acquire a promising pipeline drug (an example is the case of Gilead acquiring Pharmasset, a global leading US company engaged in anti-viral and anti-cancer drugs).

Automobile sector and technology hardware and electronic equipment sectors seem to engage more in greenfield FDI to benefit from local R&D resources. Often these projects involve the active participation of local companies. For instance, Huawei has opened an R&D centre in Spain, together with Telefonica to focus on fixed line and wireless communications equipment.

Both companies, Gilead and Huawei, have had outstanding R&D performance in the last few years.

Some figures concerning foreign direct investments (FDI) over the past 8 years (2007-2014) for the top 50 R&D investors are provided in Table 2.1. The table reports the total value of M&A deals, the number of cross-border M&A, the total number of M&A deals, the total value and number of greenfield FDI projects.

Some of the companies do not report any M&A figures. In some cases, such as BMW, this is due to the business strategy of the company, in others, such as FIAT and Abbvie, this depends on a recent demerger (Abbvie, 2013) or from a recent merger (Fiat Chrysler, 2014). Although not available for all world top 50 R&D investors, the values of M&As are on average larger than those of greenfield FDI. There are also cases where companies agree to exchange assets and R&D programmes; a recent example was the deal between Novartis and GlaxoSmithKline over cancer drugs, consumer health products and vaccines.

Table 2.1 – Merger and acquisition activities involving *Scoreboard* Companies.

Name	Tot value of M&A deals (€bn)	Cross border M&A	Tot n. of deals	Tot value of FDI (€bn)	N. FDI projects
PFIZER	64.89	4	19	0	
MERCK US	47.84	1	5	2.7	49
ROCHE	45.89	22	22	3.7	46
NOVARTIS	38.1	7	10	5.7	61
ORACLE	22.47	9	65	1	57
VOLKSWAGEN	20.71	3	12	43.3	266
GENERAL ELECTRIC	20.52	16	30	23.2	275
MICROSOFT	19.44	25	65	9.3	183
ASTRAZENECA	18.59	11	12	1.2	25
SANOFI-AVENTIS	18.46	14	17	3.8	54
GOOGLE	18.45	33	122	6.2	97
JOHNSON & JOHNSON	18.32	3	11	1.9	54
HEWLETT-PACKARD	17.25	10	39	7.1	171
CISCO SYSTEMS	16.07	12	56	5.6	75
SIEMENS	15.64	32	39	14.5	252
GLAXOSMITHKLINE	14.91	15	17	3.3	62
TAKEDA PHARMACEUTICAL	13.49	4	5	0.7	30
ELI LILLY	12.86	2	10	1.9	21
BAYER	12.44	2	5	4	124
IBM	11.37	26	79	10.1	383
BRISTOL-MYERS SQUIBB	10.94	0	7	1.2	12
HITACHI	10.88	8	27	10.2	143
GILEAD SCIENCES	10.63	0	7	0.2	10
AMGEN	10.58	4	10	0.5	9
PANASONIC	10.46	7	25	4.1	96
INTEL	8.06	18	37	8.2	69
NOKIA	6.97	16	19	2.2	87
ROBERT BOSCH	5.69	14	32	7.5	191
SAP	5.54	24	30	1.4	71
ERICSSON	4.68	31	33	3	72
GENERAL MOTORS	4.16	1	3	32.3	158
APPLE	4.08	12	35	0.3	20
SONY	3.34	2	14	4.3	86
QUALCOMM	2.94	8	22	2.2	23
EMC	2.25	6	34	1.4	61
TATA MOTORS	1.54	3	5	1	13
TOYOTA MOTOR	1.3	2	7	26.9	282
SAMSUNG ELECTRONICS	1.19	12	24	16.3	59
DAIMLER	0.47	4	14	22.2	139
FORD MOTOR	0.23	9	10	26.1	120
HONDA MOTOR	0.21	3	7	1.2	8
LG ELECTRONICS	0.16	1	6	1.8	52
NISSAN MOTOR	0.13	1	2	1.9	11
DENSO	0.01	2	2	1.7	60
FIAT CHRYSLER AUTOMOBILES	0	1	1	27.1	160
AIRBUS	0	1	1	9.8	167
HUAWEI INVESTEMENT & HOLDING CO				5.6	131
BMW				10.2	80
ABBVIE				0.3	4
BOEHRINGER INGELHEIM				1	28

Source: Zephir database, Bureau van Dijk and fDi Markets database, the Financial Times.

2.3 Long-term performance of top R&D companies

This section analyses the behaviour of the top companies over the last 10 years based on our history database containing company data for the period 2002-2013. Results of companies showing outstanding R&D and economic results are underlined.

Ranking of the top 50

Table 2.2 shows the evolution of the R&D rankings of the top 50 companies since the first *Scoreboard* in 2004 and the most important changes are highlighted. It is important to note, as stated in the previous section and in past reports, that the growth of companies is often accompanied by mergers and acquisitions.

There are 15 EU companies (18 in 2004) and 35 non-EU companies (32 in 2004).

In the EU group, six companies left the top 50 (Alcatel, Istituto Finanziario Industriale, Philips, Renault, BAE Systems and Peugeot) and three companies joined the top 50 (Boehringer Ingelheim, Fiat Chrysler and SAP).

In the non-EU group, eleven companies left the top 50 (Fujitsu, Canon, Fujitsu, Matsushita Electric, NEC, NTT, Motorola, Nortel Networks, Wyeth, Delphi and Sun Microsystems) and fourteen companies joined the top 50 (AbbVie, Amgen, Apple, Denso, EMC, Gilead Sciences, Google, Huawei, LG Electronics, Oracle, Panasonic, Qualcomm, Takeda Pharmaceuticals and Tata Motors).

The distribution of the top 50 companies by main industrial sector and region changed from 2004 to 2014 as follows:

- Automobiles & Parts, from 13 (EU 7) to 12 (EU 5)
- Pharma & Biotech, from 11 (EU 3) to 16 (EU 5)
- ICT industries, stable at 13 (EU 3)

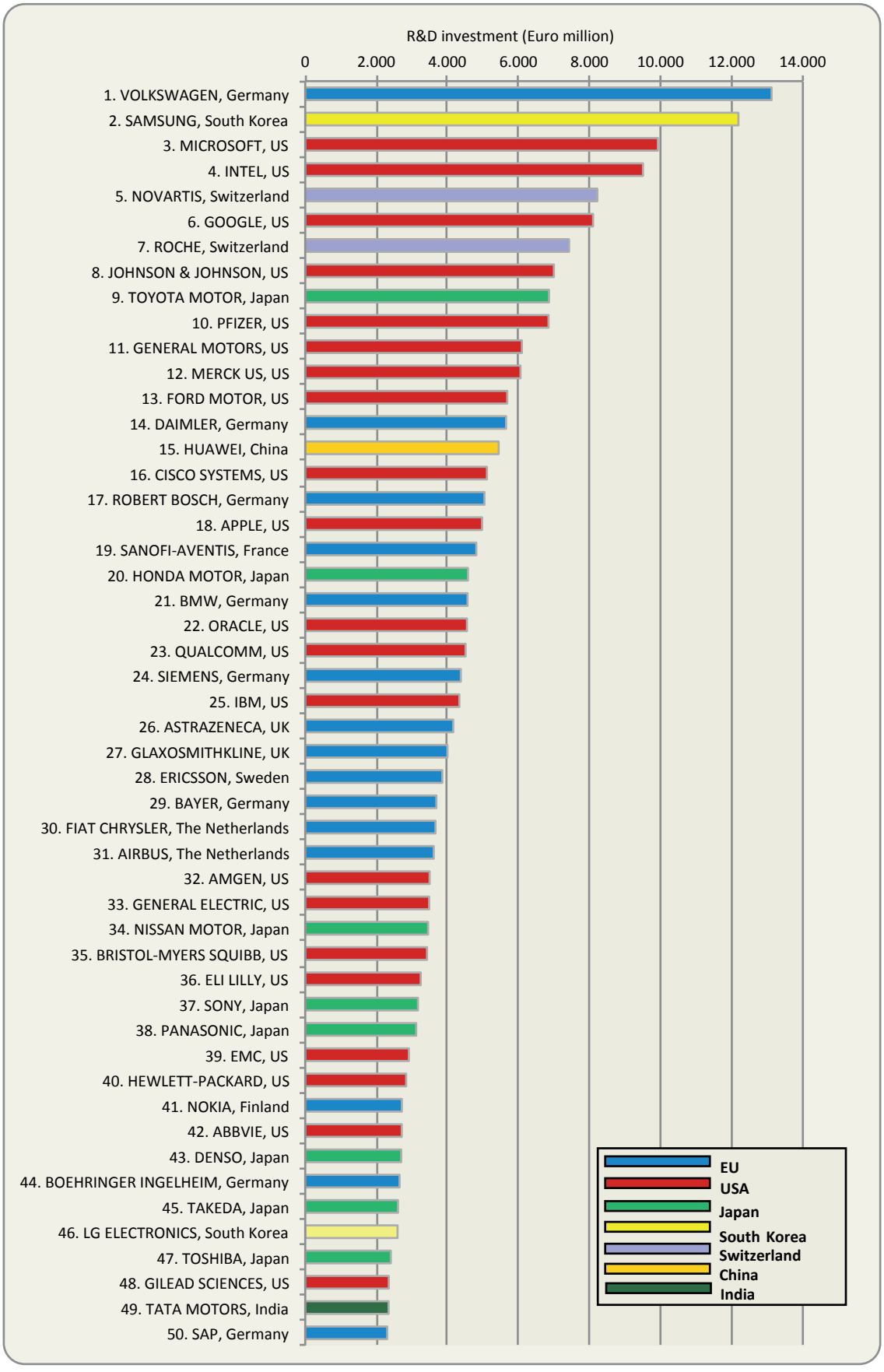
The EU companies that improved by at least 20 places are Bayer (now ranked 29th) and SAP (now 50th).

There are 9 non-EU companies that gained more than 20 places. They include Google, (now 6th), Samsung Electronics (now 2nd), Huawei (now 15th), Apple (now 18th), Oracle (now 22nd) Qualcomm (now 23rd), EMC (now 39th), Takeda (now 45th), LG Electronics (now 46th), Gilead Sciences (now 48th) and Tata Motors (now 49th)[8]. *These examples illustrate the big advances made in this ten year period in software/ internet and biotechnology.*

Three companies dropped twenty or more places but remained within the top 50: Sony (now 37th), Panasonic (now 38th) and Nokia (now 41st).

8 Amazon could be in the top 20 companies by R&D but it does not separate R&D and content sufficiently in its annual report to enable the overall R&D figure to be reliably extracted. The only R&D included in the listing is therefore that which was capitalised rather than expensed.

Figure 2.1. The world's top 50 companies by their total R&D investment (€m) in the 2014 *Scoreboard*.



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 2.2 – The top 50 companies in 2015 *Scoreboard*: R&D data and rank change 2004-2015.

Rank in 2015	Company	Country	R&D in 2014 (€m)	R&D intensity (%)	Rank change 2004-2015
1	VOLKSWAGEN	Germany	13120.0	6.5	up 7
2	SAMSUNG	South Korea	12187.0	7.9	up 31
3	MICROSOFT	US	9921.7	12.9	up 10
4	INTEL	US	9502.5	20.6	up 10
5	NOVARTIS	Switzerland	8217.6	16.7	up 15
6	GOOGLE	US	8098.2	14.9	up > 200
7	ROCHE	Switzerland	7422.1	18.8	up 11
8	JOHNSON & JOHNSON	US	6996.1	11.4	up 4
9	TOYOTA MOTOR	Japan	6858.4	3.7	down 4
10	PFIZER	US	6844.6	16.8	down 8
11	GENERAL MOTORS	US	6095.0	4.7	down 5
12	MERCK US	US	6056.3	17.4	up 17
13	FORD MOTOR	US	5683.2	4.8	down 12
14	DAIMLER	Germany	5650.0	4.4	down 11
15	HUAWEI	China	5441.2	14.0	up > 200
16	CISCO SYSTEMS	US	5112.4	12.6	up 14
17	ROBERT BOSCH	Germany	5042.0	10.3	up 10
18	APPLE	US	4975.7	3.3	up 86
19	SANOFI-AVENTIS	France	4812.0	14.2	down 3
20	HONDA MOTOR	Japan	4576.6	5.0	down 9
21	BMW	Germany	4566.0	5.7	up8
22	ORACLE	US	4549.9	14.5	up 24
23	QUALCOMM	US	4511.2	20.7	up 69
24	SIEMENS	Germany	4377.0	6.1	down 19
25	IBM	US	4335.7	5.7	down 15
26	ASTRAZENECA	UK	4164.4	19.4	down 1
27	GLAXOSMITHKLINE	UK	4002.0	13.5	down 16
28	ERICSSON	Sweden	3856.7	15.9	down 11
29	BAYER	Germany	3689.0	8.7	up 31
30	FIAT CHRYSLER	The Netherlands	3665.0	3.8	new
31	AIRBUS	The Netherlands	3616.0	6.0	up 4
32	AMGEN	US	3498.9	21.2	up 5
33	GENERAL ELECTRIC	US	3486.5	2.8	up 4
34	NISSAN MOTOR	Japan	3455.7	4.4	unchanged
35	BRISTOL-MYERS SQUIBB	US	3426.4	26.2	up 7
36	ELI LILLY	US	3249.5	20.1	up 5
37	SONY	Japan	3170.1	5.7	down 22
38	PANASONIC	Japan	3121.8	5.9	down 31
39	EMC	US	2915.7	14.5	up 21
40	HEWLETT-PACKARD	US	2839.1	3.1	down 17
41	NOKIA	Finland	2718.0	17.9	down 31
42	ABBVIE	US	2715.6	16.5	new
43	DENSO	Japan	2699.4	9.2	down 8
44	BOEHRINGER INGELHEIM	Germany	2654.0	19.9	up 18
45	TAKEDA	Japan	2608.7	21.5	up 28
46	LG ELECTRONICS	South Korea	2596.9	5.9	up 64
47	TOSHIBA	Japan	2407.9	5.3	down 17
48	GILEAD SCIENCES	US	2350.7	11.5	up 318
49	TATA MOTORS	India	2345.5	6.9	new
50	SAP	Germany	2307.0	13.1	up 20

Note: companies in "blue" went up more than 20 ranks and in "red" lost more than 20 ranks
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

High R&D performance among the top 100

Since the beginning of the crisis in 2008, many companies among the top 100 group have shown outstanding performance: Twenty-one companies have at least doubled their R&D investment (3 of them based in the EU, 10 from the US and 8 from other countries). This group of companies is drawn mainly from high R&D-intensive sectors (12) and from medium-high R&D intensive sectors (5). Twelve out of the 22 companies have increased net sales by more than 100% (7 from the US and 5 from other countries) and seven companies increased employment by more than 100% (6 based in the US and 1 from other non-EU countries). Many of these companies have made substantial acquisitions.

Since 2010, when companies from most regions started to recover from the crisis (see chapter 1), many companies among the top 100 group have accelerated their R&D investments. The table 2.3 presents the list of 14 companies that increased R&D investment by more than 100% in the period 2010-2014 (3 based in the EU, 8 from the US and 3 from other countries). As mentioned above, many companies' large increases in R&D are driven by acquisitions.

Table 2.3 - Companies among the top 100 R&D investors that showed the largest R&D investment growth since 2010.

World rank	Company	Country	Sector (ICB 3-d)	R&D in 2014 (€bn.)	R&D int. (%)	R&D growth 2010-2014 (%)
49	TATA MOTORS	IN	Automobiles & Parts	2.3	6.9	859.9
91	CHINA RAILWAY	CN	Construction & Materials	1.3	1.6	365.0
55	FACEBOOK	US	Software & Computer Services	2.2	21.4	359.7
18	APPLE	US	Technology Hardware & Equipment	5.0	3.3	239.0
48	GILEAD SCIENCES	US	Pharmaceuticals & Biotechnology	2.4	11.5	205.7
6	GOOGLE	US	Software & Computer Services	8.1	14.9	161.4
90	SAFRAN	FR	Aerospace & Defence	1.3	8.7	155.9
86	WESTERN DIGITAL	US	Technology Hardware & Equipment	1.4	11.3	134.1
30	FIAT CHRYSLER	NL	Automobiles & Parts	3.7	3.8	118.2
59	EBAY	US	General Retailers	2.0	13.4	117.4
23	QUALCOMM	US	Technology Hardware & Equipment	4.5	20.7	114.9
1	VOLKSWAGEN	DE	Automobiles & Parts	13.1	6.5	109.7
76	BOMBARDIER	CA	Aerospace & Defence	1.5	9.1	106.4
62	CELGENE	US	Pharmaceuticals & Biotechnology	1.9	30.0	105.9

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

High R&D intensive companies among the top 100

There are 42 companies out of the top 100 that invested in R&D more than 10% of their net sales. These companies are mostly from Pharmaceuticals & Biotechnology (22) and ICT sectors (16). Twenty-two of them are based in the US and thirteen in the EU. It is interesting to note that 80% of these high R&D-intensive companies also have double-digit profitability.

This group of companies includes US leading companies in biotechnology (Celgene, Amgen, Biogen, Gilead, and Bristol-Myers Squibb) and fast growing software/internet companies (Facebook, Google and Oracle). These companies have succeeded in exploiting new technologies and some of them are exploiting their cash piles to engage in new technological areas, e.g. Google expansion in self-driving cars, advanced robotics and automation including internet-of-things.

The EU companies in this group are also mostly from the Pharmaceuticals & Biotechnology sector (7 out of 13). *A successful company in this group is the Danish company Novo Nordisk, which is the world leader in treatments for diabetes, the world's fastest growing major disease, with around 50% global market share. A company demerged from Novo Nordisk in 2000, Novozymes (now ranked #43 in the Scoreboard), is the world leader in industrial enzymes for household products, biofuels and bioenergy.*

3 R&D distribution by industrial sector

This chapter presents the main R&D trends among the 2015 *Scoreboard* companies aggregated by industrial sectors[9]. It comprises the ranking of sectors by their level of R&D investment, R&D intensities, rates of R&D growth and the comparison of such trends across world regions.

Key findings

- Companies from the Software & Computer Services showed the highest R&D growth (12.8%). This sector is dominated by the US companies which account for 77% of the total world R&D and increased it by 13.1% in 2014. Large companies such as Facebook and Google showed big changes in their R&D investments (88.4% and 24.3% respectively). Also many software companies from China showed double digit R&D growth, e.g. Baidu (69.9%) and Tencent (52.2%).

- The top two R&D investing sectors achieved an increase of R&D above the world average (6.8%), Pharmaceuticals & Biotechnology (7.2%) and Automobile & Parts (9.9%). Other sectors that achieved a fair increase on R&D were Technology Hardware & Equipment (6.7%) and Health Care Equipment & Services (8.7%). Among the large R&D sectors, those showing a poor performance were Industrial Engineering (2.0%), Chemicals (1.9%) and Aerospace & Defence (1.5%).

- In the Pharmaceuticals & Biotechnology sector, companies operating in biotechnology increased R&D by 21.3% whereas the traditional pharmaceutical companies increased it only by 4.8%. As observed in the previous edition, this is due to the rapid development of biotechnology, illustrated by an outstanding performance by the top biotechnology companies mostly based in the US.

- Among the top 5 sectors, companies based in the EU had the highest R&D growth in Automobile & Parts (7.9 %) and Pharmaceuticals & Biotechnology (6.5 %). The highest R&D growth in the EU was showed by the Health Care Equipment & Services sector (8.0%).

- Trends observed in the *Scoreboard* over the last 10 years show characteristic but very different industrial specialisations by the EU and US companies. This difference persisted after the financial crisis and appears to have been reinforced over the past few years:

  - Concentration of the EU companies in medium-high R&D intensity sectors (total domestic and sector world R&D shares of 44.6% and 33.8% respectively). In particular in Automobiles & Parts with domestic and world R&D shares of 26.2 % and 47.3 % respectively.

  - Dominance of US companies in high R&D-intensity sectors (total domestic and sector world R&D shares of 74.2% and 54.7% respectively) and particularly in ICT industries and biotechnology. The US companies in ICT have domestic and sector world R&D shares of 45.8% and 67.1% respectively.

- A detailed analysis of the health and ICT sectors shows a significant gap for the EU vis-à-vis the US in terms of number of companies, R&D investment and R&D intensity. However, the *Scoreboard* also shows a number of world-beating EU companies of substantial size in these sectors, e.g. Novo Nordisk, ASML and ARM all invest heavily in R&D and dominate their world market niches. The gap is due to the fact that there are too few of them.

3.1 General R&D trends

Figure 3.1 shows the R&D rankings of companies from the main industrial sectors including the relative R&D share by main world region. The specialisation of the main world regions, represented by the share of sectors within the regions' total R&D investment, is given in figure 3.2.

- R&D investment in the *Scoreboard* remains highly concentrated by sector: Out of 41 industrial sectors, the top three –Pharmaceuticals & Biotechnology, Technology Hardware & Equipment and Automobiles & Parts– account

9 According to the Industry Classification Benchmark (ICB) applied in the *Scoreboard*.

for 49.4% of the total R&D investment by the *Scoreboard* companies; the top 6 and top 15 sectors constitute, respectively, 67.4 % and 91.5% of the total R&D in the *Scoreboard*. A similar concentration of R&D in a relatively small number of industrial sectors has been observed over the last 12 years.

- The ranking of the top 11 sectors has changed as follows: The Automobiles & Parts sector took over the 2nd position from the Technology Hardware & Equipment (now 3rd).

- The Pharmaceuticals & Biotechnology sector is in the first position in the R&D ranking, maintaining a similar share of the total R&D investment (18.2%). It is followed by the Automobile & Parts and Technology Hardware & Equipment sectors with a similar share of R&D, 15.6%.

- The R&D specialisation (share of R&D investment) of the main regions in the top 3 sectors are:

  - In the EU, Automobiles & Parts (26.3 %), Pharmaceuticals & Biotechnology (18.4 %), and Technology Hardware & Equipment (8.8 %);

  - In the US, Technology Hardware & Equipment (24.7 %), Pharmaceuticals & Biotechnology (21.2 %) and Software & Computer Services (21.0 %);

  - In Japan, Automobiles & Parts (28.6%), Electronic & Electrical Equipment (13.0%) and Pharmaceuticals & Biotechnology (10.7%).

- The contribution to the total *Scoreboard* R&D:

  - by EU companies is 48.6 % to Aerospace & Defence, 47.4% to Automobiles & Parts and 35.4% to the Industrial Engineering sectors;

  - the US contributes 75.0% to Software and Computer Services, 63.7% to Health Care Equipment & Services and 55.6% to Technology Hardware & Equipment and;

  - Japan contributes 60.7 % to Leisure Goods, 29.1 % to General Industrials, 28.1% to Chemicals and 26.0 % to Automobiles & Parts.

3.2 R&D growth by industrial sector

The actual contribution of an industrial sector to the overall R&D growth of a region depends on its rate of R&D change and the sector's share of total R&D of the region. Figures 3.1 and 3.2 show the shares of the main industrial sectors and table 3.1 shows their ranking by R&D annual growth rate worldwide for the *Scoreboard* companies based in the main world regions (EU-608, US-829, and Japan-360, RoW group-703).

The following points are observed for the top 11 sectors accounting for 85.4% of the total R&D investment of the *Scoreboard* companies:

- Worldwide, the Software & Computer Services sector shows the highest one-year growth rate (12.8%) followed by Automobiles & Parts (9.9%) and Health Care Equipment & Services (8.7%) sectors. *The significant R&D growth rate of the Software & Computer Services sector is due to a large extent by the R&D growth of US companies such as Facebook (88.4%) and Google (24.3%). Many Chinese companies showed double digit R&D growth, e.g. Baidu (69.9%) but with Chinese software R&D significantly less than 10% of US R&D in this sector.*

- Among the companies based in the EU, Health Care Equipment & Services sector shows the highest one-year growth rate (8.0%), followed by the Automobiles & Parts (7.9%). The sectors showing the lowest one-year R&D growth are Leisure Goods (-4.9%) and Industrial Engineering (-4.1%). *The significant R&D growth of the Automobiles & Parts sectors is mostly due to large companies that increased R&D above the sector's average rate, e.g. Peugeot (14.9 %), Continental (14.4 %), and Mahle (64.3 %).*

- Among the companies based in the US, the Software & Computer Services sector shows the highest one-year growth rate (13.1%) followed by Pharmaceuticals & Biotechnology (10.7%). Sectors showing the lowest one-year R&D growth are General Industrials (-2.5 %) and Industrial Engineering (0.8%).

- For Japanese companies, the highest one-year growth rate is shown by Industrial Engineering (12.4%). The poorest performance was shown by Software & Computer Services (-5.7%) and Leisure Goods (-2.9%).

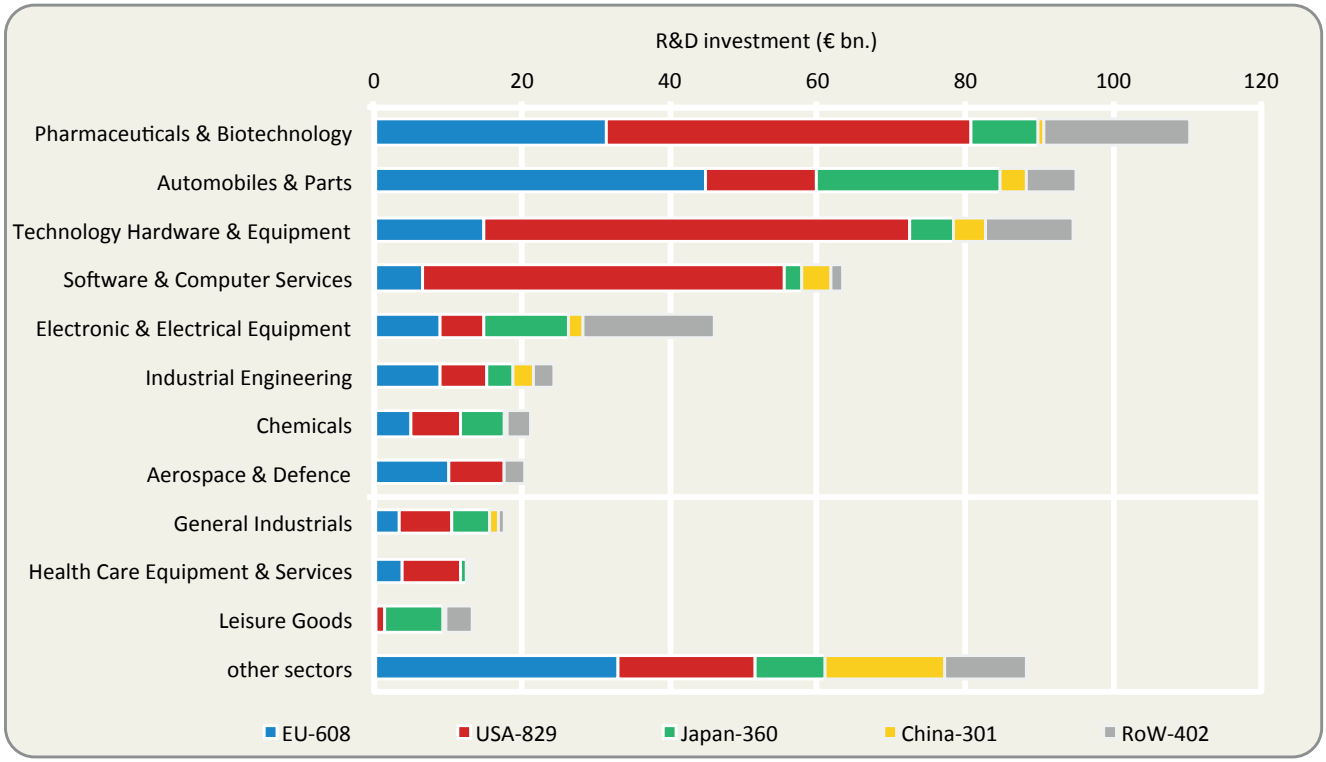
- The companies from the RoW group had impressive R&D growth rates in Automobiles & Parts (39.6%) and Software & Computer Services (34.4%). *The Automobiles & Parts sector in this group is led by a few large companies that showed a high R&D increase, for example, Tata Motors (108.9%), Hyundai (26.9%) and Saic Motor (16.0%). The highest R&D growth companies in the Software & Computer Services were Chinese companies, e.g. Baidu (69.9%), Tencent (52.2%) and Qihoo 360 Technology (59.2%).* However, almost half of the total Chinese R&D comes from the 'other sectors' group – a much higher proportion than for the other major country/regional groupings (as shown in Fig. 3.1).

Apart from the top industries, there were important R&D changes in some other sectors:

- Most services sectors showed double-digit R&D growth, e.g. Financial Services (22.2%), Travel & Leisure (22.6 %) and General Retailers (15.1 %).

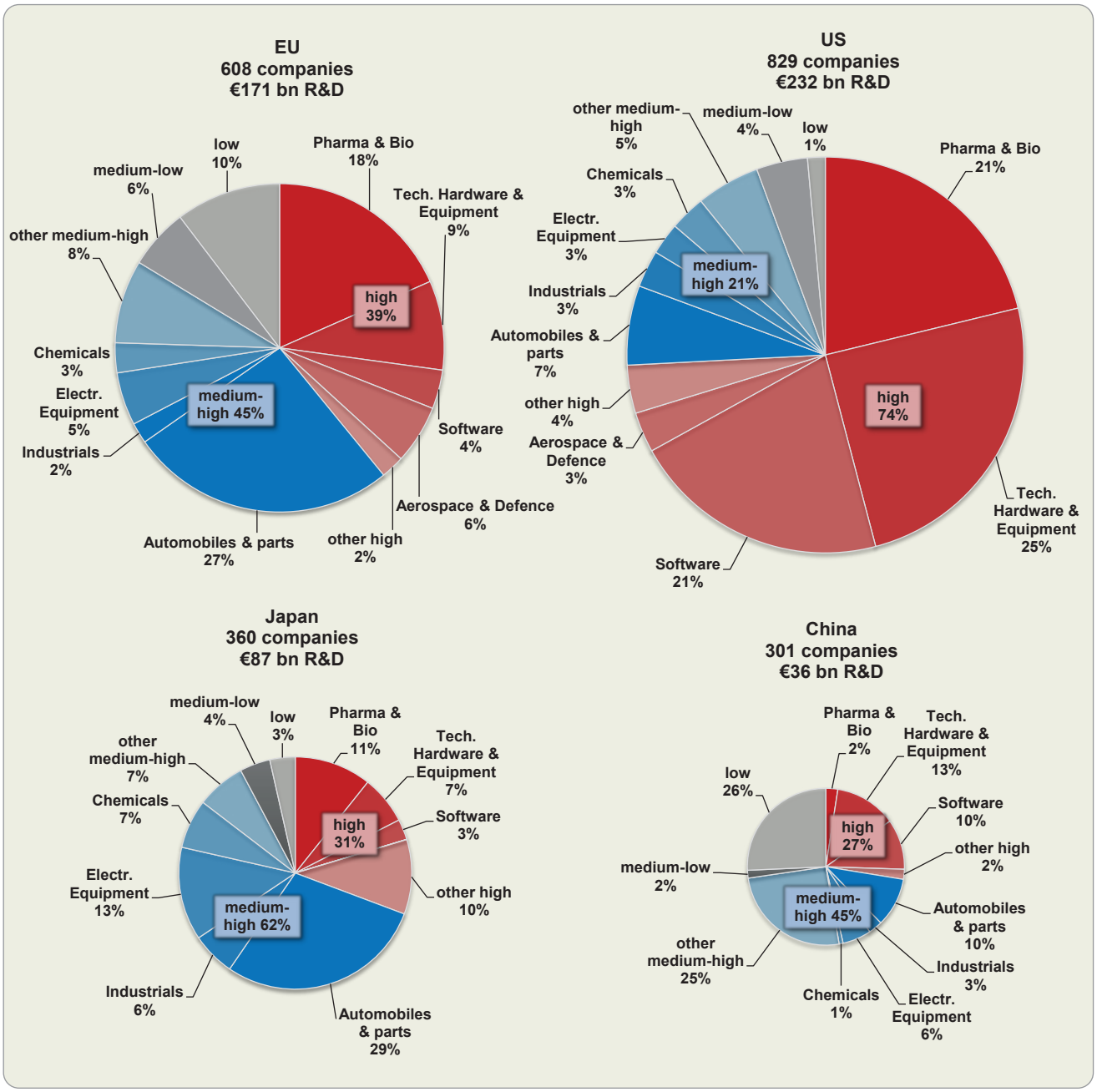
- As observed in the past three years, the alternative energy sector that showed a substantial increase of R&D investment before the crisis, continued to decrease R&D investment in 2014 though at a lower pace (-1.1 %), compared with (-1.9 %) in the previous period and the sharp R&D reduction in 2012 (-22.9%).
- In 2014, the Industrial Transportation sector reversed the negative trend of the past years, increasing significantly R&D (13.8 %).

Figure 3.1 - R&D ranking of industrial sectors and regional shares for the world's top 2500 companies.



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 3.2 - R&D shares of sectors of the main world regions.



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 3.1 - Ranking of top 11 industrial sectors by overall one-year R&D growth in the 2015 *Scoreboard*.

Sector	Global R&D change (%)	EU-608 R&D	US-829 R&D	Japan-360 R&D	RoW-703 R&D
Software & Computer Services	12.8	4.6	13.1	-5.7	34.4
Automobiles & Parts	9.9	7.9	6.3	6.6	39.6
Health Care Equipment & Services	8.7	8.0	8.7	7.4	14.3
Pharmaceuticals & Biotechnology	7.2	6.5	10.7	-1.0	4.2
Technology Hardware & Equipment	6.7	-1.7	7.0	1.3	16.7
Electronic & Electrical Equipment	6.1	2.0	4.9	2.1	11.0
Industrial Engineering	2.0	-4.1	0.8	12.4	8.3
Chemicals	1.9	-0.8	1.3	3.3	4.7
General Industrials	1.5	-2.1	-2.5	5.4	14.4
Aerospace & Defence	1.5	1.2	3.4	20.6	-2.7
Leisure Goods	1.0	-4.9	8.0	-2.9	8.2
Top 11 industries	**7.1**	**4.0**	**8.3**	**3.0**	**13.2**
Rest of 30	**5.1**	**0.5**	**6.1**	**-1.0**	**12.9**
All 41 industries	**6.8**	**3.3**	**8.1**	**2.6**	**13.1**

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

3.3 R&D intensity by sector

Table 3.2 provides the list of the main industrial sectors ranked by worldwide R&D intensity for the 2500 *Scoreboard* companies grouped by main world region.

The following points are observed:

- Some industrial sectors increased their R&D intensity as R&D investment increased more than net sales in 2014, in particular the Automobiles & Parts sector (9.9% vs. 5.9%). The opposite happened for Leisure Goods (1.0 % vs. 3.3%) and Health Care Equipment & Services (8.7% vs. 17.5%).

- Four sectors have an R&D intensity of more than 5.0%: Pharmaceuticals & Biotechnology, the IT sectors (Software & Computer Services and Technology Hardware & Equipment) and Leisure Goods (mainly electronic leisure). The sector with the lowest R&D intensity is Oil & Gas Producers (0.3%).

- Among the top 11 sectors, the R&D intensity of EU companies is larger than that of the US and Japan in 6 sectors (Electronic & Electrical Equipment, Technology Hardware & Equipment, Industrial Engineering, General Industrials, Automobiles & Parts and Aerospace & Defence). Japanese companies show higher R&D intensity than the EU and the US in sectors such as Health Care Equipment & Services and Chemicals. The R&D intensity of US companies is higher than that of the EU and Japan in Pharmaceuticals & Biotechnology and Software & Computer Services.

- As observed in previous *Scoreboards*, the overall lower average of R&D intensity of the EU companies is due to their large share of low R&D-intensive sectors with very large sales such as Oil & Gas, Mining, Banks, as compared to a similar group of non-EU companies. Conversely, the high average R&D intensity of the US companies is due to their considerable weight in high R&D-intensive sectors (see Figures 3.1 and 3.2)

Table 3.2 - Ranking of the top 11 industrial sectors by overall R&D in the 2015 *Scoreboard*.

Sector	Global R&D intensity (%)	EU-608 R&D intensity (%)	US-829 R&D intensity (%)	Japan-360 R&D intensity (%)	RoW-703 R&D intensity (%)
Pharmaceuticals & Biotechnology	14.4	13.3	17.1	13.3	12.0
Software & Computer Services	10.1	10.6	13.2	2.1	6.8
Technology Hardware & Equipment	8.0	15.1	9.9	5.2	4.2
Leisure Goods	5.8	3.0	5.8	5.8	6.2
Aerospace & Defence	4.5	6.0	3.2	1.4	6.0
Electronic & Electrical Equipment	4.5	5.2	4.0	4.4	4.3
Automobiles & Parts	4.4	5.5	4.0	4.1	2.7
Health Care Equipment & Services	3.8	5.0	3.1	6.9	9.9
Industrial Engineering	2.9	3.2	2.9	2.8	2.6
Chemicals	2.6	2.1	3.4	3.6	1.7
General Industrials	2.5	4.2	2.7	2.9	1.1
Top 11 industries	**5.7**	**6.2**	**7.2**	**4.3**	**4.1**
Rest of 30	**1.0**	**0.8**	**1.3**	**1.1**	**1.0**
All 41 industries	**3.4**	**2.8**	**5.2**	**3.3**	**2.4**
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.					

3.4 Growth of net sales and profitability level by industrial sector

Table 3.3 shows the ranking of the top 11 industrial sectors, accounting for 85.4% of the total R&D and 50.8% of the total net sales, by overall one-year growth of net sales for the companies based in the EU, the US, Japan and the RoW group.

The following points are observed:

- Worldwide, the Health Care Equipment & Services sector shows the highest one-year growth rate of net sales (17.5%) led mainly by Mckesson (US), largest sector's company by sales and, to a lesser extent, by Thermo Fisher Scientific (US), Fresenius (Germany) and Medtronic (Ireland) [10]. The following sectors by growth rate on sales were Software & Computer Services (9.5%) and Automobiles & Parts (5.9%).

- Among the companies based in the EU, the highest growth rates of net sales are in Health Care Equipment & Services (10.7%) and Leisure Goods (7.6 %). The sector showing the lowest one-year sales growth is General Industrials (-6.7%). *Among the largest sectors in the EU, the highest profitability is shown in Software & Computer Services (17.3 %) followed by Pharmaceuticals & Biotechnology and Health Care Equipment & Services (14.7 %). The EU companies' lowest profitability is in the Oil & Gas Producers sector (5.2 %).*

- Among the companies based in the US, the Health Care Equipment & Services sector shows for the second consecutive year the highest one-year growth rate for sales (20.5%) followed by Software & Computer Services (6.6%). The sector showing the lowest one-year R&D growth is Automobiles & Parts (1.2 %). *The US-based companies have the highest profitability in Pharmaceuticals & Biotechnology (24.4 %) and Software & Computer Services (21.7 %). The US companies' lowest profitability is in the Automobiles & Parts sector (3.6 %).*

- For Japanese companies, the highest one-year growth rate for sales is shown by the relatively small sector of Software & Computer Services (12.4%) and by Industrial

10 Headquartered in Ireland but with operational centre in the US.

Engineering (10.9%). The poorest performance is shown by Pharmaceuticals & Biotechnology (-2.4%). *The profitability of companies based in Japan is generally lower than their counterparts in the EU and the US, for example 10.2 % for Pharmaceuticals & Biotechnology. The highest profitability sector for Japanese companies is Health Care Equipment & Services (11.8 %).*

- The companies based in the RoW group showed the highest increase in net sales in Software & Computer Services (22.4%) which also shows the highest profitability (23.2%).

Table 3.3 - Ranking of top 11 industrial sectors by overall one-year net sales growth in the 2015 *Scoreboard*.

Sector	Overall sales change (%)	EU-608 Sales change (%)	US-829 Sales change (%)	Japan-360 Sales change (%)	RoW-703 Sales change (%)
Health Care Equipment & Services	17.5	10.7	20.5	7.9	11.9
Software & Computer Services	9.5	6.5	6.6	12.4	22.4
Automobiles & Parts	5.9	5.6	1.2	7.9	8.6
Technology Hardware & Equipment	4.8	-6.5	6.2	4.7	6.2
Pharmaceuticals & Biotechnology	4.6	3.4	6.5	-2.4	6.5
Aerospace & Defence	4.2	1.8	3.8	11.0	16.5
Leisure Goods	3.3	7.6	1.6	2.5	5.4
Industrial Engineering	2.3	1.6	1.5	10.9	-0.4
Electronic & Electrical Equipment	2.0	-0.7	3.2	5.0	1.0
Chemicals	1.0	0.3	2.8	5.1	-2.9
General Industrials	0.3	-6.7	2.0	3.5	-1.9
Top 11 industries	**4.5**	**2.6**	**5.3**	**6.1**	**3.9**
Rest of 30	**-0.1**	**-2.9**	**0.3**	**0.8**	**3.6**
All 41 industries	**2.2**	**-1.0**	**3.6**	**4.3**	**3.7**

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

3.5 Changes in indicators by region and sector groups

It is interesting to see the distribution of R&D investment of the *Scoreboard* companies across regions and sectors using an aggregation of the 41 industrial sectors into four groups of high-, medium-high-, medium-low- and low- R&D intensity (see definitions in Box 1.2 in chapter 1).

It is interesting to compare the distribution of the R&D investment grouped into sectors between regions (world distribution showing the weight of each region in each sector) and within regions (domestic distribution showing the region's sector specialisation).

The R&D investment grouped into sectors can be distributed across regions (world distribution) to show the region's weight per sector and within regions (domestic distribution) to show the region's sector specialisation. As shown in Table 3.4, the world and domestic distribution of the R&D investment shows clear differences by world region:

- Companies based in the EU specialise in medium-high R&D-intensive sectors (44.6% of total R&D of the EU companies) and contribute 33.8% of the total world R&D of that sector group. *Industrial sectors accounting for a large share of total world R&D of these sectors are Automobiles & Parts (47.5%), Aerospace & Defence (48.5%) and Industrial Engineering (35.4%).*

- Those based in the US specialise in high R&D intensive sectors (74.2% of total R&D of the US companies) and contribute 54.7% of the world R&D of that sector group. Industrial sectors accounting for a large share of total world R&D of these sectors are Software & Computer Services (77.0%), Technology Hardware & Equipment (60.7%) and Health Care Equipment & Services (59.7%). *The R&D share of US companies is also larger than that of the other regions in the Pharmaceuticals & Biotechnology sector (44.7%) and much larger in the Biotechnology sub-sector (88.0%).*

- Japanese companies specialise in medium-high R&D intensive sectors (61.5% of total domestic R&D) while contributing 23.7% of the world R&D of that sector group. *The industrial sectors with highest weight in the total world R&D are Leisure Goods (60.7 %), General Industrials (29.1 %) and Chemicals (28.1 %).*

- Chinese companies specialise in medium-high and low R&D-intensive sectors (45.1% and 25.7% respectively) and contribute 23.3% of the world R&D in the low sectors.

- Companies based in other countries (mainly Switzerland, South Korea and Taiwan) specialise in high and medium-high R&D-intensive sectors (48% and 40% respectively) and contribute 16.4% of the world R&D in the low sectors.

Table 3.4 - World and domestic R&D distribution of the 2500 *Scoreboard* companies by sector groups for the main regions.

	Sector								
	High Share (%)		Medium-high Share (%)		Medium-low Share (%)		Low Share (%)		Region's world Share (%)
Region	world	domestic	world	domestic	world	domestic	world	domestic	
EU	21.2	39.1	33.8	44.6	37.1	6.0	44.3	10.3	28.1
US	54.7	74.2	20.8	20.2	35.4	4.2	8.4	1.4	38.2
Japan	8.5	30.7	23.7	61.5	13.4	4.2	7.7	3.5	14.3
RoW	15.6	41.7	21.7	41.5	14.1	3.3	39.7	13.5	19.4

Note: Sector groups as defined in Box 1.1
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

3.6 Comparison of the EU and US companies in health and ICT industries

This section describes the main characteristics of the samples of companies based in the EU and the US for high R&D-intensive industries that are important from R&D and economic perspectives. R&D plays an important role for the competitiveness of these industries and they have a role as enablers for the whole value-chain of key sectors ranging from ICT-related industries, transport and health.

Moreover, EU based companies compared with their main US counterparts present a weak structural position both in terms of number and weight of companies in most of these industries. As observed in previous *Scoreboard* editions, the EU gap in these industries is particularly sizeable and widening against the US companies. In fact trends observed over the past 10 years show a growing dominance of US companies in sectors such as Software/Internet and Biotechnology where a number of larger key companies are rapidly moving up the R&D rankings (as shown in chapter 2).

Table 3.5 describes the main characteristics of the companies based in the EU and the US in three sub-sectors, namely those related with health and ICT and figure 3.3 shows the evolution of R&D investment for these sectors over the period 2006-2014.

The salient points from table 3.5 and figure 3.3 are the following:

- Overall, the US has 3 times more companies and 3 times more R&D investment than the EU in these industries whereas the US has only 36% more total R&D than the EU in the *Scoreboard*.

- The Pharmaceuticals sub-sector is the only one where the EU and the US have similar numbers of companies, R&D investment and R&D intensity.

- In the Biotechnology sub-sector, the US dominates the EU in number of companies (6 times more numerous), R&D investment (11 times larger) and larger average R&D intensity per company. *A particular strength of the US lies in its large biotech companies such as Amgen, Gilead Sciences, Biogen, Celgene and Regeneron. These companies have grown fast through the early adoption of biotech and development of successful biotech drugs (they all have blockbuster drugs on the market). Most of them are now sufficiently large that they are unlikely to be acquired by pharmaceutical companies.*

- In the ICT industries a large gap in number of companies and level of R&D investment is observed across all sectors, especially in Semiconductors and Computer Hardware but also in Software and Internet. *The US has led the way in the development of software/internet companies such as Google, Facebook, Twitter, Linkedin, eBay and Amazon.*

- In the period 2006-2014 the EU/US gap, measured as the R&D ratio between the US and the EU companies, significantly increased from 2.8 to 3.9 for the IT hardware sector. For Software & Services it changed from 8.6 to 9.5 and only from 1.4 to 1.5 for health related sectors.

Apart from the above mentioned figures, it is worth emphasising the significant number of successful EU companies in these sectors that have established market-leading positions in their sub-sectors (see chapter 4). In fact, the *Scoreboard* contains world-leading EU companies of substantial size in these industries. The following examples illustrate this point:

- **Novo Nordisk** from Denmark (and **Novozymes** which was demerged from Novo Nordisk in 2000). The reason is that Novo Nordisk is the world leader in treatments for diabetes, the world's fastest growing major disease, with around a 50% global market share. Novozymes is the world leader in industrial enzymes for household products, biofuels and bioenergy.

- **ASML** from the Netherlands is the world leader in precision lithography, the key step in making all semiconductor chips. It has around an 80% global market share and is the only company with next generation EUV (extreme ultraviolet) systems with customers. It has strong links with key firms such as Intel, Samsung and TSMC.

- **ARM** from the UK is the world leader in low power consumption semiconductor chip designs for mobile devices. ARM chips are in 95% of the world's smartphones and 80% of all digital cameras. Over 60 billion ARM chips have been shipped to date and ARM is a leader in the global technology hardware sector.

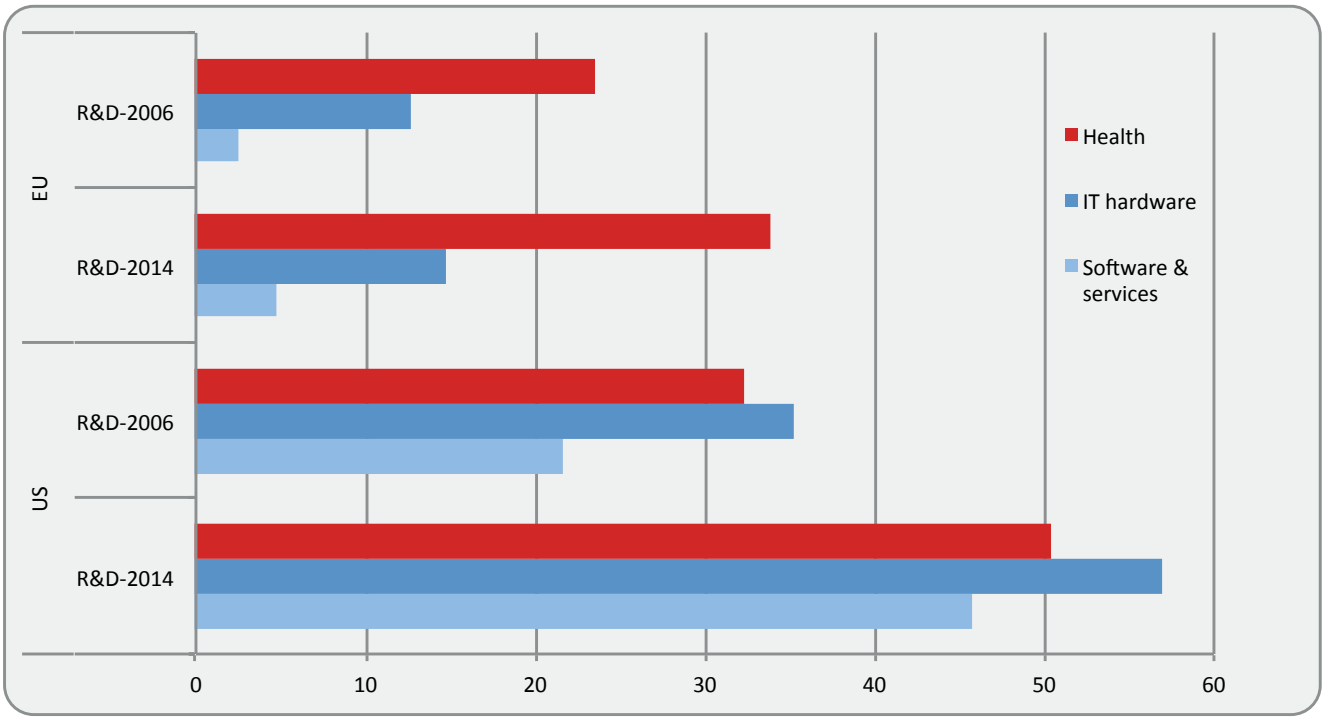
- **Dassault Systèmes** from France is a world leader in 3D CAD design software and product lifecycle management. 3D design is essential for additive manufacturing (3D printing).

Table 3.5 - Sample of EU and US companies in health and ICT related sectors.

Industry	# companies		R&D in 2013 (€m)		R&D intensity (%)	
	EU	US	EU	US	EU	US
Health						
Pharmaceuticals	50	45	29.8	32.8	13.1	15.2
Biotechnology	19	116	1.5	16.4	18.0	23.1
Health Care Equip. & Services	20	60	3.8	7.8	5.0	3.1
IT hardware						
Semiconductors	16	72	4.1	27.2	16.5	17.7
Computer Hardware	5	25	1.2	14.6	8.9	4.9
Telecommunications Equipment	13	31	9.6	15.0	16.1	13.8
Electronic Office Equipment	1	2	0.1	0.5	5.7	2.7
Software & services						
Software	30	101	4.9	28.3	15.0	15.4
Computer Services	14	33	1.4	7.0	5.4	6.9
Internet	2	22	0.2	13.2	8.6	16.3
Total	**170**	**507**	**56.7**	**162.8**		

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 3.3 - R&D investment 2006-2014 for the EU and US companies in health and ICT sectors (€bn).



Note: Figures refer to 132 EU companies and 371 US companies that reported R&D over the whole 2006-2014 period.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

4. High-performing R&D-driven innovators in the EU

The objective of this chapter is to identify EU *Scoreboard* companies, which show high performance over time, and to look at their main characteristics in terms of sector of activity, location, size and age. The identification of high-performing firms and the possible determinants of their growth trajectories is an important economic and policy issue. These firms, leading the introduction of innovations and the development of new products and processes, play major role for jobs creation and economic growth.

The conditions that favour firms' growth are multiple and few studies to date have included the economic and growth prospects, the influence of the institutional, regulatory and business environment (e.g. administrative burden for business creation), availability of early-stage finance, the market potential or income growth, the stage of economic development, the education level and the quality of human resources, and also the industry-, firm- and leader-specific features as well as the wider stakeholder expectations on future growth.

The analysis presented in this chapter is based on the enlarged sample of the top 1000 EU R&D companies (2014 *Scoreboard* edition[11]). The identification of "high-performing" companies within this sample of EU R&D driven innovators proceeds in two steps. The first step identifies firms with positive R&D investment performances on the short and longer term, applying for this purpose a set of sound growth rates calculations over the 2000-2013 period. The resulting sample (459 companies) is then characterized according to specific corporate attributes including the geographical origin, the technological intensity, the age and the growth of labour productivity, net sales and employment. In a second step, the selected companies are further screened both in relation to their sector's benchmark and in absolute terms. Multiple performance criteria are applied in order to identify "high-performing" companies (e.g. "high-growth" of R&D and sales indicators, "high R&D intensity" criteria, high labour productivity and positive profits). The set of selection criteria is not based on any pre-defined conception of "high-performance" and rather considers a wide typology of good performing R&D-driven innovators showing further grow potential. Hence, the resulting list does not pretend to be exhaustive. The last section gives an overview of the corporate characteristics of the resulting list of "high-performing" companies.

11 This sample includes 633 EU companies ranking in the world top 2500 and the 367 next largest companies ranked by level of R&D investment in 2013. These companies all had R&D investments exceeding €5.0 million in 2013.

Key findings

The findings of this chapter confirm that Europe can rely on a relevant in-house potential to increase the relative importance of its high R&D intensive sectors as well as to speed up the upgrading of its more traditional and less R&D intensive industries. Both aspects are important to build up a globally stronger and technologically more competitive industry. Salient points for the chapter are:

- EU *Scoreboard* companies showing positive growth of R&D are concentrated in few countries including the UK, Germany, France and Sweden, respectively. The majority of these R&D investors operate in high and medium-high technology sectors. Among these, high-tech firms are, on average, younger than those in other sector groups and are also relatively more numerous.

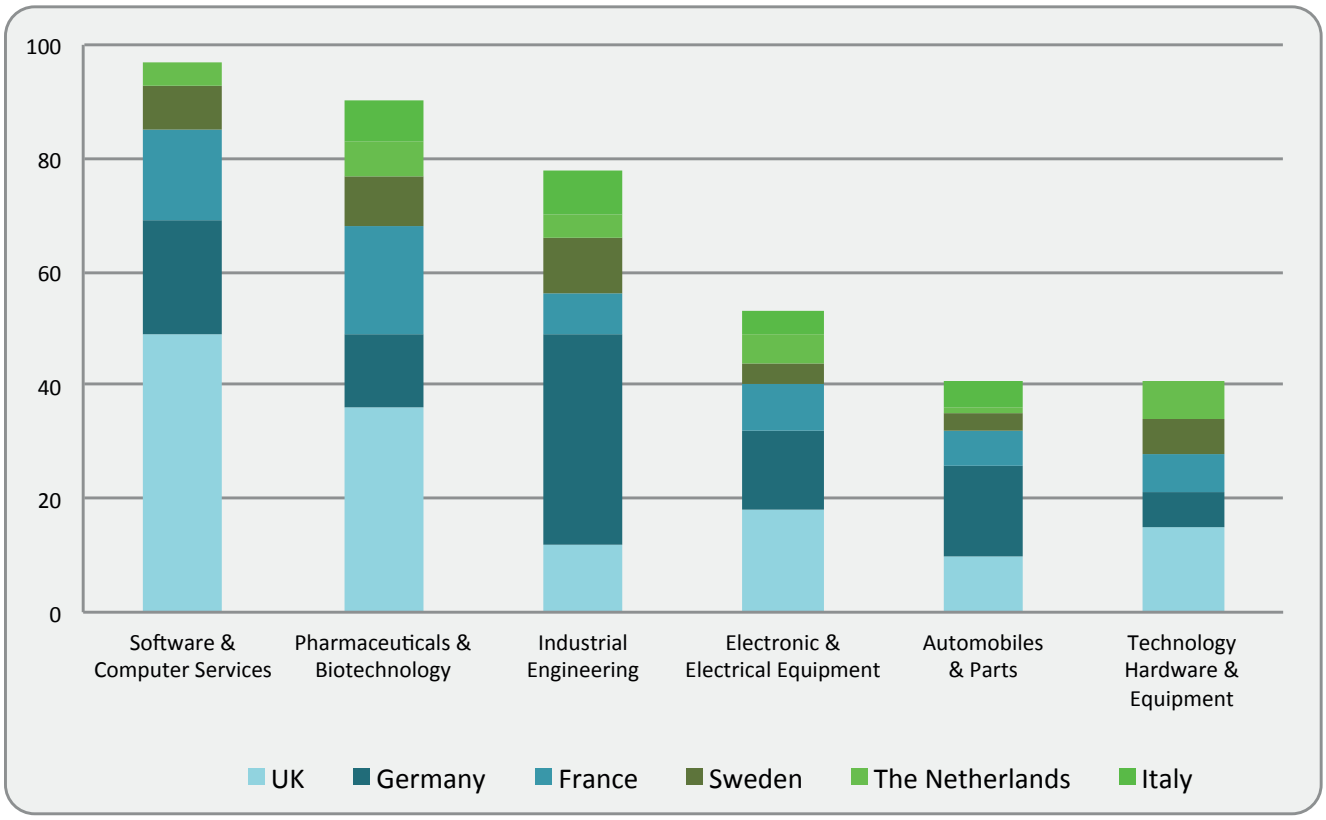
- High-performing EU R&D-driven innovators show very heterogeneous corporate trajectories. They include dynamic firms, mainly from the ICT-related sectors and few older companies from the medium-high and or low technology sectors.

- Eight of these high-performing firms show particularly strong R&D intensity (above 10%) coupled with strong net sales growth (above 10% in the period 2005-2013), positive profits and well above sectoral labour productivity average: Dialog Semiconductor, Gameloft, Bavarian Nordic, Wirecard, Parrot, Playtech, HMS Networks and Generix.

4.1 Overview

The Figure 4.1 shows the geographical distribution of the EU companies located in the top six EU countries and operating in the top six sectors (in both cases in terms of overall number of companies). These sectors include: Industrial Engineering, Software & Computer Services, Pharmaceuticals & Biotechnology, Electronic & Electrical Equipment, Technology Hardware & Equipment and Automobiles & Parts industries. These 400 companies in the top countries and sectors (40% of the EU top 1000 sample) spend more than 100 billion of euros (about 60% of the total R&D investment made by the EU top 1000 companies in 2014).

Figure 4.1 - Sectoral distribution of top EU countries in selected sectors (by number of companies)



Note: the overall number of companies represented in Figure 4.1 is 400.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The distribution shows a high concentration among the top five countries, which have companies active in all six top sectors, with Italy active in only four (not represented in Software & Computer Services and Technology Hardware & Equipment).

Different patterns can be observed in terms of country-sector representation. The UK is by far the largest contributor to the Software, Hardware and Biopharma sectors, Germany to Industrial Engineering and Automobiles and Parts, with both countries driving the Electronic & Electrical sector. Among the other countries, Sweden and France show a diversified activity in terms of number of companies across all six sectors. Sweden has a higher representation in Industrial Engineering and Biopharmaceuticals while France is in second position in Software and holds second position with the Netherlands in Technology Hardware. With less than 30 companies in each case, Italy concentrates one third of their companies in Industrial Engineering and the Netherlands, one fourth in Technology Hardware & Equipment.

4.2 R&D growing companies in the top EU-1000 ranking

This section introduces a first distinction of companies based on their R&D performances. An initial filter distinguishes companies according to the corporate resources committed in R&D investments. A second set of criteria enables further selection of companies on the basis of their R&D growth performances in the long and short term. Box 4.1 describes the R&D indicators and growth criteria considered.

Considering the trade-off existing between observing firms for a longer time period and having a relatively large number of observations, the selection has been made on the period 2005-2013. There is, of course, an element of arbitrariness in such a decision, but we note that our period of analysis covers a relatively long time period (spanning from the years before the financial crisis until the most recent available year), and also that the number of observations falls relatively sharply if a longer time period is taken. Accordingly, the selection leads to a sub-sample of 459 firms with positive R&D growth rates.

Within the resulting first sample of 459 companies with positive R&D growth rates, four countries account for more than two thirds of the companies: UK and Germany (one quarter each), France and Sweden. In terms of sectors covered, firms are concentrated in high and medium-high technology sectors (respectively 191 and 206 firms). Some companies from the medium-low and low technology sectors are also found (29 and 33 respectively). A closer look at the individual sectors shows that together the sectors of Industrial Engineering (14%), Software & Computer Services (13%), Pharmaceuticals & Biotechnology (12%) and Electronic & Electrical Equipment (10%), represent half of the companies identified on the initial R&D growth criteria.

More information on how these companies are split between sector classes can be found in Figure 4.2. More than half of companies from Germany are in high-tech or medium-high tech sectors, with a slightly smaller share of the companies in high-tech sectors for France and Sweden, respectively. UK shows quite similar shares for each sector group with a relatively smaller percentage in the medium-high tech sectors. Sweden and Denmark and, to the greatest extent Belgium, show a relatively large share of companies in low-tech sectors. Some countries with only one company obviously have this company in only one category: either high-tech (Greece, Hungary, and Slovenia), medium-high (Malta) or medium-low (Poland, Portugal).

Box 4.1 - Selection criteria for R&D performance

The following criteria are considered :

(1) The R&D intensity: an initial distinction is made at a 1% threshold of corporate R&D intensity in 2013. Among the EU 1000 companies, 803 companies have a value of **R&D intensity superior to 1%.**

(2) The growth patterns of R&D investment: companies are further investigated on the basis of their pattern of **R&D growth** over and across years. Following on from the focus of firms with R&D intensity above 1% (from (1)), the average of the annual growth rates (AAGr) and the compound annual growth rate (CAGr) of R&D investments are computed for different sub-sets of the period 2000-2013. A broader understanding of the growth performance of R&D expenditures of these firms is provided by the computations of log changes (i.e. log-difference growth rates) and compound log annual change*.

The following table presents the distribution of negative and positive corporate growth rates according to the indicators considered.

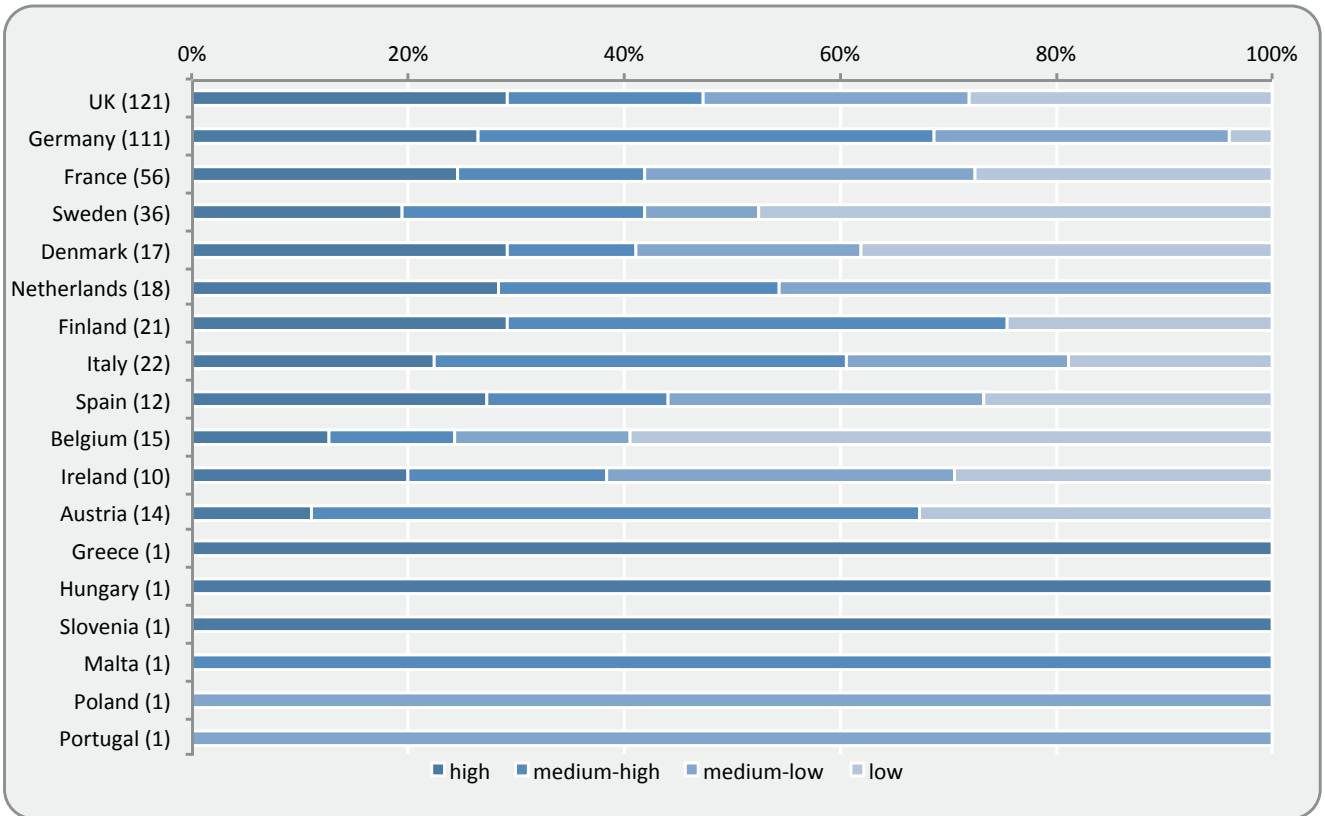
	Growth rate indicators	Number of positive corporate rates†	Number of negative corporate rates†
Average Annual Growth rates	Average Annual Growth rate (AAGr)	744	56
	Average Annual Log Growth rate (AAlogGr)	697	103
Compound Annual Growth rates Growth rates (annual change or log annual change)	CAGr13 *(2013 vs 2000)*	171	34
	CAGr12 *(2013 vs 2001)*	229	42
	CAGr11 *(2013 vs 2002)*	262	49
	CAGr10 *(2013 vs 2003)*	278	56
	CAGr9 *(2013 vs 2004)*	416	68
	CAGr8 *(2013 vs 2005)*	**480**	**77**
	CAGr7 *(2013 vs 2006)*	514	89
	CAGr6 *(2013 vs 2007)*	551	117
	CAGr5 *(2013 vs 2008)*	565	143
	CAGr4 *(2013 vs 2009)*	585	150
	CAGr3 *(2013 vs 2010)*	596	165

† positive or negative and non-missing.

In order to consider the performances of companies on the short and longer term, only companies with positive growth rates of R&D expenditures with respect to the four indicators are maintained in the sample. This procedure allows also smoothing the potential high annual fluctuations observed at the company level.

*Note: the calculation of growth rates is not a trivial matter. For example, if a firm grows from x=100 (at time t=1) to x=200 (t=2) and then reverts back to x=100 (t=3), the common method for calculating growth rates would consider this to be a 100% increase followed by a 50% decline, suggesting perhaps a positive average growth rate of around +25% - even if it did not change size over the period. Instead, the best way of calculating growth rates is to take log-differences or 'log changes'- see the discussion in Tornqvist, L., P. Vartia and Y.O. Vartia (1985). How should relative changes be measured?, American Statistician, 39(1), pp. 43–6.

Figure 4.2 - Country distribution of companies across sector classes.



Note: in brackets the number of companies for each country
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 4.1 presents further information on the characteristics of firms in different sector groups (high-tech, medium-high, medium-low and low-tech). High-tech firms are, on average, younger and smaller than those in other sector groups. Together with the medium-high tech group, they constitute the largest group in numbers. Firms operating in medium-tech sectors are on average four times bigger than those in high-tech and substantially older. Medium-low and low-tech firms, in contrast, are quite rare in this sample; they are also older than the high-tech ones and have an average size ranging between the size of high and medium-tech firms.

Table 4.2 presents further information on the companies according to their age[12]. The cut-off points for the four age classes (<20, 20-49, 50-99, and > or = 100 years) are chosen to keep the four groups roughly equi-populated. Labour productivity, in turn, is defined as the total sales divided by the total number of employees (also known as "labour revenue productivity"). Firms in the youngest age group (of less than twenty years) exhibited the fastest labour productivity growth over the period (about 30.3%). The rapid productivity growth of this group of young firms can be attributed to their particularly rapid growth of sales – the youngest age group also had the highest sales growth (group average of 93.6%) in addition to having the highest employment growth rate (average of 65%).

12 The age of the companies is calculated as the number of years from the foundation date. The foundation date of a company may refer to the historical foundation date of the business, or to the creation of a new business via mergers and acquisitions, or spin-offs (i.e. the divisions of companies become independent businesses). Hence, a firm's age 'clock' can be reset to zero if it changes its incorporation status or is acquired.

Table 4.1 - Average ages and numbers of firms by R&D intensity group.

Sector	Average age (years)	Number of firms	Average size (thousand employees)
high	46	188	10
medium-high	82	204	42
medium-low	71	29	21
low	110	32	29

Note: Sector groups as defined in Box 1.1
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 4.2- Average labour productivity growth by age class.

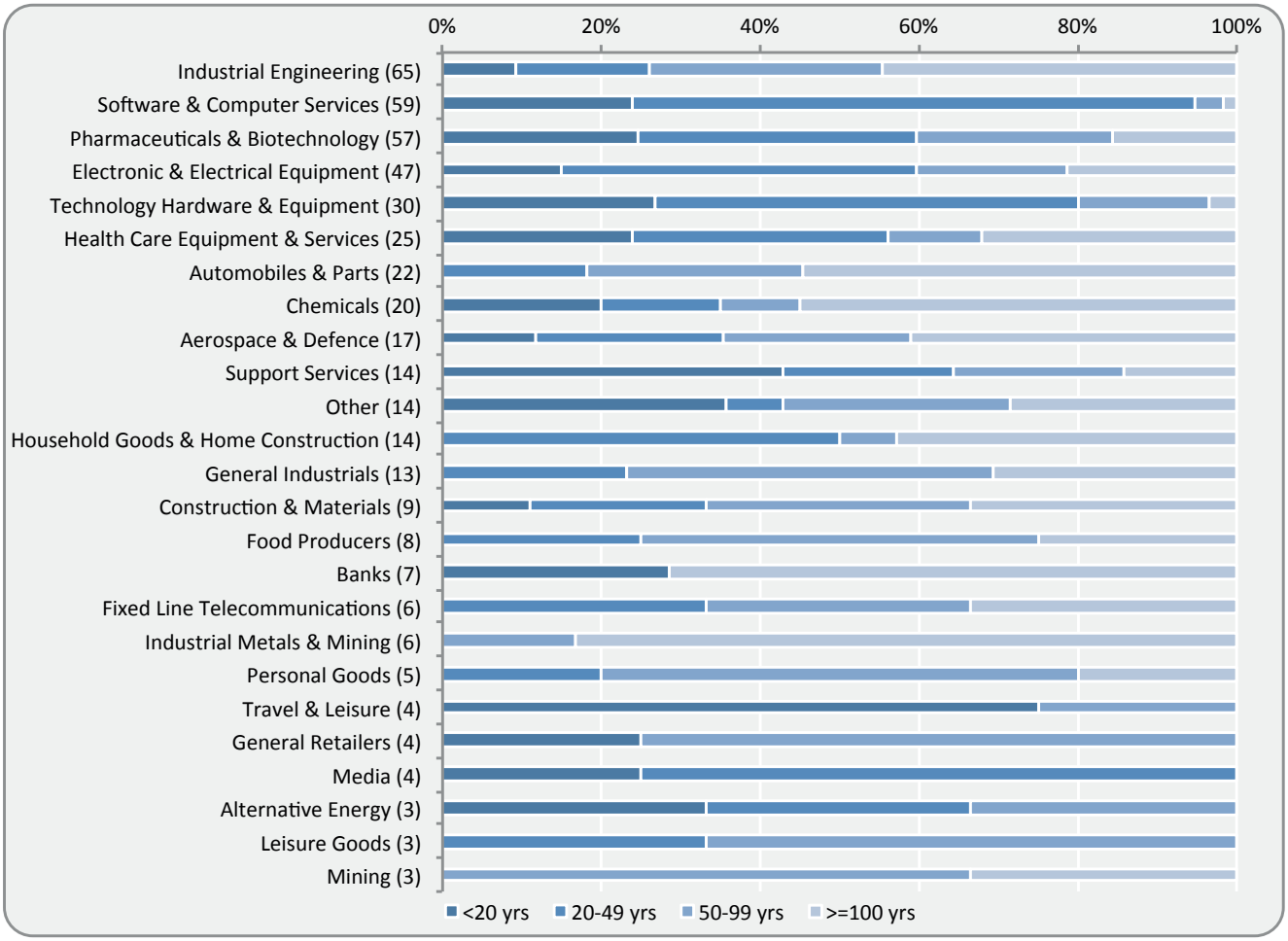
Age class	Net Sales growth (%)	Employment growth (%)	Labour productivity growth (%)
<20 yrs	93.6	65	30.3
20-49 yrs	70.8	62.7	8.0
50-99 yrs	45.1	24.3	23.7
> or = 100 yrs	49.9	31.3	19.5
Average	63.0	45.7	18.3

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The second age group consists in firms from the category 20-49 years. As for the first class, this group also shows very high sales growth. However they recorded the lowest rate of labour productivity growth out of all of the age classes (only 8%), as employment has increased in similar proportions.

For the two remaining age classes, the growth of net sales and labour productivity is roughly comparable across age ranges. Older firms exhibit somewhat higher values for both sales growth (45.1% and 49.9% respectively) and employment growth (24.3% and 31.3% respectively).

Figure 4.3 - Sectoral distribution of age classes.



Note: in brackets the number of companies for each country. Only industries with more than 3 companies are shown. Other include Financial Services (2 companies), Oil Equipment, Services & Distribution (2), Industrial Transportation (2), Electricity (2), Life Insurance (1), Tobacco (1), Forestry & Paper (1), Beverages (1), Real Estate Investment & Services (1) and Mobile Telecommunications (1).
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 4.3 expands on our analysis of the ages of our companies. The youngest firm is found in mobile telecommunications, which is not surprising, perhaps, considering the recent emergence of new niches and subsectors in this industry. Amongst the largest sectors, the Software and Hardware sectors are dominated by firms in the two younger categories. Some other new industries such as Alternative Energy and Biotechnology also appear to be composed of relatively young firms. In contrast, sectors such as Financial Services, Life Insurance and Banks are composed of old firms, as well as some mature technology sectors such as Industrial Metals, Mining, Automobiles, Tobacco and Chemicals.

4.3 High-performing R&D-driven innovators

Starting from the sample of 459 firms previously identified, an identification of high-performing firms has been carried-out on the basis of multiple performance criteria. The final set of companies presented in table 4.3 are the result of applying two scenarios of performance indicators' value.

Scenario 1 – Sector based indicators

This first scenario combines additional R&D growth criteria with a set of economic performance indicators including labour productivity, net sales and operating profits. In order to account for the industry differences, alternative industry-specific thresholds for the indicators values are considered.

The initial selection of firms is made according to the following criteria:

- A compound annual growth rate of R&D above 15% on the period 2005-2013;
- An average labour productivity growth above the median of the industry on the period 2005-2013;
- An average net sales growth above the median of the industry on the period 2005-2013 and;
- Positive operating profits in 2013.

The application of these criteria selects 43 firms which are to be found in all technological sector-groups, although more frequently in high-tech or medium-high tech sectors. Firms that are selected under this scenario have a high growth of R&D, as well as showing high growth of labour productivity, growth of sales and positive operating profits in the last year of available data (2013). They are taken from a variety of different sectors, although those that feature the most prominently include Pharmaceuticals & Biotechnology, Software & Computer services, and Technology Hardware & Equipment. In keeping with our previous results, this scenario draws on a large number of countries, although the 'usual suspects' stand out in particular, the UK, Germany, France, and Sweden are quite visible. They also display heterogeneity in their other dimensions, with perhaps the most striking heterogeneity being in terms of their size (in terms of employees) – the firms range in size from 146 employees to 97,869 employees, such that one firm may be hundreds of times larger than another firm in the same scenario grouping.

Within this first selection, a sub-group of 18 companies (marked by a star in Table 4.3) are distinguished on the basis of stricter criteria as follows:

- A compound annual growth rate of R&D above the 75th percentile of the industry on the period 2005-2013;
- An average labour productivity growth above the 75th percentile of the industry on the period 2005-2013;
- An average net sales growth above the 75th percentile of the industry on the period 2005-2013 and ;
- Positive operating profits in the last year.

The application of these criteria leads to a very small set of companies all active in high (10 firms) or medium-high (7) technology sectors, but a company from the Netherlands. These top R&D investors have a relative outstanding performance in relation to their sector peers and for the performance indicators used. These firms all hail from high- (with Technology Hardware & Equipment and Software & Computer Services in particular, being well represented) and medium-high-technology sectors including companies from the Industrial Engineering and Electronic & Electrical Equipment sectors. These firms come from a range of European countries with a prominent representation of the UK, France and Germany. Again, we can see a remarkable heterogeneity across firms in all dimensions, and particularly in terms of the dispersion of R&D intensity (ranging from 1% in several cases to 40% and even 45%), operating profits, and also number of employees.

Scenario 2 – Absolute R&D intensity and R&D and net sales growth indicators

The 43 high-performing companies identified using the indicators of scenario 1 described above constitute only one of the multiple possible selections. In order to identify other possible high-performing R&D driven innovators, alternative criteria has been applied to the initial sample of 459 firms with positive R&D growth in the period 2005-2013:

- An R&D intensity superior to 10%
- A compound annual growth rate of R&D above 10% on the period 2005-2013;
- An average net sales growth above 10% on the period 2005-2013 and;
- Positive operating profits in 2013.

The application of these criteria led to a sample of 41 firms, including 18 companies already identified in scenario 1 (underlined in light blue) and 23 new companies.

Table 4.3 High-performing R&D-driven innovators.

Short name	EU Rank (2013)	Country	ICB sector	Sector group	RD int. 2013 (%)	RD 2013	Net Sales 2013	Operating Profits 2013	EMP 2013	Growth of RD [1]	Growth of Net Sales [1]
SQUARE ENIX	130	UK	Software & Computer Services	high	91	186	205	2	207	18	17
DIALOG SEMICONDUCTOR*	196	UK	Technology Hardware & Equip.	high	17	114	655	74	1100	21	22
MERZ	200	Germany	Pharmaceuticals & Biotechnology	high	11	109	1031	329	2885	18	11
QIAGEN	207	The Netherlands	Pharmaceuticals & Biotechnology	high	11	106	944	24	4015	17	15
GAMELOFT*	211	France	Software & Computer Services	high	45	104	233	25	6391	18	20
MUNDIPHARMA RESEARCH	218	UK	Pharmaceuticals & Biotechnology	high	81	100	124	11	271	17	14
AXIS	244	Sweden	Technology Hardware & Equip.	high	16	86	532	73	1532	23	21
BAVARIAN NORDIC*	288	Denmark	Pharmaceuticals & Biotechnology	high	40	66	162	5	426	21	20
WIRECARD*	317	Germany	Electronic & Electrical Equip.	medium-high	12	56	482	98	1180	79	29
PARROT*	323	France	Technology Hardware & Equip.	high	23	54	235	6	827	29	17
PLAYTECH*	366	UK	Software & Computer Services	high	12	45	367	141	3261	61	28
FIDESSA	383	UK	Software & Computer Services	high	12	41	333	49	1671	16	17
EUROMONITOR	513	UK	Media	medium-low	28	25	89	22	823	16	18

Short name	EU Rank (2013)	Country	ICB sector	Sector group	RD int. 2013 (%)	RD 2013	Net Sales 2013	Operating Profits 2013	EMP 2013	Growth of RD [1]	Growth of Net Sales [1]
THROMBOGENICS	519	Belgium	Pharmaceuticals & Biotechnology	high	22	24	113	26	146	16	37
LPKF LASER & ELECTRONICS	622	Germany	Electronic & Electrical Equipment	medium-high	12	16	130	24	752	23	16
HMS NETWORKS*	724	Sweden	Technology Hardware & Equip.	high	21	12	57	10	359	24	11
USU SOFTWARE	813	Germany	Software & Computer Services	high	17	9	56	3	452	18	12
GENERIX*	942	France	Software & Computer Services	high	13	6	49	4	348	21	29
NOVO NORDISK	24	Denmark	Pharmaceuticals & Biotech.	high	14	1567	11196	4219	37978	10	11
SHIRE	52	UK	Pharmaceuticals & Biotech.	high	18	645	3578	1148	5000	13	14
LLOYDS BANKING	81	UK	Banks	low	1	327	22065	496	97869	27	7
VILMORIN	86	France	Food Producers	medium-low	20	289	1472	156	6079	21	14
HEXAGON	93	Sweden	Industrial Engineering	medium-high	11	274	2430	501	13931	27	11
RECKITT BENCKISER	103	UK	Household Goods & Home Constr.	medium-high	2	238	11992	2800	37100	16	11
ARM HOLDINGS	106	UK	Electronic & Electrical Equip.	medium-high	27	231	853	296	2598	12	14
WARTSILA	110	Finland	Industrial Engineering	medium-high	5	218	4654	497	18663	15	7
CHIESI FARMACEUTICI	120	Italy	Pharmaceuticals & Biotechnology	high	18	198	1107	182	3822	16	9
CLAAS	121	Germany	Industrial Engineering	medium-high	5	198	3825	326	9697	16	7

ELEKTA	176	Sweden	Health Care Equip.& Serv.	high	11	136	1207	186	3775	17	11
JOHN LEWIS	184	UK	General Retailers	medium-low	1	129	10780	564	86600	22	7
GRIFOLS	189	Spain	Pharmaceuticals & Biotechnology	high	4	122	2742	737	11779	85	21
PACE	215	UK	Technology Hardware & Equip.	high	6	101	1790	104	2051	16	25
KONE*	227	Finland	Industrial Engineering	medium-high	1	97	6933	954	43298	16	15
FRIESLANDCAMPINA INTERNATIONAL HOLDING*	263	The Netherlands	Food Producers	medium-low	2	77	5042	261	12542	15	4
PRYSMIAN*	274	Italy	Electronic & Electrical Equip.	medium-high	1	74	7273	366	19374	20	19
DYSON TECHNOLOGY	283	UK	General Industrials	medium-high	42	69	164	73	640	29	17
NORDEX	285	Germany	Alternative Energy	medium-low	5	68	1429	55	2592	35	19
ADVA	286	Germany	Technology Hardware & Equip.	high	21	66	311	7	1425	15	11
RENISHAW	306	UK	Electronic & Electrical Equip.	medium-high	14	57	414	98	3092	11	10
BTG	310	UK	Pharmaceuticals & Biotech.	high	16	57	347	49	776	23	22
AKKA TECHNOLOGIES	318	France	Support Services	medium-high	6	56	879	50	10784	37	25
KAPSCH TRAFFICCOM	320	Austria	Electronic & Electrical Equip.	medium-high	11	55	487	23	3308	18	18
MICRO FOCUS INTERNATIONAL	373	UK	Software & Computer Services	high	13	42	314	116	1219	13	12

Short name	EU Rank (2013)	Country	ICB sector	Sector group	RD int. 2013 (%)	RD 2013	Net Sales 2013	Operating Profits 2013	EMP 2013	Growth of RD [1]	Growth of Net Sales [1]
AVEVA	380	UK	Software & Computer Serv.	high	15	41	283	84	1432	11	16
KTM	406	Austria	Automobiles & Parts	medium-high	5	37	716	55	1808	23	8
F-SECURE	404	Finland	Software & Computer Serv.	high	24	37	155	27	939	12	11
MOLNLYCKE HEALTH CARE*	407	Sweden	Health Care Equipment & Services	high	4	36	901	212	454	22	5
UNIBET	424	Malta	Travel & Leisure	medium-high	12	35	280	54	882	40	21
TKH	431	The Netherlands	Electronic & Electrical Equip.	medium-high	3	34	1198	67	4802	25	10
OHB TECHNOLOGY*	452	Germany	Aerospace & Defence	high	5	31	680	36	2412	17	22
WEIR*	457	UK	Industrial Engineering	medium-high	1	30	2901	590	13750	22	14
MORPHOSYS	479	Germany	Pharmaceuticals & Biotech.	high	36	28	78	10	299	11	11
VISTAPRINT	491	The Netherlands	Support Services	medium-high	3	26	921	62	5000	31	27
MEDIVIR	494	Sweden	Pharmaceuticals & Biotech.	high	51	26	50	3	153	10	18
EVS BROADCAST EQUIPMENT	538	Belgium	Electronic & Electrical Equip.	medium-high	18	23	129	49	471	23	11
INTRALOT*	589	Greece	Technology Hardware & Equip.	high	1	18	1539	103	709	20	13
BASWARE	585	Finland	Software & Computer Serv.	high	15	18	123	3		14	14
ADVANCED BUSINESS SOFTWARE AND SOLUTIONS	691	UK	Software & Computer Serv.	high	14	13	95	13	653	21	13
GENTIUM	695	Italy	Pharmaceuticals & Biotech.	high	32	13	40	7	76	14	26

BETSSON	764	Sweden	Travel & Leisure	medium-high	4	10	280	68	789	42	21
NEXUS	784	Germany	Software & Computer Serv.	high	14	10	73	7	644	14	16
FIRST SENSOR*	880	Germany	Electronic & Electrical Equip.	medium-high	7	8	109	3	698	30	24
INNOVIA GROUP*	916	UK	Chemicals	medium-high	2	7	402	27	1346	26	22
VITROLIFE	927	Sweden	Health Care Equipment & Serv.	high	13	7	51	9	240	18	17
SCHOELLER BLECKMANN OILFIELD EQUIPMENT*	975	Austria	Industrial Engineering	medium-high	1	6	459	92	1564	33	12
NETGEM	999	France	Media	medium-low	6	5	81	9	195	17	19

Notes: companies are ranked according to their R&D investments in 2013 – Except the growth indicators and ranks, all variables are expressed in million euros.

[1] The compound annual growth of R&D (CAGr) and the average annual growth of Net sales are computed for the period 2005-2013. R&D investors marked with (*) are the firms identified from the second set of criteria of scenario 1.*

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

4.4 Overview of the corporate characteristics of the high-performing R&D-driven innovators.

This section outlines the characteristics of the 66 companies identified in the previous section as the high-performing R&D-driven innovators. These companies all have an R&D intensity above 1%, a compound annual R&D growth above 10% on the period 2005-2013, positive net sales growth and operating profits in 2013.

A first observation is that the country and sector distributions are quite similar to those of the 459 firms listed from the first step (i.e. R&D intensity above 1% and positive R&D growth). Indeed both in terms of countries and sectors, our 'usual suspects' are well featured in this restricted sample, although some noticeable variations may be observed. The UK with about one third of the 66 companies is still leading the group in terms of number of companies, while Germany remains second but with a lesser proportion of companies, about one fifth of the companies (as compared to about one quarter each in the 459 firms sample). Sweden is now more represented than France in the high-performing R&D-driven innovators group (respectively 12 and 9% of companies).

In terms of sectoral representativeness, the same concentration in high- and medium-high tech firms shows up in the 66 firms listed; they represent about 90% of the total number of companies. Within the high tech group of firms, Biopharma and Software industries feature prominently while Electronic & Electrical Equipment and Industrial engineering are again dominant in the medium high tech group of firms. Although with different rankings, these four industries were already prevailing in the first step.

Within the group of 66 companies some EU R&D driven innovators, mostly from the biopharma and ICT-related industries, comply with both the criteria considered for the first step of scenario 1 and those selected for the scenario 2 (18 underlined in blue in table 4.3).

Eight outstanding companies that are worth noticing include *Dialog Semiconductor, Gameloft, Bavarian Nordic, Wirecard, Parrot, Playtech, HMS Networks and Generix* (marked with a star and underlined in blue in the table 4.3). They record particularly strong R&D intensity (above 10%), positive profits in 2013 and well above sectoral R&D growth, net sales growth and labour productivity average. They are in general young firms founded or established between the end of the eighties and the end of the nineties and mostly, but not exclusively, include firms from the high tech sectors (ICT-related sectors, in particular, Technology Hardware & Equipment and Software and Computer Services). Importantly in this group the corporate acquisitions constitute one of the key dimensions of the growth strategy. Furthermore the maximum values for the R&D growth are observed in this group, which also presents the higher growth rate in average.

Of the 23 new entities identified only on the basis of the scenario 2 (where industry-specific values are not considered), more than one third of the firms are from the UK, followed by Sweden having 3 out of its 4 companies in health-biopharma industries. The other countries, but Finland with two software companies, only have one company represented each, including Austria, Belgium, Denmark France, Italy and Malta. These 23 new companies contain a number of world class EU R&D companies that have global market positions. Few of them illustrating the diversity of activities amongst successful and innovative EU firms, include:

- Companies operating in ICT-related industries such as ARM in low power consumption chip for smartphones and digital cameras; AVEVA in 3D engineering design software for complex structures such as oil & gas rigs, power stations and ships;

- Companies in biopharma industries as for instance MorphoSys (therapeutic antibodies), Novo Nordisk (treatments for diabetes) and Shire (treatments for rare diseases and other specialised conditions) and;

- Companies in medical instruments as Elekta (radiotherapy systems), in general industrials as Dyson (bagless vacuum cleaner, innovative fans, heaters, hand driers, lighting and tools) and more diversified companies such as Renishaw, which has products in precision metrology, precision healthcare and additive manufacturing (3D printing in metals) and serves a wide range of industries from jet engine and wind turbine manufacture to dentistry band brain surgery.

5 Location of companies' economic and innovation activities

It is crucial for policy makers to understand better the actual geographic distribution of companies' activities to improve the effectiveness of policies aimed to support specific industries. Currently, the *Scoreboard* allocates companies to the countries where they have their headquarters (HQ); however, companies often operate in several countries and may have diverse locations for their decision, production and innovation centres. Different location choices -due to market strategies, optimisation of costs or fiscal purposes- have important policy implications and affect the analysis of economic and R&D trends of companies aggregated by country and region.

The objective of this chapter is to improve the characterisation of companies regarding the location of their economic and innovation activities in order to obtain a first estimate of the actual distribution of jobs, value-added and knowledge across countries and regions.

First, an overview of the location of companies' activities is presented, showing the worldwide distribution of their subsidiaries. Then a pilot exercise is carried out for a representative sample, using information from the annual reports and accounts of parent companies and their subsidiaries. Finally, the location of the innovation is estimated by analysing the patent portfolio of the whole *Scoreboard* sample, focusing on the international location of companies' affiliated inventors.

Key findings

- A number of companies do not show any activity in their headquarter country. These are mainly companies from the Cayman Islands and Bermuda (94) that have been reassigned to China (80), US (7), Taiwan (5) and Singapore (2), where they have their main economic centres.

- The country distribution of patents filed by a company's subsidiaries offer a good proxy for the location of companies' innovation activity. This analysis shows that 80% of patents were developed by inventors residing in the same world region as the HQ of the parent company that owns the rights.

- Patent analysis for the Pharmaceuticals & Biotechnology sector shows the US lead in this sector: 81.2% of patents by US companies are nationally developed and it is the preferred location to develop international inventions by all other world regions (21.6% of patents by EU companies and 43.7% by Swiss companies).

- Patent analysis for the Automobiles & Parts sector shows that companies based in Japan and the EU hold 77% of patent families in the sector. The EU is particularly attractive for the development of inventions by the other regions (28.1% of patents by US companies) and almost 85 % of patents by EU companies are domestically developed.

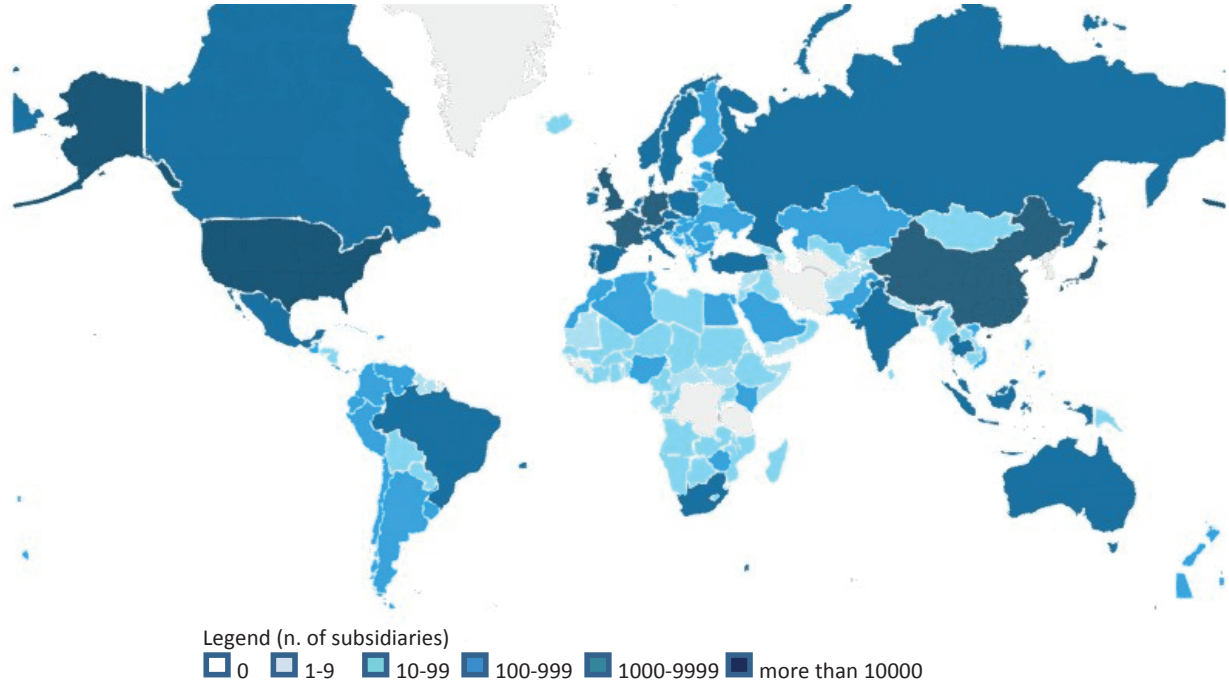
5.1 Introduction

Preliminary information on the location of companies' activities is provided by examining the geographic distribution of the subsidiaries of the *Scoreboard* companies. We retrieved information on the ownership structure for 2255 companies (out of the 2500 *Scoreboard* sample), accounting for 271533 subsidiaries scattered around the world (excluding branches[13]).

A total of 215 countries and independent territories host at least one subsidiary of a *Scoreboard* company (figure 5.1).

13 The very high number of branches in the sample hides an extremely skewed distribution across companies, providing unreliable figures on the network size of some company. Moreover, there are large country and industry differences in the share of branches. For these reasons we decided to drop branches from the analysis.

Fig 5.1 - Subsidiaries (both national and international) by country of destination.



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

We split the group of subsidiaries between international (i.e. located in a country different from the HQ) and national (i.e. located in the same country as the HQ). In the sample, 177443 (64.3%) subsidiaries are international, 94090 are national (see Table 5.1).

The country where the majority of the international subsidiaries are located is the US, followed by the UK and China. The ratio between international and national subsidiaries is higher in countries where less *Scoreboard* company HQs are located.

Figure 5.2 looks at the number of *Scoreboard* companies present in a country, either through their HQ or by means of at least one of their subsidiaries, while table 5.2 focuses on the top 20 countries by presence of *Scoreboard* companies

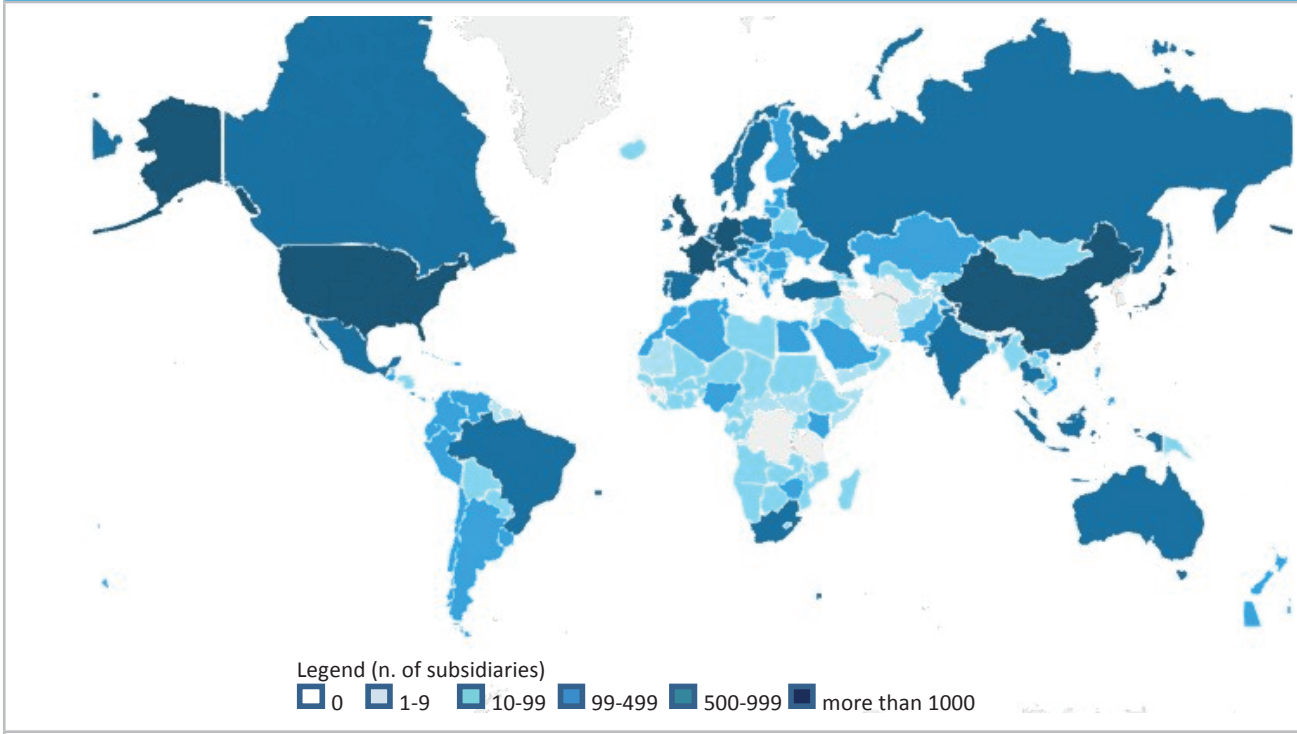
There are countries where the *Scoreboard* companies are much more present than looking just at the HQ location would suggest. Apart from the extreme cases of countries hosting only one *Scoreboard* company HQ, we have countries like Spain, Belgium or Italy that experience a very consistent presence of *Scoreboard* companies inside their boarders even if the number of HQs located there is relatively low.

Table 5.1 - international vs national subsidiaries by country of destination (top 20 countries).

Country	n. of international subsidiaries by country of destination	n. of national subsidiaries in the country	ratio (international over national subsidiaries)
US	38578	39538	0.98
UK	15435	7312	2.11
China	10307	6504	1.58
Germany	8688	7294	1.19
Japan	1924	11361	0.17
France	5360	7196	0.74
Netherlands	6390	1147	5.57
Canada	6655	282	23.6
Australia	5049	1340	3.77
Spain	3672	2290	1.6
Italy	3560	1634	2.18
Mexico	3896	38	102.53
Brazil	3364	262	12.84
Russian Federation	2036	1267	1.61
Sweden	2243	1060	2.12
India	2400	401	5.99
Switzerland	2268	530	4.28
Singapore	2760	38	72.63
Ireland	2411	334	7.22
Malaysia	1661	660	2.52
Other countries (185)	48786	3602	13.54
Total	**177443**	**94090**	**1.89**

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Fig 5.2 - *Scoreboard* companies presence (both through their HQ or at least one subsidiary).



Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 5.2 – Number of *Scoreboard* companies presented via HQ or subsidiaries by country of HQ (top 20 countries).

Country	n. of SB companies with HQ located in the country	n. of SB companies present in the country through their subsidiaries	ratio (SB presence through subsidiaries over SB presence through HQ)
UK	124	1567	12.6
China	270	1398	5.2
Germany	126	1301	10.3
US	733	1255	1.7
Canada	24	1130	47.1
Netherlands	38	1126	29.6
Singapore	5	1119	223.8
France	82	1088	13.3
Brazil	9	1033	114.8
India	24	1008	42
Italy	26	984	37.8
Australia	16	967	60.4
Spain	16	932	58.3
Japan	351	919	2.6
Mexico	1	908	908
Switzerland	51	765	15
South Korea	60	755	12.6
Belgium	16	719	44.9
Russian Federation	3	694	231.3
Sweden	41	693	16.9

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

This shows the widespread geographic distribution of companies' activities and confirms that allocating the whole company activity to the HQ location significantly underestimates the effects of cross-border activities. However, in a globalised world a successful company needs to have a substantial presence in all the main world regions. Furthermore, some R&D needs to be located in each region to ensure that new products take into account the special needs of each region. Therefore, this complexity needs to be taken account of when analysing the economic and R&D trends of groups of companies aggregated by country and world region. For example, a European or Asian biopharma company is likely to be less successful if it has no R&D located in the US which is the most important drug market in the world with the highest concentration of biopharma R&D. An important benefit of the country and regional analyses presented in the *Scoreboard* is the way they show how particular countries and regions excel in particular sectors.

5.2 Pilot analysis on a selected sample of companies

A pilot exercise was carried out to test the feasibility of assessing the worldwide distribution of companies' activities and in particular of identifying and distinguishing the actual location of their economic and innovation activities. A sample of 100 companies has been selected according to their relevance in terms of R&D investment, type of industry (key manufacturing sectors) and country of legal head office.

The latter criterion focussed on countries where the total R&D of the *Scoreboard* companies largely exceeds the country's official business enterprise R&D, thus indicating that the R&D is most likely performed in another country (see company sample aggregated by country in Table 5.3).

These companies have been examined one by one using all available information from public sources for the parent company and for their subsidiaries. The data at the parent company level comes from the consolidated report comprising main economic and financial indicators, the international distribution of assets and sales, address of trading office, number of patents, etc. In a second step, the analysis included the information on ownership structure of the parent companies and available data on their subsidiaries such as the number of subsidiaries per country, turnover, employees, assets and patents.

Table 5.3 - Sample of companies for testing actual location of activities.

Country (headquarter)*	# companies analysed	# companies showing headquarter different from trading address**
The Netherlands	31	6
Cayman Islands	18	18
Bermuda	17	17
Luxembourg	11	4
Ireland	5	3
UK	4	2
Hong Kong	4	1
Singapore	3	0
France	2	0
Germany	2	0
Liechtenstein	1	0
Japan	1	0
Switzerland	1	0

*Notes: * Country where the company has its registered office.*
*** Country where the company carries out its business and where the company`s assets are likely to be found.*
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The combination of all available data for these companies show interesting insights on the actual location of their economic and innovation activities and a great variety of cases. The main conclusions on the pilot exercise are as follows:

- There are a number of companies that show no economic and innovation activity in the country of their registered office (headquarters). These are mainly the companies based in Cayman Islands and Bermuda. The extension of the analysis to the whole sample of *Scoreboard* companies from these countries confirms this finding and allows the reassignment of these companies to the countries where they have the main economic centre. The 94 companies from Cayman Islands and Bermuda in this year's *Scoreboard* have been reassigned to China (80), US (7), Taiwan (5) and Singapore (2).

- Some companies that are highly distributed worldwide show a weak relationship between their main economic and innovation centres and headquarters but there is not enough or conclusive information to reassign them to a single country.

- There are cases where a company has intentionally moved its HQ for tax reasons. Apart from the Cayman Islands and Bermuda, this is the case for several US companies which have moved their HQs to Ireland. The most recent large example is Medtronic, the world's largest R&D investor in the health equipment sector, which has just acquired Covidien and the HQ of the combined company is now in Ireland although both companies have most of their innovation and much of their production activities in the US.

- A clear difference between the economic and innovation centres is showed by other companies, in particular in the manufacturing sector. It appears that innovation (measured by patents) is performed in the home country or region whereas the production is carried out abroad, often in countries where labour costs are lower.

- The results show a general estimate of the location of companies' economic activity in terms of jobs and value-added, however a precise calculation is not possible due to the lack of information. For example the number of employees is often missing for the subsidiaries and even for the parent company. Another limitation is the insufficient information provided by companies to distinguish the type of activity carried out by the subsidiaries, e.g. production, distribution, financing, etc.

- The country distribution of patents filed by the subsidiaries seems to be a good proxy to estimate the international location of companies' innovation activity. This is shown in the next section where the analysis is extrapolated to the whole sample of companies in the *Scoreboard*.

- The results of this exercise suggest that it is possible to extend the approach to analyse value-chains, e.g. incorporating data from companies in the supply chain.

5.3 Patent analysis to assess companies' major innovation location

This section focuses on the international dimension of innovative activities. In particular, information on the location of inventors and owners, as reported in patent documents, is used as a proxy for the localization of the R&D activities of *Scoreboard* companies. In particular, patents are defined as international when the location of the inventors differs from that of the *Scoreboard* company legally owning the intellectual property rights. In the cases of multi-inventors from multiple countries, fractional counts of the same patent between the different countries are applied.[14] Finally, in order to control for the multiple filing of the same invention, different patent applications have been matched through INPADOC families[15] to avoid double counting. An extensive analysis of the innovation activities of the world's top corporate R&D investors can be found in Dernis et al. (2015).

The analysis is carried out using the sample of top 2000 R&D investors worldwide as reported in the 2014 edition of the *Scoreboard*. The patents filed by these companies at the European Patent Office (EPO) and the US Patent Office (USPTO) over the period 2010-2012 have been retrieved from the PATSTAT[16] database in the framework of a JRC-OECD joint project. The matching has been carried out on a by-country basis using a series of string matching algorithms contained in the Imalinker system (Idener Multi Algorithm Linker) developed for the OECD by IDENER, Seville, 2013. [17]

The first section presents a general overview of the patenting activities of *Scoreboard* companies and their distribution across main world regions (according to the total patents filed and the two patent offices considered). The "Automobiles and Parts", "Pharmaceuticals" and "Biotechnology" sectors are further studied. For these sectors, the geographical distribution of the patenting activities for the top 20 companies in terms of R&D investment is also presented.

14 See Dernis et al. (2001) for a more in depth description of the methodology used.

15 See definition at: http://www.epo.org/searching/essentials/patent-families/inpadoc.html

16 PATSTAT is the European Patent Office's Worldwide Patent Statistical Database which contains data about 70 million applications of more than 80 countries. See more details at http://www.epo.org.

17 For a description of Imalinker, see http://www.idener.es/?portfolio=imalinker.

5.3.1 Distribution of patents by world region

The analysis of the 510,250 patent families that were filed during the period under study shows that 80% were developed by inventors residing in the same world region as the company legally owning the rights. The remaining 20% were developed by inventors residing in a different region.

As reported in table 5.4, the recourse to international development of inventions varies across regions.

Table 5.4 - Mapping the international location of patenting activities.

		Inventor location					
		EU	**USA**	**Japan**	**Asian Tigers**	**Switzerland**	**RoW**
Company's headquarter location	EU *(102,714)*	73.9%	18.9%	0.8%	0.8%	1.0%	4.6%
	USA *(171,699)*	10.3%	77.9%	1.5%	1.5%	0.7%	8.1%
	Japan *(145,618)*	2.5%	5.0%	91.4%	0.3%	0.05%	0.8%
	Asian Tigers *(61,065)*	0.7%	3.8%	0.5%	85.0%	0.01%	9.9%
	Switzerland *(10,483)*	37.6%	31.5%	1.4%	0.3%	24.9%	4.3%
	RoW *(18,670)*	8.9%	21.4%	0.4%	3.3%	0.6%	65.4%

Note: Patent families are fractional counted in case of multiple inventors and/or multiple applicants. RoW does not include the Asian Tigers and Switzerland as in other parts of the present report.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Japan based companies are by far the least internationalised, with less than 10% of patent families developed outside Japan. On the other side of the spectrum, Switzerland based companies develop the vast majority (75%) of their patent families abroad, and in particular in the EU (37.6%) and in the US (31.5%). The development of patent families in the US is largely due to the massive R&D facilities Novartis and Roche have there (reflected by their patenting activity, see table 5.6).

EU and US based companies appear to be more internationalized than the sample average with 73.9% and 77.9% of their patent families developed within their respective region. However, while 18.9% of EU owned patent families are developed by inventors residing in the US, EU developed patent families represent 10.3% of the total US owned ones. It is worth noting, that if the total number of patent families is considered, the difference between these two 'flows' in not very important (19,443 EU -> US; 17,651 US -> EU).

Overall, the US appears to be the most attractive region of the world for the R&D investment of the top R&D investors worldwide.

5.3.2 Distribution of patents by economic area: pharma and biotech sector

Firms in the "Pharmaceuticals and Biotechnology" sector have filed 20,352 patent families over the period under study. The ratio of patent families with inventors residing in the same world region with the applicant is 65%: lower than the average of the total sample (80%). Thus, R&D activities of firms in this sector look more internationalised than the activities of firms in other sectors. Some Japanese biopharma companies do take the alternative route of licensing/jointly developing with US companies.

In Table 5.5 the distribution of patent families across different world regions based on "applicant " and "inventor" information retrieved from filings by firms in the "Pharma & Biotech" sector is presented.

Table 5.5 - Mapping the international location of patenting activities (Pharmaceuticals & Biotech).

		Inventor location				
		EU	USA	Japan	RoW	Switzerland
Company's headquarter location	EU *(6,635)*	72.2%	21.6%	1.3%	3.9%	1.0%
	USA *(8,619)*	10.3%	81.2%	1.7%	5.0%	1.8%
	Japan *(1,342)*	5.8%	18.5%	67.8%	7.7%	0.21%
	RoW *(860)*	18.1%	30.5%	0.1%	50.3%	1.12%
	Switzerland *(2,897)*	31.0%	43.7%	2.6%	3.8%	18.8%

Note: Patent families are fractional counted in case of multiple inventors and/or multiple applicants. RoW does not include Switzerland as in other parts of the present report.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Figure 5.5 shows that the higher internationalisation of the "Pharma & Biotech" sector is due to Japan and Switzerland based companies. In particular, Switzerland based companies, which hold an important share of patent families in this sector (14%), have a rather low proportion of nationally developed inventions (less than 1 in 5). The share of US based inventors in patent families owned by Switzerland based companies is particularly high (almost 44 %) followed by EU with 31%.

US and EU based companies hold 75% of patent families in the sector. In both cases the share of patent families with inventors and applicants residing in the same world region are similar to the overall figures. In the case of US based companies the proportion of patent families that have been nationally developed is slightly higher than the average (81.2%).

In the "Pharma & Biotech" sector US appear particularly attractive. Indeed US is the preferred location to develop international inventions by all other world regions (followed by the EU). This is due to the importance of "Pharma & Biotech" companies having US R&D sites in the world's largest drugs market by value. Roche's ownership of Genentech (a very innovative US biotech company) is just one example. The US has four advantages as a location – it accounts for roughly half the world's drug market by value, almost all the major "Pharma & Biotech" companies have R&D based there, it is home to a large number of small and mid-sized biotech companies (often attractive acquisition targets) and has the availability of a large number of highly skilled people.

In tables 5.6 and 5.7 the three most important countries, in terms of residence of inventors, for the Top 20 R&D investors in the "Pharma & Biotech" sector are shown. In both tables companies are ranked according to their R&D investments.

The distribution of inventors for companies in the Pharmaceutical sector is more similar to the overall picture than those operating in the Biotechnology one. A high proportion of US based inventors is the common pattern shown by companies operating in the two sub-sectors. In particular, patent families filed by Pharmaceuticals companies based in Switzerland and UK are mostly developed by US based inventors.

Table 5.6 - First three countries of inventor location for the Top 20 Pharmaceuticals companies.

			First Inventor country (2010-2012)		Second Inventor country (2010-2012)		Third Inventor country (2010-2012)	
Company (n. of patent)	Country	R&D (2012)	Country	%	Country	%	Country	%
ROCHE (1667)	CH	7008	US	39.5	DE	27.0	CH	19.6
NOVARTIS (1165.75)	CH	6923	US	51.8	CH	13.5	DE	13.3
MERCK US (739)	US	5996	US	74.7	NL	8.1	CA	2.9
JOHNSON & JOHNSON (2046)	US	5809	US	71.5	CH	5.9	IL	4.7
PFIZER (386)	US	5740	US	84.2	GB	8.5	DE	1.2
SANOFI-AVENTIS (1171.583)	FR	4909	DE	31.0	FR	25.0	GB	22.9
GLAXOSMITHKLINE (431)	GB	4229	US	42.1	GB	31.4	BE	11.8
ELI LILLY (134.6667)	US	4000	US	85.1	ES	5.1	GB	2.5
ASTRAZENECA (346)	GB	3375	US	45.8	GB	27.3	SE	17.2
ABBOTT LABORATORIES (1271.5)	US	3276	US	84.6	DE	4.5	NL	2.3
BAYER (1684.833)	DE	3182	DE	64.7	US	19.7	FR	4.9
BRISTOL-MYERS SQUIBB (311)	US	2851	US	94.6	CA	2.0	IN	1.6
TAKEDA PHARMACEUTICAL (305.5)	JP	2840	JP	46.7	US	36.4	DE	8.0
BOEHRINGER INGELHEIM (497.5)	DE	2795	DE	60.3	US	20.7	AT	5.7
OTSUKA (45.5)	JP	1685	JP	64.8	CN	17.6	DE	8.8
DAIICHI SANKYO (214)	JP	1603	JP	50.2	IN	37.9	US	10.5
ASTELLAS PHARMA (130.8333)	JP	1593	JP	61.0	US	29.6	GB	3.8
MERCK DE (709.8333)	DE	1511	DE	54.8	US	15.8	GB	8.1
NOVO NORDISK (188)	DK	1397	DK	86.5	SE	5.5	US	2.6
EISAI (108.5)	JP	1054	JP	52.2	US	41.6	GB	4.9

Notes: To facilitate comparisons between companies the length of bars is calculated column wise.
Patent families are fractional counted in case of multiple inventors and/or multiple applicants.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Table 5.7 - First three countries of inventor location for the Top 20 Biotechnology companies.

			First Inventor country (2010-2012)		Second Inventor country (2010-2012)		Third Inventor country (2010-2012)	
Company (n. of patent)	Country	R&D (2012)	Country	%	Country	%	Country	%
AMGEN (237)	US	2562	US	92.1	CA	2.2	DE	1.7
GILEAD SCIENCES (150.25)	US	1334	US	90.9	CA	4.3	BE	0.7
CELGENE (140)	US	1206	US	92.4	GB	1.3	CN	1.1
BIOGEN IDEC (86.5)	US	1012	US	91.5	GB	3.1	CH	2.9
VERTEX PHARMACEUTICALS (241.8333)	US	572	US	66.1	GB	24.1	CA	6.0
CSL (34)	AU	280	AU	35.3	DE	23.5	US	19.1
LIFE TECHNOLOGIES (456.8333)	US	259	US	88.6	DE	2.3	IE	1.6
BIOMARIN PHARMACEUTICAL (29)	US	229	US	85.6	CN	8.0	HK	4.6
BIOMERIEUX (122)	FR	219	FR	68.9	US	18.3	GB	3.7
NOVOZYMES (381.5)	DK	194	DK	47.2	US	31.6	CN	6.4
ILLUMINA (88.5)	US	175	US	83.1	IS	6.8	GB	6.2
ALEXION PHARMACEUTICALS (23)	US	163	US	80.4	CA	10.9	GB	3.3
UNITED THERAPEUTICS (20)	US	131	US	77.5	GB	17.5	DE	5.0
SEATTLE GENETICS (29)	US	129	US	80.2	DE	9.5	GB	8.6
NEKTAR THERAPEUTICS (61)	US	118	US	86.1	GB	8.2	CN	4.9
ALKERMES (16.5)	IE	101	US	97.0	IT	3.0		
REGENERON PHARMACEUTICALS (58.5)	US	100	US	95.3	AU	2.6	CH	1.7
EXELIXIS (47.5)	US	98	US	90.7	GB	4.2	CN	1.1
CUBIST PHARMACEUTICALS (27)	US	96	US	93.8	CH	3.1	IT	1.9
QIAGEN (99)	NL	93	DE	75.8	US	8.6	AU	7.1

Notes: To facilitate comparisons between companies the length of bars is calculated column wise.
Patent families are fractional counted in case of multiple inventors and/or multiple applicants. Companies' names are as reported in 2013 (Biogen has recently dropped Idec from its name).
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Biotechnology companies, mainly locate in the US with 80% of the companies in table 5.7 having their first inventor in the US and the four largest having over 90% of inventors based in the US. And most of the others have very significant R&D in the US. The US appears to be particularly attractive, not only for the development of Biotechnology innovations, but also for the location of companies in this sector. This is partly because of the large size of the US drug market, the many biotech start-ups there (where availability of finance and ease of company formation act as attraction factors) and the ready availability of skills.

5.3.3 Distribution of patents by economic area: automobile & parts sector

Firms in the "Automobiles & Parts" sector have filed 41,927 patent families between 2010 and 2012. The proportion of patent families with inventors residing in the same world region with the applicant is about 84%, somewhat higher than the average.

In Table 5.8 the distribution of patent families across different world regions based on "applicant " and "inventor" information retrieved from filings by firms in the "Automobile & Parts" sector is presented.

Table 5.8 - Mapping the international location of patenting activities (Automobiles and Parts).

		Inventor location				
		EU	**USA**	**Japan**	**Asian Tigers**	**RoW**
Company's headquarter location	EU *(14,609)*	84.9%	10.6%	1.2%	0.9%	2.4%
	USA *(7,172)*	28.1%	65.8%	0.8%	0.4%	4.8%
	Japan *(17,508)*	1.6%	7.8%	89.9%	0.0%	0.58%
	Asian Tigers *(2,520)*	0.2%	0.8%	0.4%	97.0%	1.54%
	RoW *(118)*	71.4%	5.3%			23.3%

Note: Patent families are fractional counted in case of multiple inventors and/or multiple applicants. RoW does not include the Asian Tigers and Switzerland as in other parts of the present report.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

The behaviour of Japanese and US based companies is the opposite of what is observed in the Pharmaceutical & Biotech sector. On the one hand, the innovation activities of Japanese companies operating in the Automobile and Parts sector appear to be rather highly concentrated in Japan. On the other hand, US companies present a high degree of internationalization with almost 30% of patent families developed by EU based inventors. Japan and EU based companies hold 77% of patent families in the sector. But while for Japanese companies the share of patent families with national inventors is similar to the overall figure, in the case of EU based companies a higher than the average share of inventors residing in the EU is observed (almost 85%).

In table 5.9 the three most important countries, in terms of residence of inventors, for the Top 20 R&D investors in the Automobile and Parts sector are shown, companies are ranked according to their R&D investments.

Most of the top R&D investors operating in the Automobile and Parts sector tend to develop their technologies "in-house". Indeed, in most cases the headquarter is also the place where the majority of technologies are developed. Exceptions are represented by Fiat (due to the acquisition of Chrysler), Tata Motors (due to the acquisition of Jaguar/Land Rover) and Delphi (which started off as the parts arm of GM).

Table 5.9 - First three countries of inventor location for the Top 20 Automobile & Parts companies.

			First Inventor country (2010-2012)		Second Inventor country (2010-2012)		Third Inventor country (2010-2012)	
Company (n. of patent)	Country	R&D (2012)	Country	%	Country	%	Country	%
VOLKSWAGEN (1731)	DE	9515	DE	74.3	SE	17.0	CZ	2.7
TOYOTA MOTOR (4063)	JP	7071	JP	87.1	US	11.4	CA	0.7
DAIMLER (358)	DE	5639	DE	89.2	US	6.2	CA	3.0
GENERAL MOTORS (4546)	US	5584	US	76.5	DE	14.5	IT	2.1
ROBERT BOSCH (4883)	DE	4924	DE	73.4	US	10.7	FR	2.2
HONDA MOTOR (3034)	JP	4906	JP	81.8	US	15.7	DE	1.6
FORD MOTOR (144)	US	4169	US	66.9	DE	14.2	CA	7.6
NISSAN MOTOR (876)	JP	4115	JP	92.6	GB	4.4	ES	1.0
BMW (516)	DE	3952	DE	93.7	AT	3.2	US	1.7
FIAT (445)	IT	3295	US	39.5	IT	34.0	DE	22.0
DENSO (2673)	JP	2938	JP	95.6	US	3.5	IT	0.4
PEUGEOT (PSA) (843)	FR	2481	FR	82.2	DE	8.5	US	7.3
RENAULT (350)	FR	1889	FR	98.5	ES	0.9	CH	0.1
CONTINENTAL (1078)	DE	1827	DE	61.9	US	18.0	IT	6.9
TATA MOTORS (80)	IN	1496	GB	86.3	IN	6.3	US	5.9
AISIN SEIKI (1231)	JP	1183	JP	93.9	US	4.9	FR	0.4
SUZUKI MOTOR (268)	JP	1044	JP	99.6	GB	0.4		
HYUNDAI MOTOR (1575)	KR	934	KR	98.6	US	0.7	JP	0.4
DELPHI (523)	GB	910	US	67.0	DE	9.6	FR	9.4
ZF (605)	DE	848	DE	93.8	IT	2.4	US	1.2

Notes: To facilitate comparisons between companies the length of bars is calculated column wise.
Patent families are fractional counted in case of multiple inventors and/or multiple applicants.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

6 Extended sample of R&D investors in the EU

This chapter discusses the R&D and economic trends of companies based in Members States of the EU. This specific analysis is based on an extended sample of companies representing the top 1000 R&D investors in the EU, i.e. the 608 EU companies included in the world top 2500 sample and 392 additional companies based in the EU. The main questions addressed are firstly about the 2014 changes in R&D and economic indicators for companies based in the top 10 Member States by level of R&D investment. Secondly, the long-term trends of company results, such as the rate of growth of R&D and net sales and profitability for companies based in the top three Member States of the EU are examined.

The final section presents the results of an exercise aiming to improve the coverage of R&D investing companies in the EU and particularly in currently under-represented Member States.

Key findings

- Companies based in Germany, the top R&D investor, continued to increase R&D in 2014, at 6.3%, well above the EU average (3.3%). Companies based in the UK and France showed a modest increase of R&D (1.0% and 0.5% respectively).

- Apart from the three top Member States, among the group of 10 EU countries with most R&D companies, those based in Ireland showed the highest R&D increase (15.7%), most of it due to companies such as Allergan, Medtronic, Alkermes and Seagate Technology[18]. Other countries whose firms increased R&D above the EU average were Denmark (8.8%), Sweden (8.7%) and Spain (7.1%). Companies based in Finland decreased R&D by 15.7% (largely due to Nokia's R&D contraction, -21.4%) and those based in The Netherlands kept the same level of R&D.

- The analysis of long-term trends of R&D and economic performance for companies based in Germany, the UK and France show the effects of the financial crisis of 2008-2009 and the subsequent recovery over 2010-2012, especially for the German companies. Thereafter, the three countries show uneven trends, in 2013, the recovery slowed down with companies from the three countries showing a fall in net sales and also R&D for companies based in France. Over the last period, companies based in Germany recovered both R&D and net sales while those based in France and the UK continued to show poor results, especially in terms of net sales. The latter is mostly due to the results of large companies in terms of sales but with relatively small R&D, e.g. oil companies (Total, Shell, ENI) due to the sharply falling oil price, miners due to falling commodity prices due to the slowdown in China and banks partly because of stricter regulatory requirements following the financial crisis.

- An exercise aimed to identify further R&D investing companies in the EU found a quite limited number of companies. This is due mainly to data availability, i.e. R&D figures need to be reported in companies' annual reports and audited accounts in order to apply the *Scoreboard* methodology. A different approach could be followed, for example, based on ad-hoc surveys or questionnaires to give an indication of companies having so far unrecorded R&D (though this would not give data of the quality required for the *Scoreboard*). A long term solution needs all countries to require compulsory disclosure of R&D in company reports.

18 Companies headquartered in Ireland but with main operational centers in the US.

6.1 Overview of the EU 1000 companies

The composition of the sample of the EU 1000 companies across industrial sectors and countries is found in Annex 3. This sample, as well as the global 2500, shows a high concentration of companies by sector and country. The 12 largest sectors in terms of R&D account for 68% of the companies. These sectors and the top 5 countries in terms of number of companies are shown in Table 6.1. The UK has the most companies in the high tech sectors like biopharma and ICT while Germany has the most in medium tech sectors like automotive and engineering.

Table 6.1 – Distribution of the EU 1000 companies across main sectors and countries.

Top 12 industries by R&D (ICB 3d)	R&D 2014 (€m)	# companies	Top 5 countries by number of companies				
Automobiles & Parts	44 861.7	47	DE (16)	UK (10)	FR (6)	IT (5)	AT (4)
Pharmaceuticals & Biotechnology	31 909.6	122	UK (36)	FR (19)	DE (13)	DK (10)	SE (9)
Technology Hardware & Equipment	15 168.4	50	UK (16)	FR (7)	NL (7)	DE (6)	SE (6)
Aerospace & Defence	9 949.0	25	UK (9)	FR (7)	DE (2)	IT (2)	BE (1)
Electronic & Electrical Equipment	9 167.1	68	UK (18)	DE (14)	FR (8)	FI (5)	NL (5)
Industrial Engineering	9 139.4	101	DE (37)	UK (12)	SE (10)	IT (8)	FI (7)
Banks	7 617.9	27	DE (5)	UK (4)	BE (2)	DK (2)	IE (2)
Software & Computer Services	7 206.0	112	UK (49)	DE (20)	FR (16)	SE (8)	FI (5)
Chemicals	5 235.3	42	DE (13)	UK (11)	BE (3)	FI (3)	SE (3)
Fixed Line Telecommunications	4 285.6	11	AT (1)	BE (1)	DK (1)	FR (1)	DE (1)
Health Care Equipment & Services	3 923.0	37	DE (11)	UK (11)	SE (4)	FR (3)	BE (2)
General Industrials	3 656.5	37	DE (12)	UK (9)	SE (5)	LU (2)	NL (2)
All 41 industries	**174 962.0**	**1000**	**UK (268)**	**DE (214)**	**FR (116)**	**SE (80)**	**NL (50)**

Note: figures displayed refer to the sample of the EU1000 companies.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Trends in the sector distribution of the R&D investments in the EU 1000

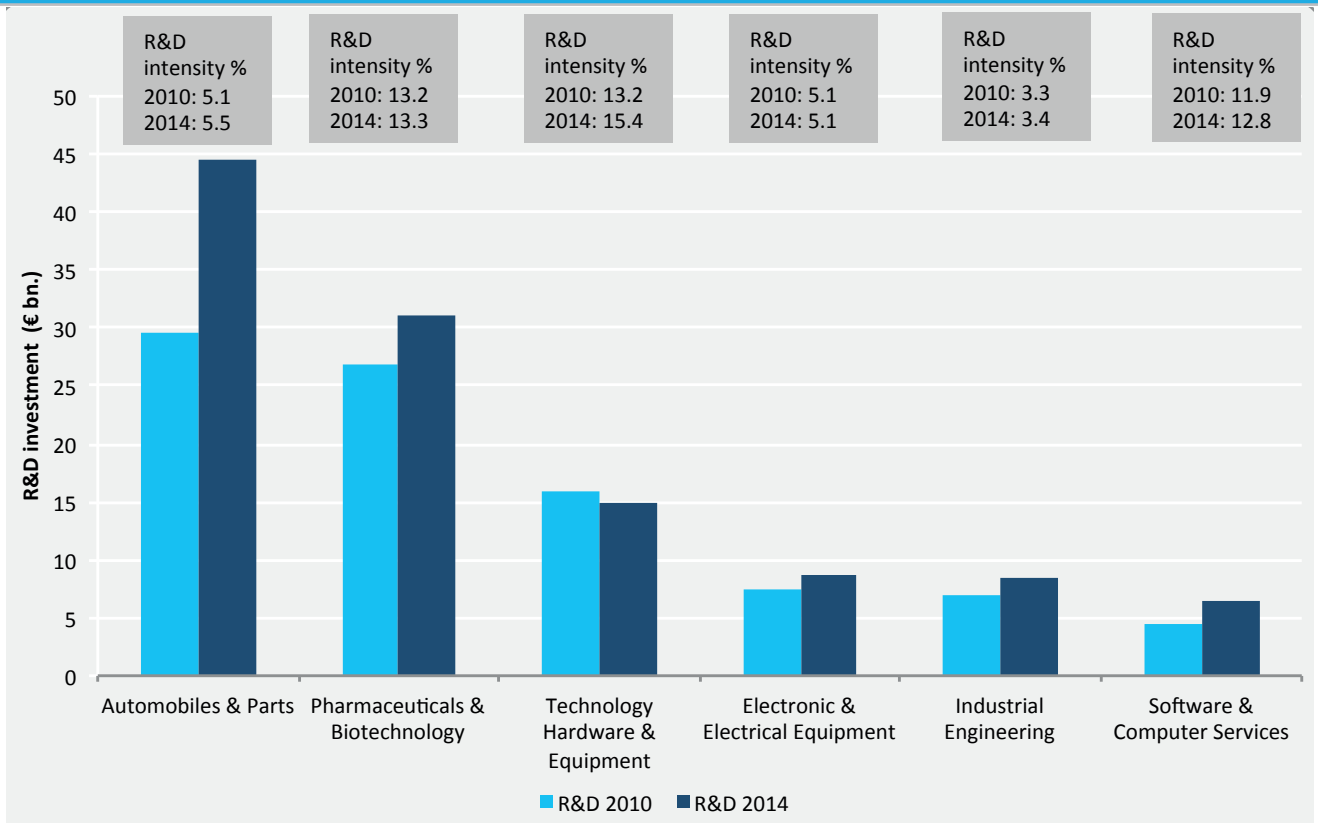
This section focuses on the trends in the R&D investments of the EU top 1000 RD investors separated into two groups: the upper reaches of the ranking (top 500 companies) and the lower reaches (bottom 500). It gives an overview of the changes between 2010 and 2014 in six selected sectors including Automobiles & Parts, Electronic & Electrical Equipment, Industrial Engineering, Pharmaceuticals & Biotechnology, Software & Computer Services and Technology Hardware & Equipment.

These six selected sectors invested in R&D respectively about €93.3m in 2010 and €117.5 m in 2014. The figures 6.1a and 6.1b show the change in the distribution of the lower and upper reaches of the EU top RD investors for the six sectors.

The figures show different sector distributions across the two subgroups:

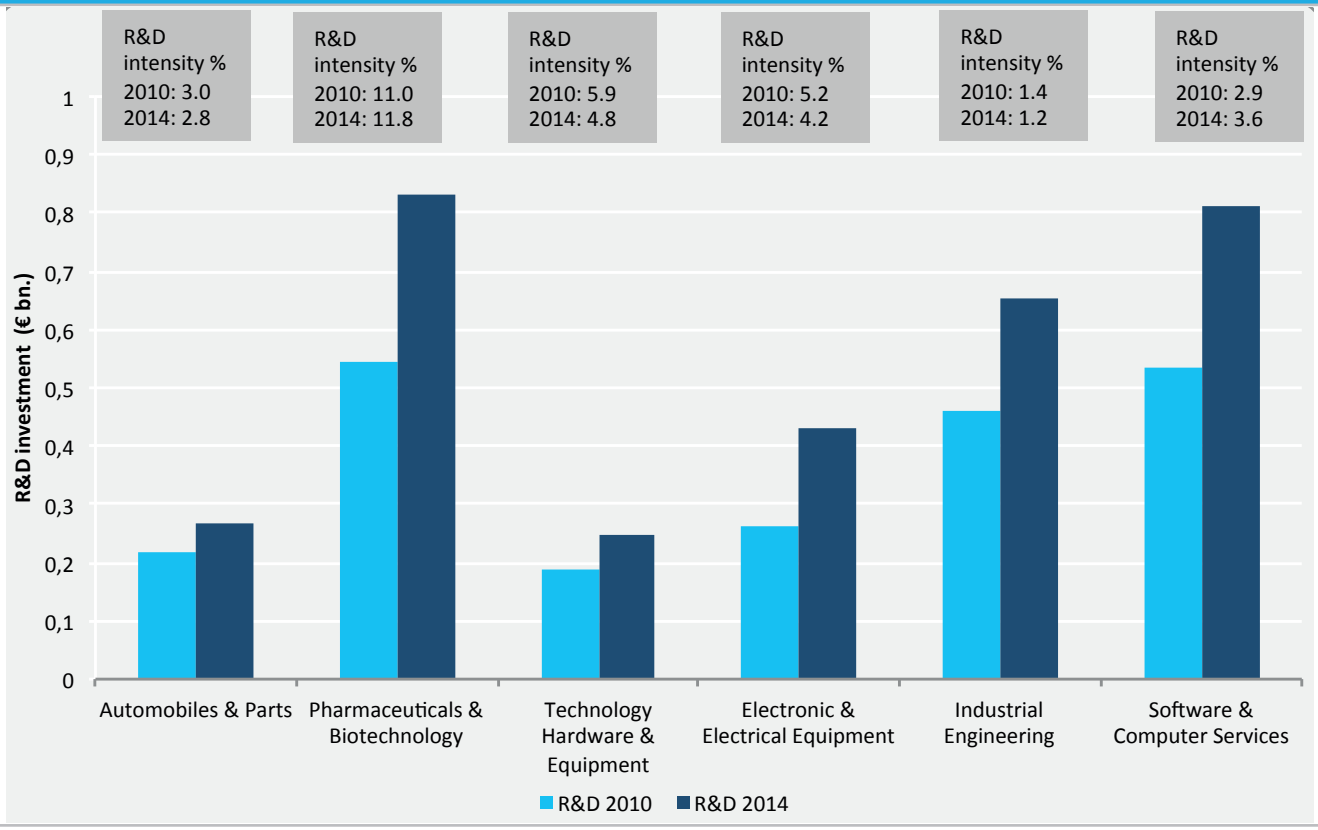
- Both subgroups have invested more than one quarter of their R&D in the Pharmaceuticals and Biotechnology industries in both 2010 and 2014. The 2014 R&D investment in software is almost as large as that in biopharma for the bottom 500 but is the lowest of the six sectors for the top 500.
- The R&D investment of the EU top 500 in Automobiles & Parts represents more than 30% while this is less than 10% of the R&D investment of the EU bottom 500 companies.
- In relative terms, the third most important sector in terms of R&D investment is Industrial Engineering for the lower reaches (about 20% over 2010-2014) and Technology Hardware and Equipment for the upper reaches (18% in 2010 and 13% in 2014).
- The R&D intensities of the two subgroups are similar for the Pharmaceuticals industry (11% to 13%), the Electronic & Electrical Equipment industry (around 4.5%) and the Industrial Engineering sector shows the lowest R&D intensities (about 1% for the lower reaches and 3% for the upper reaches).
- The R&D intensities for both the Technology Hardware & Equipment and software sectors in the upper reaches (12% to 15%) are more than twice the values for the lower reaches (3% to 6%).

Figure 6.1a - Sector distribution of R&D for the EU top 500 companies.



Note: figures displayed refer to the sample of the EU1000 companies. Please note the different scale respect to the figure 6.1b.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Figure 6.1b - Sector distribution of R&D for the EU bottom 500 companies.



Note: figures displayed refer to the sample of the EU1000 companies. Please note the different scale respect to the figure 6.1a.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

6.2 Trends of companies in the top 10 Member States of the EU

There are 898 companies based in the top 10 Member States accounting for 97.4 % of the total R&D of the 1000 EU sample (see table 6.2).

The overall performance of the EU group is largely driven by the performance of companies based in Germany, France and the UK, accounting for 68.1% of the total R&D and 68.5% of total net sales (see Tables 6.2 and 6.3). The next seven countries only add another 29% of the total R&D. The German companies are clearly the largest group by R&D and just larger than the UK group by sales; this reflects the very different sector mixes of the two countries.

The 214 German companies in the EU 1000 sample, accounting respectively for 36.4 % and 27.1 % of the total R&D and net sales, increased R&D by 6.3% and net sales by 2.8%. These results reflect to a large extent the performance of the German companies in the Automobiles & Parts sector (7.8% in R&D and 6.2% in net sales). This sector accounts for 52.2% of R&D and 31.3 % of net sales of the group of German companies.

The 116 companies based in France, accounting respectively for 16.3 % and 17.3% of the total R&D and net sales of the EU 1000 sample, increased slightly their R&D investment (0.5%) and decreased net sales (-1.4%). The largest R&D investing sectors of the French sample showed mixed results, Pharmaceuticals & Biotechnology slightly decreased R&D (-0.3%) and increased net sales (2.2%) whereas Automobiles & Parts significantly increased R&D (8.2%) with net sales rising modestly by 0.8%.

The 268 companies from the UK, accounting for 15.5 % and 24.1 % of the total R&D and net sales of the EU 1000 sample, slightly increased R&D (1.0%) and for the second consecutive year reduced net sales (-5.0%) due to the large oil & gas, mining and banking companies which have very large sales but modest R&D. The largest R&D investing sectors of the UK sample presented contrasting figures, Pharmaceuticals & Biotechnology (2.3% in R&D and -4.1% in net sales) while Automobiles & Parts significantly increased R&D (7.6%) and modestly net sales (1.6%).

Apart from the group of the three top countries, among the group of largest EU countries, those whose companies increased R&D above the EU average were Ireland (15.7%), Denmark (8.8%), Sweden (8.7%) and Spain (3.6%). Companies based in Finland significantly decreased R&D (-15.7%), mostly due to Nokia, accounting for two thirds of the total R&D by Finnish companies, showing a strong reduction of R&D (-21.3%). The companies based in the Netherlands for the second consecutive year did not increase

R&D. In term of net sales, many countries showed negative results, the poorest figures in net sales were for companies based in Finland (-11.8%) and Spain (-6.0%).

It is important to remember that in many countries, the aggregate country indicators depend to a large extent on the figures of a very few firms. This is due, either to the country's small number of companies in the *Scoreboard* or to the concentration of R&D in a few large firms. For example:

- Ericsson and Volvo accounting respectively for 40% and 20% of the total R&D by the Swedish companies largely determined the overall R&D of their group (8.7%). Ericsson increased R&D by 17.3% and Volvo decreased it by 4.4%.
- The Automobiles & Parts sector accounts for 52.2% of the R&D of companies based in Germany. Three companies in this sector, accounting for 37.5% of the German companies' R&D, contributed a large part of that country's R&D growth: Volkswagen (11.7%), Daimler (5.0%) and Robert Bosch (8.4%).
- The sharp R&D decrease of Alstom (-59.5%) affected strongly the R&D growth of the Industrial Engineering sector in the group of French companies.
- The relocation of Medtronic's headquarter to Ireland from the US substantially increased that country's R&D (since Medtronic is now Ireland's largest R&D investor). Allergan with main operational centre in the US but headquartered in Ireland increased R&D by 76%, mainly due to acquisitions - that boosted the Irish R&D growth rate.

Table 6.2 - R&D trends of companies based in the top 10 EU Member States.

Country	No. of companies	R&D Share within EU (%)	R&D one year growth (%)	Net Sales one year growth (%)
Germany	214	36.3	6.3	2.8
France	116	16.3	0.5	-1.4
UK	268	15.5	1	-5.0
The Netherlands	50	9.8	0	2.7
Sweden	80	5.5	8.7	5.3
Ireland	25	3.7	15.7	7.6
Italy	47	3.2	7.1	-2.2
Spain	22	2.6	3.6	-6.0
Finland	43	2.3	-15.7	-11.8
Denmark	33	2.3	8.8	2.0
Total EU	**1000**	**100**	**3.3**	**-0.9**

Note: figures displayed refer to the sample of the EU1000 companies.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Tab 6.3 - R&D and Net Sales growth in 2014 on the top 12 industrial sectors for German, French and UK companies.

Sector	EU 1000 R&D (€bn.)	Germany-214		France-116		UK-268	
		1-year change (%)		1-year change (%)		1-year change (%)	
		R&D	Sales	R&D	Sales	R&D	Sales
Automobiles & Parts	44.9	7.8	6.2	8.2	0.8	7.6	1.6
Pharmaceuticals & Biotechnology	31.9	7.3	3.0	-0.3	2.2	2.3	-4.1
Technology Hardware & Equipment	15.2	9.3	11.0	-4.4	-4.7	4.8	4.9
Aerospace & Defence	9.9	12.0	5.0	5.7	5.4	11.5	-6.4
Electronic & Electrical Equipment	9.2	-2.4	-3.9	9.9	4.4	9.3	3.2
Industrial Engineering	9.1	12.7	3.2	-49.0	-0.9	4.2	-3.7
Banks	7.6	33.0	-0.4	6.0	-1.3	-7.8	-7.6
Software & Computer Services	7.2	1.9	2.5	-5.2	12.7	12.1	7.1
Chemicals	5.2	3.1	1.0	11.2	0.0	10.0	-7.5
Fixed Line Telecommunications	4.3	-9.7	4.2	-6.2	-3.7	-4.3	-1.7
Health Care Equipment & Services	3.9	6.1	9.2	11.7	11.9	18.5	8.7
General Industrials	3.7	1.1	0.6	12.7	2.3	-2.3	-7.3
Top 12 industries	**152.1**	**6.7**	**3.8**	**-0.1**	**1.3**	**3.0**	**-4.6**
Rest of 28	**22.8**	**0.6**	**0.9**	**2.5**	**-2.9**	**-5.5**	**-5.1**
All 40 industries	**175.0**	**6.3**	**2.8**	**0.5**	**-1.4**	**1.0**	**-5.0**

Note: figures displayed refer to the sample of the EU1000 companies.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

6.3 Long-term performance of companies based in the 3 top EU Member States

The annual growth rates of R&D investment and net sales and profitability of companies based in Germany, France and the UK is provided respectively in figures 6.2, 6.3 and 6.4 for the period 2006-2014. These figures are based on our history database comprising R&D and economic indicators over the whole 2006-2014 period from the EU 1000 dataset, including 152 companies from Germany, 82 from France and 160 from the UK.

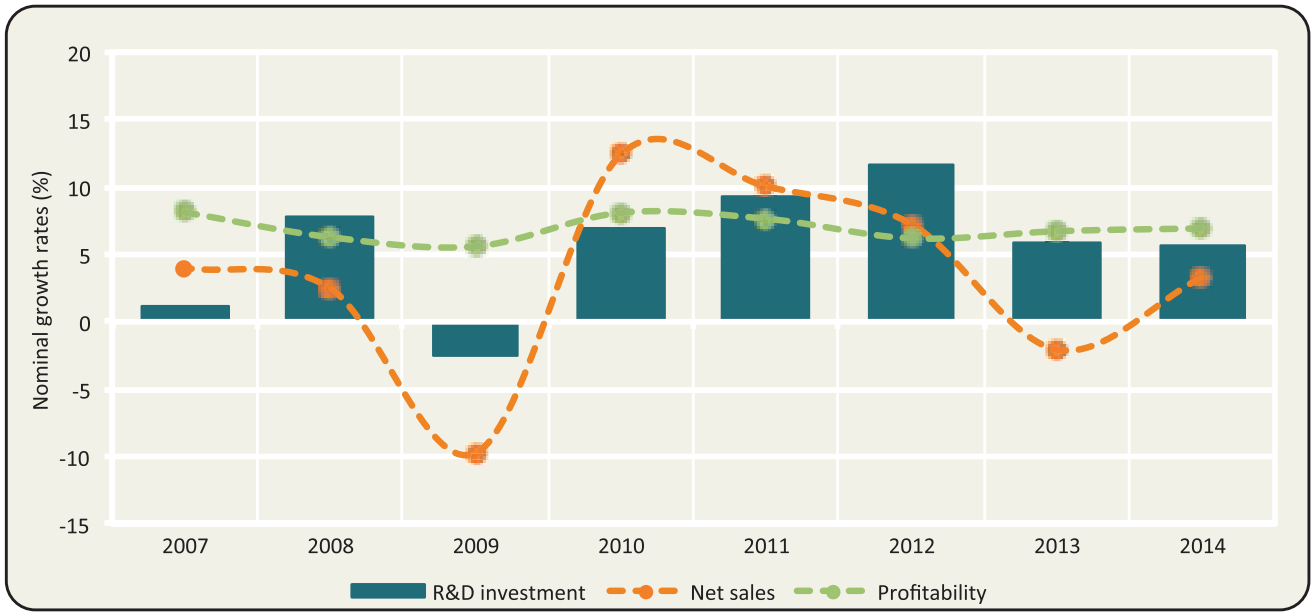
The trends observed in these figures show the behaviour of these companies including the effects of the crisis that began in 2008. The following points are observed:

- Companies based in Germany showed a good performance over the period 2010-2012, recovering the levels of growth prior to the crisis, especially in terms of R&D. In the last period, they continued to increase R&D at a slower pace while maintaining a stable level of profitability but showing a decline in net sales. In the last period they continued to show a recovery of both R&D and net sales. Profitability was lower than that of the French and UK companies over the whole period. Sales recovered over the last year.

- Companies based in France showed a recovery in R&D and net sales in 2010-2011, however, over the period 2012-2013 they presented an important decline in both net sales and R&D growth. In the last period they start recovering R&D and net sales but the growth rate for both was still negative. The average profitability of the French companies shows a decreasing trend in the period 2010-2013 that has stabilised over 2013-2014.

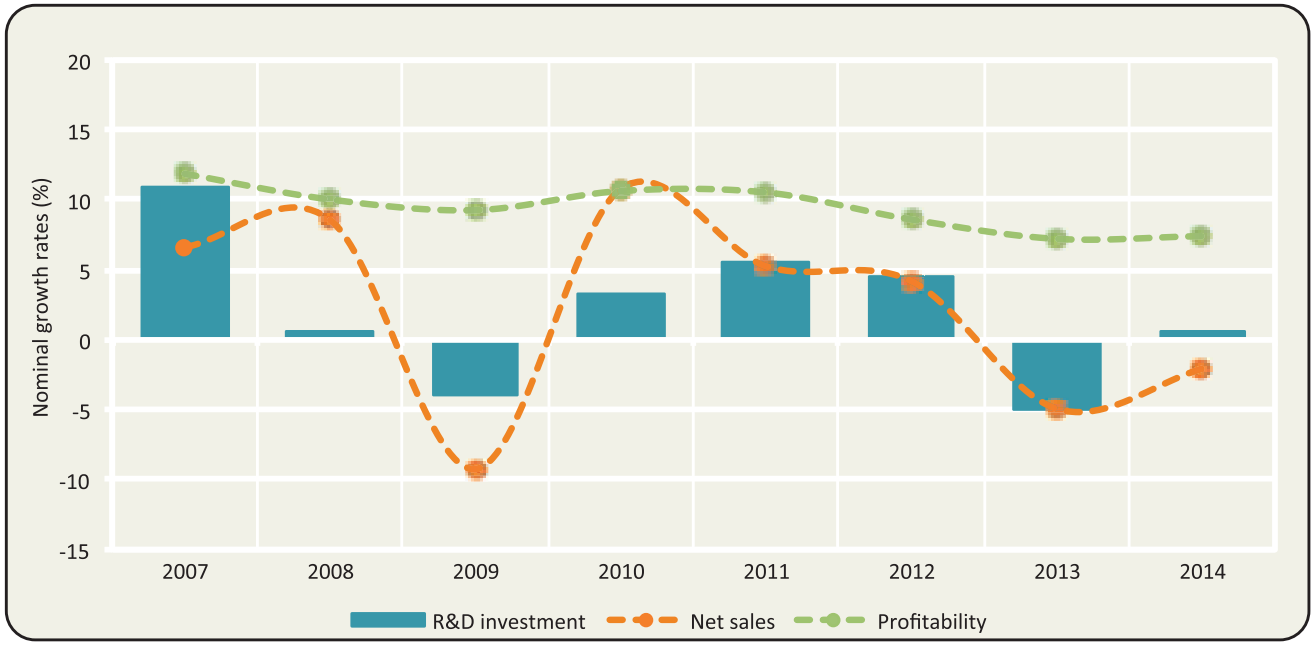
- Companies based in the UK showed a strong recovery of R&D and net sales in 2010-2011 that was broken up in 2012. In 2012-2013 their R&D investment resumed to grow at significant pace but with a level of net sales practically unchanged. In 2014, the R&D level remained practically unchanged but with a significant decrease of net sales with falling oil and metals prices being a major factor. The average profitability of the UK companies is the highest of the three countries over the whole period but shows a decreasing trend in the period 2010-2012 that has stabilised over 2012 to 2014 in the range 9%-10%.

Figure 6.2 - One-year R&D investment and net sales growth and profitability by the German companies.



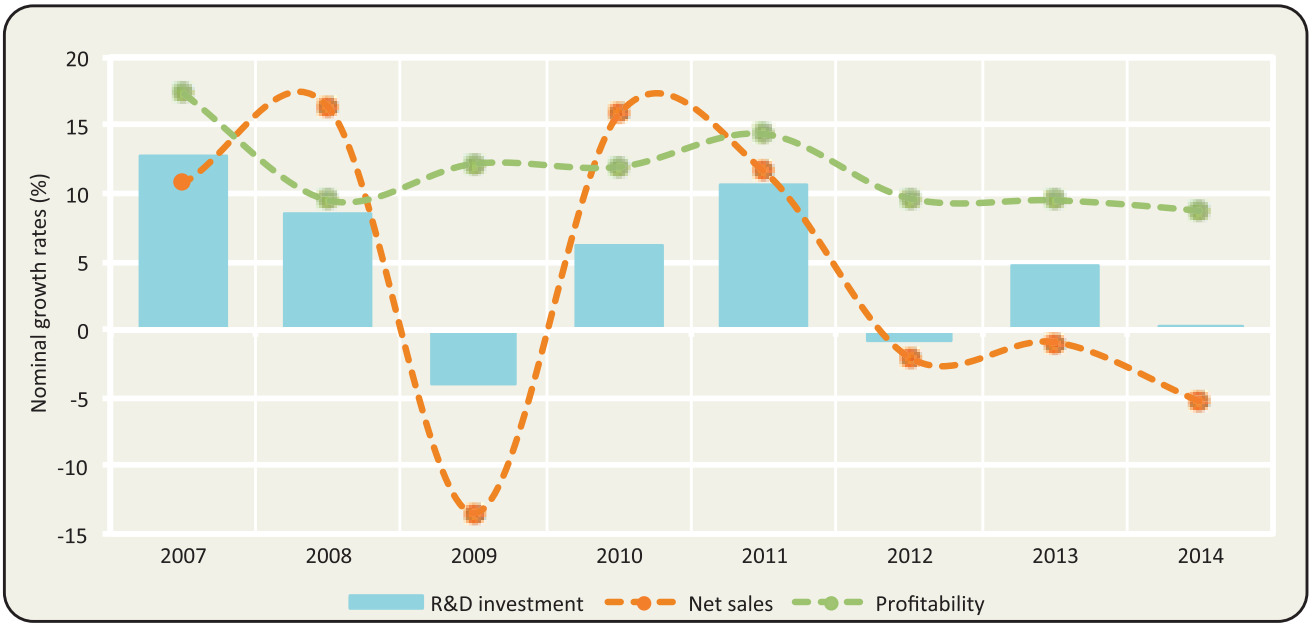
Note: growth rates for the three variables have been computed on 152 out of the 214 German companies for which data are available for the entire period 2007-2014.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Figure 6.3 - One-year R&D investment and net sales growth and profitability by the French companies.



Note: growth rates for the three variables have been computed on 82 out of the 116 French companies for which data are available for the entire period 2007-2014.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Figure 6.4 - One-year R&D investment and net sales growth and profitability by the UK companies.



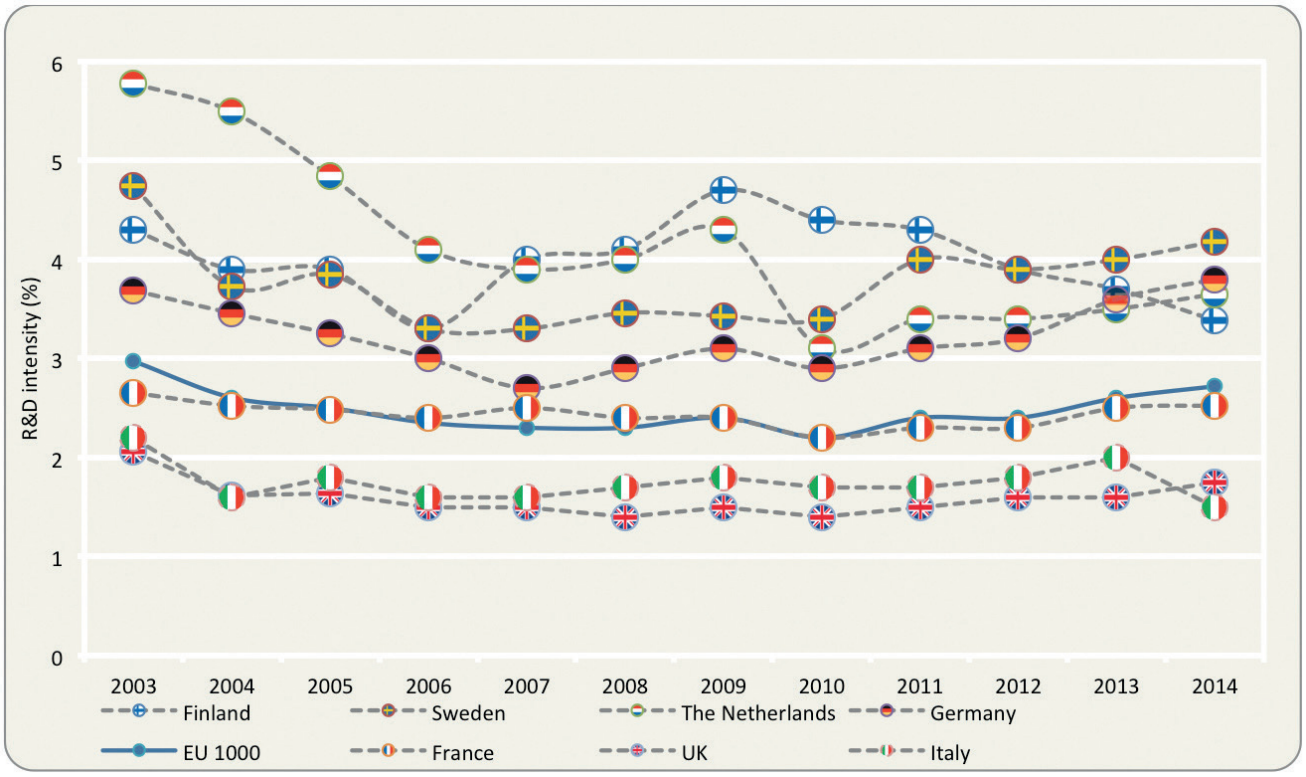
Note: growth rates for the three variables have been computed on 160 out of the 268 UK companies for which data are available for the entire period 2007-2014.
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

6.4 R&D intensity trends for companies based in selected Member States

In 2014, for the third consecutive year, the average R&D intensity of the EU-1000 companies increased because of the higher increase of R&D investments compared to that of net sales, 3.2% vs. -0.6% (see Figure 6.5).

It is important to remember that a few large but low R&D intensity sectors have a big effect on some country average R&D intensities. One example is large Oil & Gas Producers, Mining companies and Banks for the UK. In 2014, these sectors contributed over 50% of the UK's *Scoreboard* company sales, so if these three sectors had been left out, the average R&D intensity of UK companies would have increased from 1.7% to 2.9%.

Figure 6.5 - Trends in R&D intensities for EU *Scoreboard* companies in selected Member States.



Note: R&D intensity defined as R&D over Net Sales
Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

6.5 Further R&D companies in the EU

As explained in other sections of the report, industrial R&D is highly concentrated by country and by industry. In this year's edition, the ranking of the top 1000 R&D investors in the EU includes companies from 21 member states. However, most of the companies are concentrated in a few countries, e.g. the top 3 countries account for 60 % of the companies.

In addition, the methodological approach only takes into account parent companies in order to avoid double counting. For these reasons, many countries present very few companies and 7 EU countries show no company at all in the 2015 *Scoreboard*.

This section presents the results of an exercise aimed to increase the coverage of R&D investing companies in 12 member states with zero or a very small number of companies in the *Scoreboard* (Slovenia, Greece, Poland, Czech Republic, Hungary, Slovakia, Croatia, Romania, Cyprus, Estonia, Latvia and Lithuania).

This analysis followed a complementary approach, looking straightforwardly country by country for companies that report R&D figures, independently of the level of the investment and the type of company. Apart from available commercial databases, various data sources have been applied including country-specific reports and Internet research.

The results of this exercise show 81 companies reporting R&D figures according to the Frascati methodology. The main data for these companies are summarised in Table 6.4.

The full list of companies and related economic and R&D data are presented in Annex 4. Note that only 12 of the 81 companies have sufficient R&D to warrant inclusion in the *Scoreboard* EU 1000 sample.

Concluding remarks

The number of companies, based in the selected countries, providing R&D figures complying with the Frascati definition is very limited. The main reasons are the following:

- Annual reports for a considerable number of companies are not always available in some countries.
- Many companies do not yet comply with international accounting standards, in particular regarding R&D figures that are often missing or generally stated as a percentage of turnover.
- In many cases, it is not possible to separate the company's R&D effort from other funding sources such as state aids.
- Some countries have subsidiaries of foreign companies that do not file their own accounts or do not publish their own R&D figures.
- A general conclusion of this exercise is that the identification of further R&D companies in the selected countries should follow a different approach, for example supported by country relevant stakeholders and by means of ad-hoc surveys. However, these methods are unlikely to produce R&D data of the quality required for inclusion in the main *Scoreboard*. The longer term solution is for all EU countries to require all companies of significant size to publish annual reports and properly disclose R&D investment in those annual reports.

Table 6.4 - Further R&D investing companies in the EU.

Country	number of companies	Main industries	Total R&D 2014 (€m)
Czech Republic	6	Automobiles, Banks, Iron & Steel	439.4
Slovenia	11	Pharmaceuticals, Auto Parts, Building Materials & Fixtures	114.5
Hungary	3	Pharmaceuticals, Banks	52.8
Poland	12	Mobile Telecom, Banks, Software, Chemicals	38.5
Slovakia	7	Tyres, General Industrials, Pharmaceuticals	27.4
Romania	8	Banks, Aerospace, Oil & Gas	26.7
Greece	10	Telecom equip, construction, Containers & Packaging	18.4
Cyprus	3	Electricity, Industrials, Telecom	14
Croatia	8	Oil Equipment, Services & Distribution, Food & Beverage	7.9
Estonia	5	Banks, Electricity	7.5
Latvia	6	Pharmaceuticals, Electrical Components & Equip.	5.8
Lithuania	2	Retailers, Oil& Gas	0.31
Total	81		753.21

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD

Annex 1 - Background information

Investment in research and innovation is at the core of the EU policy agenda. The Europe 2020 growth strategy includes the Innovation Union flagship initiative[19] with a 3 % headline target for intensity of research and development (R&D)[20]. R&D investment from the private sector plays also a key role for other relevant Europe 2020 initiatives such as the Industrial Policy[21], Digital Agenda and New Skills for New Jobs flagship initiatives.

The Industrial Research and Innovation Monitoring and Analysis (IRIMA) project[22] supports policymakers in these initiatives and monitors progress towards the 3 % headline target. The *Scoreboard,* as part of the IRIMA project, aims to improve the understanding of trends in R&D investment by the private sector and the factors affecting it.

The annual publication of the *Scoreboard* is intended to raise awareness of the importance of R&D for businesses and to encourage firms to disclose information about their R&D investments and other intangible assets.

The data for the *Scoreboard* are taken from companies' publicly available audited accounts. As in more than 99% of cases these accounts do not include information on the place where R&D is actually performed, the company's whole R&D investment in the *Scoreboard* is attributed to the country in which it has its registered office[23]. This should be borne in mind when interpreting the *Scoreboard*'s country classifications and analyses.

The *Scoreboard*'s approach is, therefore, fundamentally different from that of statistical offices or the OECD when preparing Business Enterprise Expenditure on R&D (BERD) data, which are specific to a given territory[24] and give no information on which companies are performing the R&D and, indeed, are only based on returns from the larger companies (the smaller ones being estimated via a survey methodology). The *Scoreboard* data are primarily of interest to those concerned with benchmarking company commitments and performance (e.g. companies, investors and policymakers), while BERD data are primarily used by economists, governments and international organisations interested in the R&D being performed in territorial units defined by political boundaries. The two approaches are therefore complementary. The methodological approach of the *Scoreboard*, its scope and limitations are further detailed in Annex 2 below.

Scope and target audience

The *Scoreboard* is a benchmarking tool which provides reliable up-to-date information on R&D investment and other economic and financial data, with a unique EU-focus. The 2500 companies listed in this year's *Scoreboard* account for more than 90%[25] of worldwide business enterprise expenditure on R&D (BERD). Furthermore, the dataset is extended to cover the top 1000 R&D investing companies in the EU.

The data in the *Scoreboard*, published since 2004, allow long-term trend analyses, for instance, to examine links between R&D and business performance.

19 The Innovation Union flagship initiative aims to strengthen knowledge and innovation as drivers of future growth by refocusing R&D and innovation policies for the main challenges society faces.

20 This target refers to the EU's overall (public and private) R&D investment approaching 3 % of gross domestic product (see: http://ec.europa.eu/europe2020/pdf/targets_en.pdf).

21 The Industrial Policy for the Globalisation Era flagship initiative aims to improve the business environment, notably for small and medium-sized enterprises, and support the development of a strong and sustainable industrial foundation for global competition.

22 See: http://iri.jrc.ec.europa.eu/home /. The activity is undertaken jointly by the Directorate General for Research (DG RTD A; see: http://ec.europa.eu/research/index.cfm?lg=en) and the Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS; see: https://ec.europa.eu/jrc/en/science-area/innovation-and-growth).

23 The registered office is the company address notified to the official company registry. It is normally the place where a company's books are kept.

24 The *Scoreboard* refers to all R&D financed by a company from its own funds, regardless of where the R&D is performed. BERD refers to all R&D activities performed by businesses within a particular sector and territory, regardless of the location of the business's headquarters, and regardless of the sources of finance. The sources of data also differ: the *Scoreboard* collects data from audited financial accounts and reports whereas BERD typically takes a stratified sample, covering all large companies and a representative sample of smaller companies. Additional differences concern the definition of R&D intensity (BERD uses the percentage of R&D in value added, while the *Scoreboard* considers the R&D/Sales ratio) and the sectoral classification (BERD uses NACE (the European statistical classification of economic sectors), while the *Scoreboard* uses the ICB (the International Classification Benchmark).

25 According to latest Eurostat statistics. However BERD and *Scoreboard* figures are not directly comparable.

The *Scoreboard* is aimed at three main audiences.

- **Companies** can use the *Scoreboard* to benchmark their R&D investments and so find where they stand in the EU and in the global industrial R&D landscape. This information could be of value in shaping business or R&D strategy.

- **Investors and financial analysts** can use the *Scoreboard* to assess investment opportunities and risks.

- **Policy-makers, government and business organisations** can use R&D investment information as an input to policy formulation or other R&D-related actions such as the structure of R&D tax credit schemes.

Furthermore, the *Scoreboard* dataset has been made freely accessible so as to encourage further economic and financial analyses and research by any interested parties.

Annex 2 - Methodological notes

The data for the 2015 EU Industrial R&D *Scoreboard* (the *Scoreboard*) have been collected from companies' annual reports and accounts by Bureau van Dijk Electronic Publishing GmbH (BvD). The source documents, annual reports & accounts, are public domain documents and so the *Scoreboard* is capable of independent replication. In order to ensure consistency with our previous *Scoreboards*, BvD data for the years prior to 2012 have been checked with the corresponding data of the previous *Scoreboards* adjusted for the corresponding exchange rates of the annual reports.

Main characteristics of the data

The data correspond to companies' latest published accounts, intended to be their 2014 fiscal year accounts, although due to different accounting practices throughout the world, they also include accounts ending on a range of dates between late 2013 and mid-2015. Furthermore, the accounts of some companies are publicly available more promptly than others. Therefore, the current set represents a heterogeneous set of timed data.

In order to maximise completeness and avoid double counting, the consolidated group accounts of the ultimate parent company are used. Companies which are subsidiaries of any other company are not listed separately. Where consolidated group accounts of the ultimate parent company are not available, subsidiaries are included.

In case of a demerger, the full history of the continuing entity is included. The history of the demerged company can only go back as far as the date of the demerger to avoid double counting of figures.

In case of an acquisition or merger, pro forma figures for the year of acquisition are used along with pro-forma comparative figures if available.

The R&D investment included in the *Scoreboard* is the cash investment which is funded by the companies themselves. It excludes R&D undertaken under contract for customers such as governments or other companies. It also excludes the companies' share of any associated company or joint venture R&D investment when disclosed. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

Companies are allocated to the country of their registered office. In some cases this is different from the operational or R&D headquarters. This means that the results are independent of the actual location of the R&D activity.

Companies are in industry sectors according to the NACE Rev. 2[26] and the ICB (Industry Classification Benchmark).

Limitations

The *Scoreboard* relies on disclosure of R&D investment in published annual reports and accounts. Therefore, companies which do not disclose figures for R&D investment or which disclose only figures which are not material enough are not included in the *Scoreboard*. Due to different national accounting standards and disclosure practice, companies of some countries are less likely than others to disclose R&D investment consistently.

In some countries, R&D costs are very often integrated with other operational costs and can therefore not be identified separately. For example, companies from many Southern European countries or the new Member States are under-represented in the *Scoreboard*. On the other side, UK companies are over-represented in the *Scoreboard* since the UK requires all companies above a certain minimum size to report R&D investment.

For listed companies, country representation will improve with IFRS adoption.

The R&D investment disclosed in some companies' accounts follows the US practice of including engineering costs relating to product improvement. Where these engineering costs have been disclosed separately, they have been excluded from the *Scoreboard*. However, the incidence of non-disclosure is uncertain and the impact of this practice is

26 NACE is the acronyme for "Nomenclature statistique des activités économiques dans la Communauté européenne".

a possible overstatement of some overseas R&D investment figures in comparison with the EU.

Where R&D income can be clearly identified as a result of customer contracts it is deducted from the R&D expense stated in the annual report, so that the R&D investment included in the *Scoreboard* excludes R&D undertaken under contract for customers such as governments or other companies. However, disclosure practice differs and R&D income from customer contracts cannot always be clearly identified. This means a possible overstatement of some R&D investment figures in the *Scoreboard* for companies with directly R&D related income where this is not disclosed in the annual report.

In implementing the definition of R&D, companies exhibit variability arising from a number of sources: i) different interpretations of the R&D definition. Some companies view a process as an R&D process while other companies may view the same process as an engineering or other process; ii) different companies' information systems for measuring the costs associated with R&D processes; iii) different countries' fiscal treatment of costs.

Interpretation

There are some fundamental aspects of the *Scoreboard* which affect their interpretation.

The focus of the *Scoreboard* on R&D investment as reported in group accounts means that the results can be independent of the location of the R&D activity. The *Scoreboard* indicates the level of R&D funded by companies, not all of which is carried out in the country in which the company is registered. This enables inputs such as R&D and Capex investment to be related to outputs such as Sales, Profits, productivity ratios and market capitalisation.

The data used for the *Scoreboard* are different from data provided by statistical offices, e.g. BERD data. The *Scoreboard* refers to all R&D financed by a particular company from its own funds, regardless of where that R&D activity is performed. BERD refers to all R&D activities performed by businesses within a particular sector and territory, which are often just a part of a company, regardless of the location of the business's headquarters, and regardless of the sources of finance.

Further, the *Scoreboard* collects all data from audited financial accounts and reports. BERD typically takes a stratified sample, covering all large companies and a representative sample of smaller companies. Additional differences concern the definition of R&D intensity (BERD uses the percentage of value added, while the *Scoreboard* measures it as the R&D/Sales ratio) and the sectoral classification they use (BERD follows NACE, the European statistical classification of economic sectors, while the *Scoreboard* classifies companies' economic activities according to the ICB classification).

Sudden changes in R&D figures may arise because of a change in company accounting standards. For example, the first time adoption of IFRS[27], may lead to information discontinuities due to the different treatment of R&D, i.e. R&D capitalisation criteria are stricter and, where the criteria are met, the amounts must be capitalised.

For many highly diversified companies, the R&D investment disclosed in their accounts relates only to part of their activities, whereas sales and profits are in respect of all their activities. Unless such groups disclose their R&D investment additional to the other information in segmental analyses, it is not possible to relate the R&D more closely to the results of the individual activities which give rise to it. The impact of this is that some statistics for these groups, e.g. R&D as a percentage of sales, are possibly underestimated and so comparisons with non-diversified groups are limited.

At the aggregate level, the growth statistics reflect the growth of the set of companies in the current year set. Companies which may have existed in the base year but which are not represented in the current year set are not part of the *Scoreboard* (a company may continue to be represented in the current year set if it has been acquired by or merged with another).

For companies outside the Euro area, all currency amounts have been translated at the Euro exchange rates ruling at 31 December 2014 as shown in Table A2.1. The exchange rate conversion also applies to the historical data. The result is that over time the *Scoreboard* reflects the domestic currency results of the companies rather than economic estimates of current purchasing parity results. The original domestic currency data can be derived simply by reversing the translations at the rates above. Users can then apply their own preferred current purchasing parity transformation models.

27 Since 2005, the European Union requires all listed companies in the EU to prepare their consolidated financial statements according to IFRS (International Financial Reporting Standards, see: http://www.iasb.org/).

Table A2.1 - Euro exchange rates applied to the 2015 *Scoreboard* data for companies based in different currency areas (as of 31 Dec 2014).

Country	As of 31 Dec 2013	As of 31 Dec 2014
Australia	$ 1.56	$ 1.48
Brazil	3.25 Brazilian real	3.22 Brazilian real
Canada	$ 1.47	$ 1.41
China	8.42 Renminbi	7.43 Renminbi
Czech Republic	27.43 Koruna	27.72 Koruna
Denmark	7.46 Danish Kronor	7.43 Danish Kronor
Hungary	297.62 Forint	314.46 Forint
India	85.40 Indian Rupee	76.86 Indian Rupee
Israel	4.79 Shekel	4.72 Shekel
Japan	145.14 Yen	146.41 Yen
Mexico	18.03 Mexican Peso	17.87 Mexican Peso
Norway	8.38 Norwegian Kronor	9.02 Norwegian Kronor
Poland	4.15 Zloty	4.26 Zloty
Russia	45.15 Rouble	68.31 Rouble
South Korea	1449.28 Won	1333.33 Won
Sweden	8.86 Swedish Kronor	9.39 Swedish Kronor
Switzerland	1.23 Swiss Franc	1.20 Swiss Franc
Turkey	2.95 Turkish lira	2.82 Turkish lira
UK	£ 0.84	£ 0.78
USA	$ 1.38	$ 1.21
Taiwan	$ 41.42	$ 40.02

Source: The 2015 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD.

Glossary of definitions

1. **Research and Development (R&D) investment** in the *Scoreboard* is the cash investment funded by the companies themselves. It excludes R&D undertaken under contract for customers such as governments or other companies. It also excludes the companies' share of any associated company or joint venture R&D investment. Being that disclosed in the annual report and accounts, it is subject to the accounting definitions of R&D. For example, a definition is set out in International Accounting Standard (IAS) 38 "Intangible assets" and is based on the OECD "Frascati" manual. **Research** is defined as original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding. Expenditure on research is recognised as an expense when it is incurred. **Development** is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use. Development costs are capitalised when they meet certain criteria and when it can be demonstrated that the asset will generate probable future economic benefits. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

2. **Net sales** follow the usual accounting definition of sales, excluding sales taxes and shares of sales of joint ventures & associates. For banks, sales are defined as the "Total (operating) income" plus any insurance income. For insurance companies, sales are defined as "Gross premiums written" plus any banking income.

3. **R&D intensity** is the ratio between R&D investment and net sales of a given company or group of companies. At the aggregate level, R&D intensity is calculated only by those companies for which data exist for both R&D and net sales in the specified year. The calculation of R&D intensity in the *Scoreboard* is different from than in official statistics, e.g. BERD, where R&D intensity is based on value added instead of net sales.

4. **Operating profit** is calculated as profit (or loss) before taxation, plus net interest cost (or minus net interest income) minus government grants, less gains (or plus losses) arising from the sale/disposal of businesses or fixed assets.

5. **One-year growth** is simple growth over the previous year, expressed as a percentage: 1 yr growth = 100*((C/B)-1); where C = current year amount, and B = previous year amount. 1yr growth is calculated only if data exist for both the current and previous year. At the aggregate level, 1yr growth is calculated only by aggregating those companies for which data exist for both the current and previous year.

6. **Three-year growth** is the compound annual growth over the previous three years, expressed as a percentage: 3 yr growth = 100*(((C/B)^(1/t))-1); where C = current year amount, B = base year amount (where base year = current year - 3), and t = number of time periods (= 3). 3yr growth is calculated only if data exist for the current and base years. At the aggregate level, 3yr growth is calculated only by aggregating those companies for which data exist for the current and base years.

7. **Capital expenditure (Capex)** is expenditure used by a company to acquire or upgrade physical assets such as equipment, property, industrial buildings. In accounts capital expenditure is added to an asset account (i.e. capitalised), thus increasing the asset's base. It is disclosed in accounts as additions to tangible fixed assets.

8. **Number of employees** is the total consolidated average employees or year-end employees if average not stated.

Annex 3 – Composition of the EU 1000 sample

The analysis of chapter 5 applies an extended sample of 1000 companies based in the EU. It consists of 608 companies included in the world R&D ranking of top 2500 companies and additional 392 companies also ranked by level of R&D investment. The composition by country and industry of the EU 1000 sample is presented in the table A3.1 below.

Table A3.1 Distribution of the sample of 1000 companies based in the EU by country and industry.

Industry	EU country codes																					
ICB 3 digit	AT	BE	CY	CZ	DE	DK	ES	FI	FR	GR	HU	IE	IT	LU	MT	NL	PL	PT	RO	SE	SI	UK	Total
Aerospace & Defence		1		1	2		1		7				2			1				1		9	**25**
Alternative Energy					3	1								1								1	**6**
Automobiles & Parts	4				16			1	6				5			1				3	1	10	**47**
Banks		2			5	2	2		1	1		2	2			2		2		2		4	**27**
Beverages		1				1																1	**3**
Chemicals	2	3			13	1		3	3							3				3		11	**42**
Construction & Materials	2	5			6	1	4	3	5			2	2			1				2	2	3	**38**
Electricity		1	1	1	1		2	2	2				2					1		1		3	**17**
Electronic & Electrical Equipment	3	3			14	2		5	8			1	4	1		5				4		18	**68**
Financial Services					4				1					1		1				4		5	**16**
Fixed Line Telecommunications	1	1			1	1	1		1				1				1	1		1		1	**11**
Food & Drug Retailers		1														1						4	**6**
Food Producers	1				2	1		3	3	1		3		1		5						8	**28**
Forestry & Paper								3	1			1								3		1	**9**
Gas, Water & Multi-utilities	1				2				3				1									3	**10**
General Industrials		1			12	1	1	1	1			1	1	2		2				5		9	**37**
General Retailers					3				1													6	**10**
Health Care Equipment & Services		2			11	2			3			1	1			2				4		11	**37**
Household Goods & Home Construction					4			1	2				2	1		1				2	2	4	**19**

ICB 3 digit	AT	BE	CY	CZ	DE	DK	ES	FI	FR	GR	HU	IE	IT	LU	MT	NL	PL	PT	RO	SE	SI	UK	Total
Industrial Engineering	5	1			37	3	3	7	7			2	8	2		4			10			12	**101**
Industrial Metals & Mining	2	3			5		1	1	1					3		1				2			**19**
Industrial Transportation				1	1	1			3				3							1		1	**11**
Leisure Goods					1	2		1								1						1	**6**
Life insurance					1				1													2	**4**
Media									5				1							1		6	**13**
Mining														1						2		4	**7**
Mobile telecommunications					1			1														2	**4**
Nonlife Insurance					2																	1	**3**
Oil & Gas Producers	1						1	1	1				1						1			4	**10**
Oil Equipment, Services & Distribution									2			1		1		1							
Personal & Household Goods					1																		**1**
Personal Goods	1				7				3				3	2									**16**
Pharmaceuticals & Biotechnology		5			13	10	4	2	19	1	1	7	7			6		1		9	1	36	**122**
Real Estate Investment & Services		1			2																		**3**
Software & Computer Services	2				20	2	2	5	16			2				4	1	1		8		49	**112**
Support Services						15				2			1				1					19	**42**
Technology Hardware & Equipment	2	2			6	1		2	7	1		1				7				6		15	**50**
Tobacco																							
Travel & Leisure	1																			1		1	**2**
Utilities						1																	**1**
TOTAL	**28**	**33**	**1**	**3**	**214**	**33**	**22**	**43**	**116**	**4**	**1**	**25**	**47**	**16**	**1**	**50**	**2**	**6**	**1**	**80**	**6**	**268**	**1000**

Annex 4 – Extra R&D companies in selected Member States

Company name	Country	Industry (ICB)	R&D investment 2014 (€k)	Net Sales 2014 (€k)	CAPEX 2014 (€k)	Operating Profit 2014 (€K)	Employees 2014	C. code	I. code
SKODA AUTO	Czech Republic	Automobiles	397 182.5	9 980 495.0	0.0	488 371.1	10 000	C2	C
LEK FARMACEVTSKA DRUZBA	Solvenia	Pharmaceuticals	76 947.5	761 338.1	0.0	68 262.9	2 978	U1	D
EGIS	Hungary	Pharmaceuticals	40 240.3	413 127.5	0.0	41 346.4	0	C2	D
KOMERCNI BANKA	Czech Republic	Banks	37 730.7	1 113 416.7	0.0	578 225.0	8 573	C2	D
CONTINENTAL MATADOR RUBBER	Slovakia	Tires	21 452.0	821 858.0	0.0	135 855.0	2 500	U1	D
UNICREDIT BANK	Romania	Banks	21 363.2	349 117.3	0.0	39 855.7	3 369	C2	D
TELEKOMUNIKACJA POLSKA	Poland	Mobile Telecommunications	14 795.4	2 867 950.0	505 625.3	282 051.1	19 094	C1	D
ELECTRICITY AUTHORITY OF CYPRUS	Cyprus	Electricity	13 746.0	796 930.0	0.0	106 555.0	2 269	C2	U
CIB BANK	Hungary	Banks	11 916.3	274 123.6	0.0	-320 056.7	2 921	C2	B-
LETRIKA	Solvenia	Auto Parts	8 290.0	242 807.0	0.0	12 005.0	2 416	C1	D
HELIOS TOVARNA BARV	Solvenia	Building Materials & Fixtures	6 133.0	203 322.5	0.0	11 821.3	762	U1	D
BSH HISNI APARATI	Solvenia	Durable Household Products	5 896.6	0.0	0.0	0.0	0	U1	D
	Solvenia	Auto Parts	5 473.5	137 808.5	0.0	11 697.3	681	U1	D
FORTHNET	Greece	Telecommunications Equipment	4 707.1	374 914.0	56 277.0	-28 461.0	1 266	C1	B+
TELEKOM SLOVENIJE	Solvenia	Mobile Telecommunications	4 364.0	756 454.0	80 178.0	18.225	4 431	C1	D
BANK OCHRONY SRODOWISKA	Poland	Banks	3 944.5	128 273.4	0.0	19 257.4	0	C2	D
SEB PANK	Estonia	Banks	3 700.0	133 500.0	0.0	79 400.0	1 086	C2	D

Company name	Country	Industry (ICB)	R&D investment 2014 (€k)	Net Sales 2014 (€k)	CAPEX 2014 (€k)	Operating Profit 2014 (€K)	Employees 2014	C. code	I. code
GEK TERNA	Greece	Heavy Construction	3 636.0	923 894.0	85 604.0	-9 225.0	1 747	C1	A
BRE BANK	Poland	Banks	3 515.2	947 372.3	0.0	388 131.4	6 318	C2	D
JADRANSKI NAFTOVOD	Croatia	Oil Equipment, Services & Distribution	3 155.5	58 352.7	13 723.6	15 415.6	383	C1	B+
U.S. STEEL KOSICE	Slovakia	General Industrials	3 100.0	3 349.6	0.0	1.177	175	U1	D
EESTI ENERGIA	Estonia	Electricity	3 000.0	349 400.0	0.0	69 700.0	0	U1	D
COMARCH	Poland	Software	2 949.9	243 853.5	18 773.7	27 606.3	4 129	C1	B+
AEROSTAR	Romania	Aerospace	2 767.1	58 320.5	2 524.9	4 085.9	1 868	C1	D
GRUPA AZOTY ZAKLADY AZOTOWE PULAWY	Poland	Chemicals	2 695.3	1 274 513.7	91 963.9	66 479.7	4 511	C1	D
FRIGOGLASS	Greece	Containers & Packaging	2 655.0	487 046.0	23 351.0	39 861.0	5 411	C1	B+
GRINDEKS	Latvia	Pharmaceuticals	2 530.0	88 488.0	3 655.0	-1 766.0	1 162	C1	B+
MARFIN INVESTMENT	Greece	Business Support Services	2 452.0	1 155 900.0	0.0	-185 400.0	10 723	C2	A+
INFORM P LYKOS	Greece	General Industrials	2 326.6	126 150.0	0.0	5 418.0	459	C1	D
LTH CASTINGS	Solvenia	Nonferrous Metals	2 240.0	0.0	0.0	0.0	0	U1	D
FAMUR	Poland	General Mining	2 217.9	166 453.1	30 363.8	28 193.6	2 293	C1	D
KGHM POLSKA MIEDZ	Poland	Nonferrous Metals	2 113.6	4 812 482.1	806 464.2	766 070.5	34 097	C1	B+
INTEGER.PL	Poland	Transportation Services	2 062.7	141 863.5	54 972.3	-68.6	1 551	C1	B+
TRINECKE ZELEZARNY	Czech Republic	Iron & Steel	2 060.3	1 383 489.7	0.0	137 845.8	7 500	U2	D
RIGAS ELEKTROMASINBUVES RUPNICA	Latvia	Electrical Components & Equipment	1 997.1	33 765.0	4 223.0	8.860	936	C2	B+
BORYSZEW	Poland	Chemicals	1 957.2	1 187 883.7	34 476.9	42 329.3	8 285	C1	D
KREDITNA BANKA ZAGREB	Croatia	Banks	1 827.9	17 447.8	0.0	-5 188.6	195	U1	A+
ISKRA ZASCITE PODJETJE ZA IZVAJANJE ZASCIT	Solvenia	Electronic & Electrical Equipment	1 761.1	0.0	0.0	0.0	120	U1	D

Company name	Country	Industry (ICB)	R&D investment 2014 (€k)	Net Sales 2014 (€k)	CAPEX 2014 (€k)	Operating Profit 2014 (€K)	Employees 2014	C. code	I. code
ETI ELEKTROELEMENT	Solvenia	Electrical Components & Equipment	1 596.1	83 846.1	0.0	5.913	794	U1	A+
MERCOR	Poland	Building Materials & Fixtures	1 354.8	48 556.9	1 844.0	4 389.3	312	C1	B+
AGROKOR	Croatia	Food & Beverage	1 295.2	49 981.4	0.0	-13 064.9	232	U2	D
STREKOV FATTY ACIDS	Czech Republic	Chemicals	1 243.7	33 053.9	0.0	3.642	15	U1	-
ROMPETROL RAFINARE	Romania	Integrated Oil & Gas	1 187.0	3 582 116.0	57 138.9	6 805.0	1 223	C1	B+
UNIPETROL	Czech Republic	Integrated Oil & Gas	1 082.1	4 481 117.3	73 549.6	-35 963.2	3 674	C1	D
MYTILINEOS HOLDINGS	Greece	Industrial Metals & Mining	9.470	1 240 317.0	49 448.0	188 497.0	1 807	C1	A
ISKRAEMECO	Solvenia	Electronic Equipment	9.247	0.0	0.0	0.0	0	U1	D
BIOTON	Poland	Biotechnology	8.995	88 608.4	6 537.7	4 950.3	902	C1	A+
HELLA SATURNUS	Solvenia	Electronic & Electrical Equipment	8.950	249 844.3	0.0	-9 633.4	1 518	U1	D
BIOTIKA	Slovakia	Pharmaceuticals	8.563	35 026.0	0.0	2 827.0	0	C1	B+
ZELEZIARNE PODBREZOVA	Slovakia	Iron & Steel	7.030	476 139.1	0.0	46 111.3	8 062	C1	C+
GENERA	Croatia	Pharmaceuticals	6.988	27 574.2	2 934.6	7.748	278	C1	D
SYNERGON INFORMATION SYSTEMS	Hungary	Computer Services	6.919	13 246.6	186	-2 611.4	0	C1	A
FLEXOPACK	Greece	Building Materials & Fixtures	6.610	58 273.0	4 914.0	5 314.0	269	C1	B+
HRVATSKA POSTANSKA BANK	Croatia	Banks	6.149	101 066.6	0.0	-82 390.2	1 120	C2	D
HARJU ELEKTER	Estonia	Electrical Components & Equipment	6.040	50 606.0	7.650	2 228.0	483	C1	B+
SLOVAK TELEKOM	Slovakia	Telecommunications	5.730	561 584.7	0.0	49 147.8	7 500	C2	D
EXIMBANK ROMANIA	Romania	Specialty Finance	5.670	47 965.4	0.0	10 567.1	0	C2	D
SAF TEHNIKA	Latvia	Telecommunications Equipment	5.242	12 026.0	0.0	3.050	0	C1	A+

Company name	Country	Industry (ICB)	R&D investment 2014 (€k)	Net Sales 2014 (€k)	CAPEX 2014 (€k)	Operating Profit 2014 (€K)	Employees 2014	C. code	I. code
SLOVNAFT	Slovakia	Oil Equipment, Services & Distribution	4.660	4 005 993.0	211 278.0	22 920.0	3 259	C1	D
ELVAL HELLENIC ALUMINIUM INDUSTRY	Greece	Aluminium	4.380	1 060 397.0	61 195.0	35 650.0	2 211	C1	D
VALMIERAS STIKLA SKIEDRA	Latvia	Diversified Industrials	3.744	108 441.0	16 533.0	3 255.0	1 098	C1	B+
SNAIGE	Lithuania	Specialty Retailers	3.050	42 194.5	8.336	-512.1	722	C1	D
BYTE COMPUTER	Greece	Computer Services	3.019	29 182.0	1 739.0	1 681.0	188	C1	A
OLAINFARM	Latvia	Pharmaceuticals	2.980	93 654.0	12 975.0	19 126.0	1 231	C1	B+
EYATH	Greece	Water	2.860	73 693.0	5 930.0	23 232.0	229	C1	D
ELECTROMAGNETICA	Romania	Telecommunications Equipment	2.689	95 623.3	1 396.7	-433.4	626	C1	B+
I.D.C. HOLDING	Slovakia	Food Products	2.680	102 205.0	0.0	9 795.0	0	U1	B+
HEP-OPERATOR DISTRIBUCIJSKOG SUSTAVA	Croatia	Conventional Electricity	2.554	872 480.5	0.0	111 638.5	7 645	U1	D
HELESI	Cyprus	Diversified Industrials	2.230	28 795.0	0.0	-4 490.0	277	C1	A+
ELECTRICA FURNIZARE	Romania	Conventional Electricity	2.214	896 222.3	0.0	49 986.1	1 219	U1	D
SNTGN TRANSGAZ	Romania	Gas Distribution	1.967	360 715.0	31 734.9	141 334.5	4 820	C1	D
COMPANIA NATIONALA DE TRANSPORT AL ENERGIEI ELECTRICE TRANSELECTRICA SA	Romania	Conventional Electricity	1.789	630 599.2	43 822.3	109 582.2	0	C1	D
LANEX	Czech Republic	Clothing & Accessories	1.424	25 663.7	0.0	9.918	375	U1	D
TALLINNA KAUBAMAJA GRUPP	Estonia	Clothing & Accessories	1.250	535 045.0	8 982.0	23 787.0	3 824	C1	D
EKSPRESS GRUPP	Estonia	Media	710	52 793.0	3 101.0	6 906.0	786	C1	C+
LATVIJAS JURAS MEDICINAS CENTRS	Latvia	Health Care Providers	427	5 485.0	3.310	1 182.0	393	C1	A+
LOGICOM	Cyprus	Telecommunications Equipment	400	631 176.0	1 896.0	13 144.0	0	C1	D

Company name	Country	Industry (ICB)	R&D investment 2014 (€k)	Net Sales 2014 (€k)	CAPEX 2014 (€k)	Operating Profit 2014 (€K)	Employees 2014	C. code	I. code
HOK OSIGURANJE	Croatia	Insurance	220	22 497.9	0.0	1 661.0	0	U1	D
AGRAM LIFE OSIGURANJE	Croatia	Insurance	167	0.0	0.0	0.0	0		U
ORLEN LIETUVA	Lithuania	Integrated Oil & Gas	25	4 662 716.6	0.0	-656 851.2	1 367	C1	D
WASKO	Poland	Software	0.0	87 485.9	2 542.9	4 678.6	1 092	C1	D

Annex 5 - Access to the full dataset

The 2015 *Scoreboard* comprises two data samples:

- The world's top 2500 companies that invested more than €18.0m in R&D in 2014.
- The top 1000 R&D investing companies based in the EU with R&D investment exceeding €5.5m.

For each company the following information is available:

- Company identification (name, country of registration and sector of declared activity according to ICB classifications).
- R&D investment
- Net Sales
- Capital expenditure
- Operating profit or loss
- Total number of employees
- Main company indicators (R&D intensity, Capex intensity, Profitability)
- Growth rates of main indicators over one year and three years.

The following links provide access to the two *Scoreboard* data samples containing the main economic and financial indicators and main statistics over the past four years.

R&D ranking of world top 2500 companies: http://iri.jrc.ec.europa.eu/documents/10180/d7f67bce-288d-4c71-9d5d-67058c912511

R&D ranking of EU top 1000 companies:

http://iri.jrc.ec.europa.eu/documents/10180/c0035c57-3ba5-4dbc-85f1-1a669f50f9fb

European Commission
EUR 27540 EN – Joint Research Centre – Institute for Prospective Technological Studies – DG Research

Title: The 2015 EU Industrial R&D Investment Scoreboard

Authors: Héctor Hernández, Fernando Hervás, Alexander Tübke, Antonio Vezzani, Mafini Dosso, Sara Amoroso, Nicola Grassano, Alexander Coad, Petros Gkotsis

Luxembourg: Publications Office of the European Union, 2015

2015 - 104 pp. - 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)

ISBN 978-92-79-53020-3 (pdf), ISBN 978-92-79-53021-0 (print)

doi:10.2791/15792 (online), doi:10.2791/50785 (print)

Abstract
The 2015 EU R&D Scoreboard reports economic and financial information on the world's top 2500 companies that invested €607.2 billion in R&D over the last fiscal year (2014). It comprises 608 companies based in the EU, 829 companies based in the US, 360 in Japan and 703 from the rest of the world.

Key findings from the 2015 Scoreboard:

- In 2014, the top world 2500 R&D Scoreboard companies raised their R&D by 6.8%, while revenues continued to grow at a significant lower pace (2.2%).

- Companies based in the EU showed an annual R&D investment growth rate of 3.3%, slightly improving the previous year's performance (2.5%). Companies based in the US showed a stronger R&D investment growth rate (8.1%). The Chinese companies, 3rd largest country by number of companies in this edition, increased R&D investments by 23.6%.

- Companies in the ICT, Pharmaceuticals and Automobiles sectors continue to dominate the top 10 places in the world ranking. As in the previous edition, the top R&D investors are Volkswagen, Samsung, Microsoft, Intel and Novartis. The most significant changes at the top of the ranking in 2014 are the climb of Google to 6th place (from 9th), and of Pfizer to the 10th place (from 15th). Huawei (15th) and Apple (18th) accelerated in 2014 their race to the top, jumping 11 and 17 positions respectively.

- An analysis of the patent portfolios of the world's top R&D investors shows that EU and US companies have the highest degrees of internationalisation of their inventive activities: 26% and 22% of their patent families are developed by inventors located outside the region. While the US appear to be the preferred location for health related inventions (pharma and biotech in particular), Europe is the most attractive place for the inventive activities of automobile companies.

LF-NA-27540-EN-N

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools sharing standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

Publications Office

doi:10.2791/15792
ISBN 978-92-79-53020-3