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The 2017 PREDICT Key Facts Report

An Analysis of ICT R&D in the EU and Beyond

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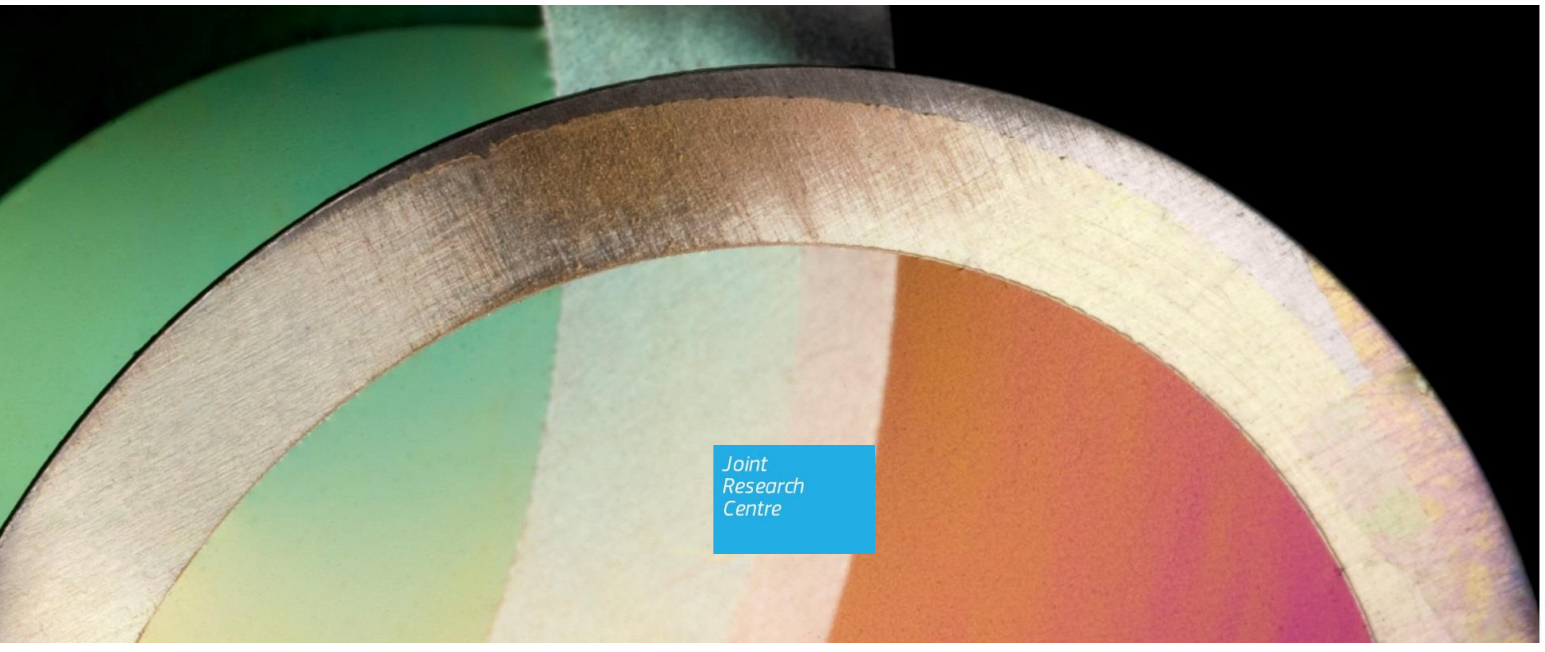

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Abstract

The 2017 PREDICT Key Facts Report provides a detailed analysis of the state of ICT R&D activities in the European Union. This is the tenth edition of a series that is published annually. Like the previous editions, an online version is available at: https://ec.europa.eu/jrc/en/predict.

The PREDICT dataset 2017 is based on the latest data available from official sources (such as the Eurostat and OECD, National Accounts and R&D statistics). It also includes the novelty of backwards reconstruction of the series from 1995, which allows it to cover the period from 1995 to 2014. Therefore, it provides a long-term analysis of the EU ICT sector and its R&D, covering a whole cycle since the initial expansion years, the double recession that began in early 2008, and the most recent evolution up to 2014.

Keywords
R&D, ICT, innovation, statistics, digital economy, ICT industry analysis, ICT R&D and innovation

Contents

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Foreword

PREDICT: Prospective Insights on R&D in ICT

PREDICT has been producing statistics and analyses on ICT industries and their R&D in Europe since 2006. The project covers major world competitors including 40 advanced and emerging countries – the EU28 plus Norway, Russia and Switzerland in Europe, Canada, the United States and Brazil in the Americas, China, India, Japan, South Korea and Taiwan in Asia, and Australia. It also covers a growing array of indicators related to the ICT content of economic activities.

Rationale

ICTs determine competitive power in the knowledge economy. For the aggregate of the 40 economies under scrutiny in the project, almost one fourth of total Business expenditure in R&D (BERD) originates in the ICT sector alone. Besides the impact ICT uptake has on the organisation of businesses, this sector also plays an important enabling role for innovation in other technological domains. This is reflected at the EU policy level, where the Digital Agenda for Europe in 2010 was identified as one of the seven pillars of the Europe 2020 Strategy for growth in the Union. In addition, the achievement of a Digital Single Market (DSM) has been one of the 10 political priorities of the Commission since 2015.

Statistics and indicators

PREDICT provides indicators in a wide variety of topics, including value added, employment, labour productivity and BERD, distinguishing fine grain economic activities in ICT and media and content industries (up to 22 individual activities, 14 of which are at the class level, i.e. at 4 digits in the ISIC classification) and at a higher level of aggregation for all the other industries in the economy. It also produces data on government financing of R&D in ICTs, and total R&D expenditure at the country level. Now-casting of more relevant data in these domains has also been performed, and time series go back to 1995.

Team

PREDICT is a collaboration between the JRC and the European Commission Communications Networks, Content and Technology (CNECT) Directorate General.
Since 2013, data collection and analysis has been carried out jointly by JRC and the Valencian Institute of Economic Research (Instituto Valenciano de Investigaciones Económicas - Ivie).

Introduction

The 2017 edition of the PREDICT Key Facts Report is based on the latest data available from official sources, such as the Statistical Office of the European Communities (Eurostat) and the Organisation for Economic Co-operation and Development (OECD). This PREDICT Report includes the novelty of backwards reconstruction of the series from 1995, so that it covers the period between 1995 and 2014. Therefore, it provides a long-term analysis of the European Union (EU) ICT sector and its R&D, covering a whole cycle from the initial expansion years, through to the double recession that began in early 2008, and the most recent evolution up to 2014. PREDICT analyses follow the Statistical Classification of Economic Activities in the European Community (NACE) Rev 2 definition of the ICT sector[1]. This new definition of the ICT sector was adopted in 2006, and since 2008 all Member States have been required to adopt it when reporting ICT sector data[2].

The present Report includes:

- an introduction showing the EU ICT sector trajectory, including its R&D since 1995;
- a comparison of the EU with other twelve leading ICT countries from the five continents in terms of the relevance of the ICT industry and its R&D;
- a complete analysis of the importance of the EU ICT sector and sub-sectors in the EU and Member States;
- a summary of the ICT indicators by sub-sector for the European Union, Member States and other economies.

Due to the relevancy of the Media and content sector[3] and its growing inter-relation with the ICTs, this sector is presented in some of the graphs. Similarly, the Retail sale via mail order houses or via Internet is also included.

The data and analyses are provided according to the following dimensions:

- size of the ICT sector value added and its share of GDP,
- ICT sector employment and labour productivity (both productivity per person employed and productivity per hour worked),
- ICT sector business enterprise expenditure on R&D (ICT sector BERD), Public Funding of ICT R&D (ICT GBARD), that is now offered by industries,
- ICT sector R&D personnel and researchers.

The data and analyses available here are based on data from National Accounts and R&D statistics.

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1 OECD Information Economy–Sector definitions based on the international classification equivalent to European NACE Rev. 2, the International Standard Industry Classification (ISIC 4), Annex 1, p.15, available at: http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf.

2 More details on methodology are provided in Mas, Robledo and Pérez (2012), *ICT sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note*, Ivie.

3 The Media and content sector is defined "as industries that are engaged in the production, publishing and/or the electronic distribution of content products" by OECD (2011), *Guide to measuring the Information Society*. ISBN 978-92-64-09598-4. http://www.oecd.org/sti/measuring-infoeconomy/guide.

1 Overview of the ICT sector and its R&D in the EU

In this section and the following ICT sector is defined along with the Operational classification shown in Box 1. This classification departs from the OECD (2007) classification followed in Section 2 as it does not include the ICT trade industry (NACE Rev. 2 465) and Manufacture of magnetic and optical media (NACE Rev.2 268). The adoption of the operational classification allows the comparison of the data over the long term and with non-EU countries, which would have been impossible in case of adoption of a comprehensive definition, due to lack of data for the two above mentioned sectors particularly for non-EU countries,

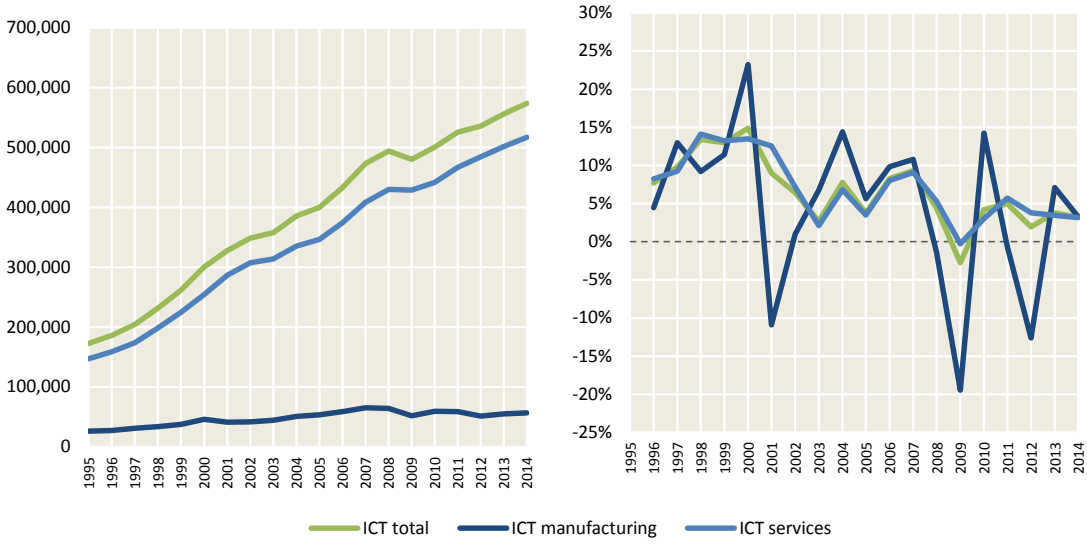
Box 1: List of NACE Rev. 2 ICT sub-sectors. Operational definition

Nace Rev. 2	Description
261-264, 582, 61, 62, 631, 951	**ICT total (operational)**
261-264	**ICT manufacturing industries (operational)**
261	Manufacture of electronic components and boards
262	Manufacture of computers and peripheral equipment
263	Manufacture of communication equipment
264	Manufacture of consumer electronics
582, 61, 62, 631, 951	**ICT services industries**
61	Telecommunications
582, 62, 631, 951	Computer and related activities

Figure 1: ICT sector VA in the European Union (1995-2014)

a) Million constant [base year 2010] EUR

b) Annual real growth rates



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

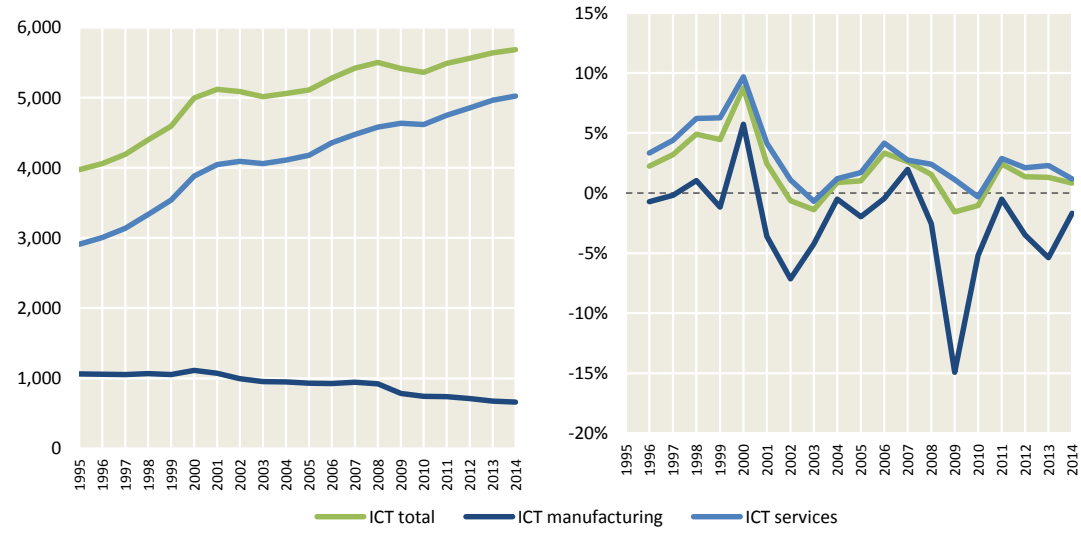
EU ICT sector VA reached 573.617 constant million EUR in 2014, having more than tripled its size in the last two decades in real terms. This long-term upward trend was only interrupted in 2009, one of the worst years of the economic crisis, when VA fell by 2.8%.

ICT services, the largest ICT sub-sector, defines the behaviour of total ICT. This sector represented 90.1% of the total in 2014 and gained weight during the analysed period. In the case of ICT services, the contraction in 2009 was minor (-0.3%). VA for the ICT manufacturing sector was more volatile than it was for ICT services, and its growth fell sharply in 2001 (-10.9%), 2009 (-19.5%) and 2012 (-12.6%) (Figure 1).

Figure 2: ICT sector employment in the European Union (1995-2014)

a) Thousand persons employed

b) Annual growth rates



Note: ICT sectors correspond to the operational definition of ICT sector.

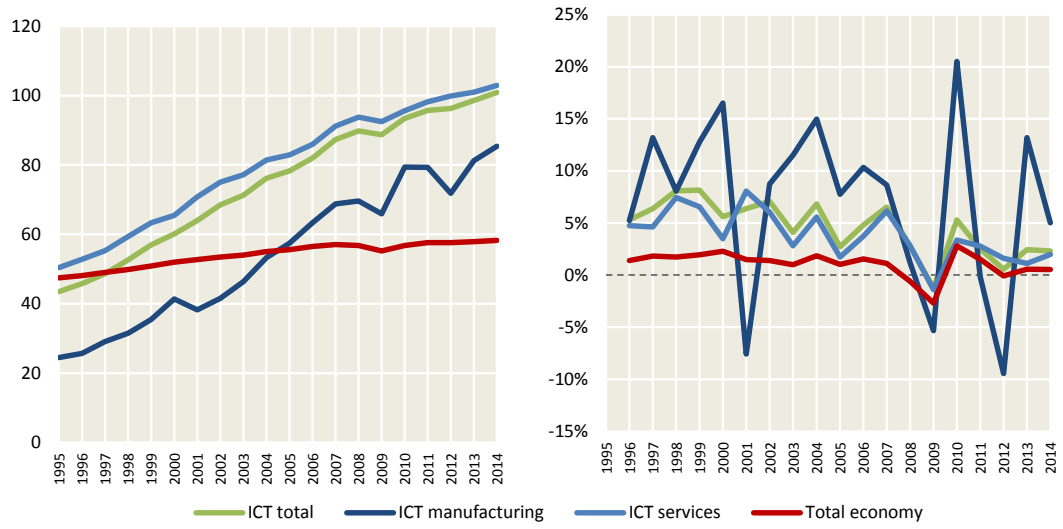
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT sector employment in the EU exceeded 5.6 million employed in 2014, 1.5 times higher than it was in 1995, the beginning of the period. The overall positive growth of ICT sector employment experienced a slight reduction in only two periods: 2001-2003 and 2008-2010. ICT manufacturing employment represented around 27% of total ICT employment in 1995. However, since then this percentage has been decreasing because ICT manufacturing employment experienced negative growth rates from the late 90s onwards. The largest negative growth rates in employment in the ICT manufacturing industries occurred in 2002 (-7.2%) and in 2009 (-14.9%). The trajectory of ICT services was similar to the total ICT sector, although it only had negative growth rates in 2003 and 2010 (Figure 2).

Figure 3: ICT sector productivity per person employed in the European Union (thousand constant [base year 2010] EUR per person; 1995-2014)

a) Thousand constant [base year 2010] EUR per person

b) Annual real growth rates



Note: ICT sectors correspond to the operational definition of ICT sector.

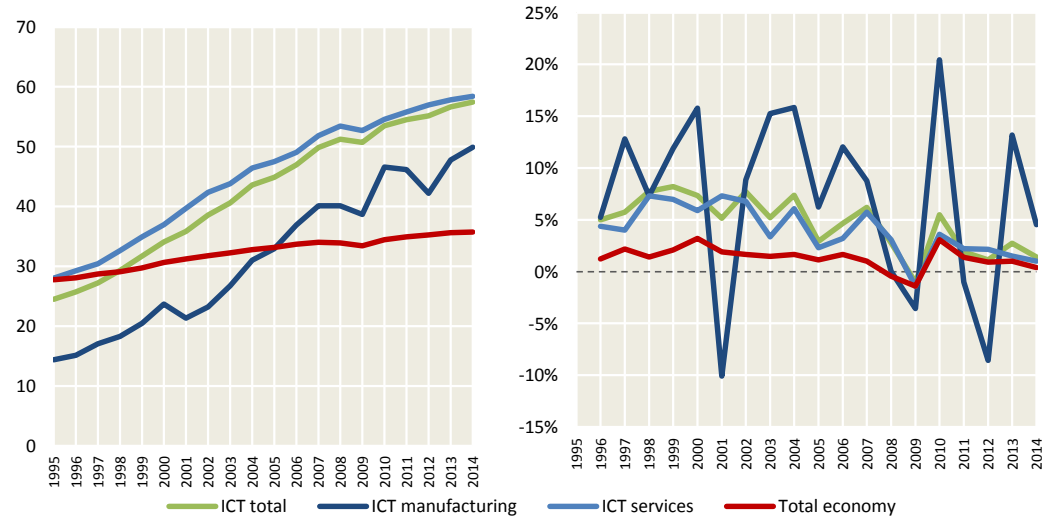
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity in all the ICT sub-sectors exceeded that of the total economy; especially ICT services (76.7% higher than the productivity in the total economy). However, in 1995, the productivity per person employed in the ICT sector was 8.4% lower than it was in the total economy. In the ICT manufacturing sector, the differential was greater, this sector's productivity representing in 1995 only 48.5% of what was in the total economy. Only ICT services presented a higher level of productivity, 6.2% more. The intense growth rates of productivity in the ICT sectors throughout the period —with only a few exceptions in ICT manufacturing— led it to exceed by far the total economy levels (Figure 3).

Figure 4: ICT sector productivity per hour worked in the European Union (constant [base year 2010] EUR per hour worked; 1995-2014)

a) Thousand persons employed

b) Annual real growth rates



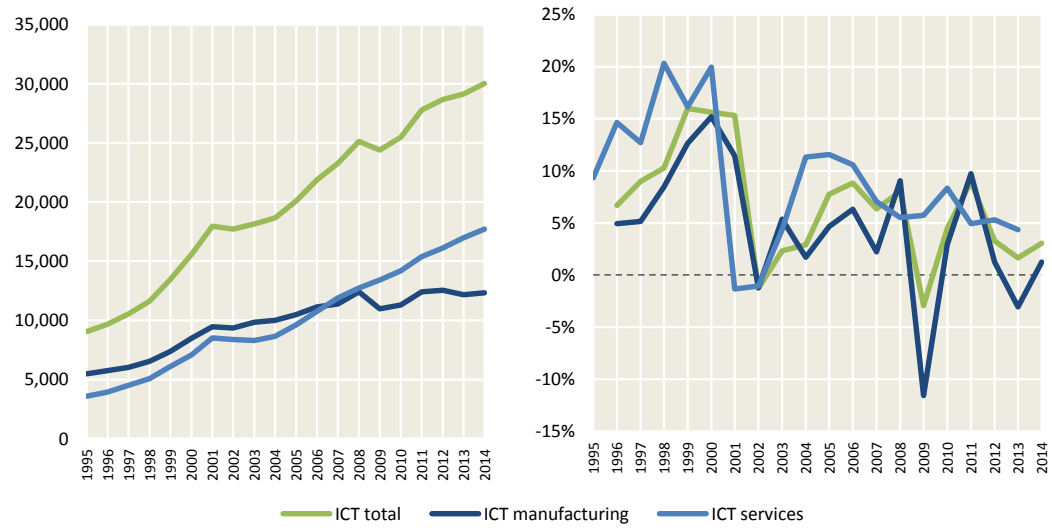
Note: ICT sectors correspond to the operational definition of ICT sector.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The evolution of productivity per hour worked in the ICT sector in EU is very similar to the productivity per person employed (Figure 3). In 1995, only the ICT services sector exceeded total economy levels, and then just barely (+0.97%). The higher growth rates of ICT sector productivity during the subsequent period —with some exceptions in ICT manufacturing (in 2001, 2009, 2011 and 2012)— led it to greatly surpass total economy levels. In 2014, ICT sector productivity was 60.8% higher than that of the total economy (Figure 4).

Figure 5*:* ICT sector BERD in the European Union (1995-2014)

a) Million of constant [base year 2010] EUR *b) Annual real growth rates*



Note: ICT sectors correspond to the operational definition of ICT sector.

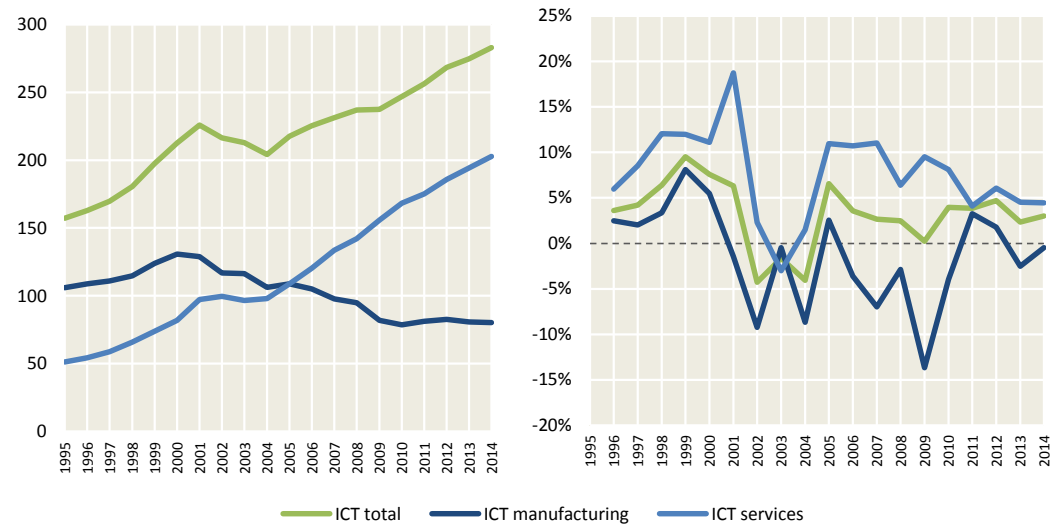
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT sector BERD in the EU reached 30,031 million of constant EUR in 2014. Like the case of VA, it tripled its size in real terms between 1995 and 2014. Positive growth in the ICT sector was only interrupted in 2002 (-1.3%) and 2009 (-2.9%). ICT sector BERD was higher in ICT manufacturing than in services until 2007. After that year, the higher growth rates observed by ICT services during almost all the period combined with the relative slowdown of ICT manufacturing levels in the last economic crisis (-11.58% of annual growth in 2009) allowed ICT services to overtake in terms of BERD (Figure 5).

Figure 6: ICT sector R&D personnel in the European Union (1995-2014)

a) Thousand full-time equivalent

b) Annual growth rates



Note: ICT sectors correspond to the operational definition of ICT sector.

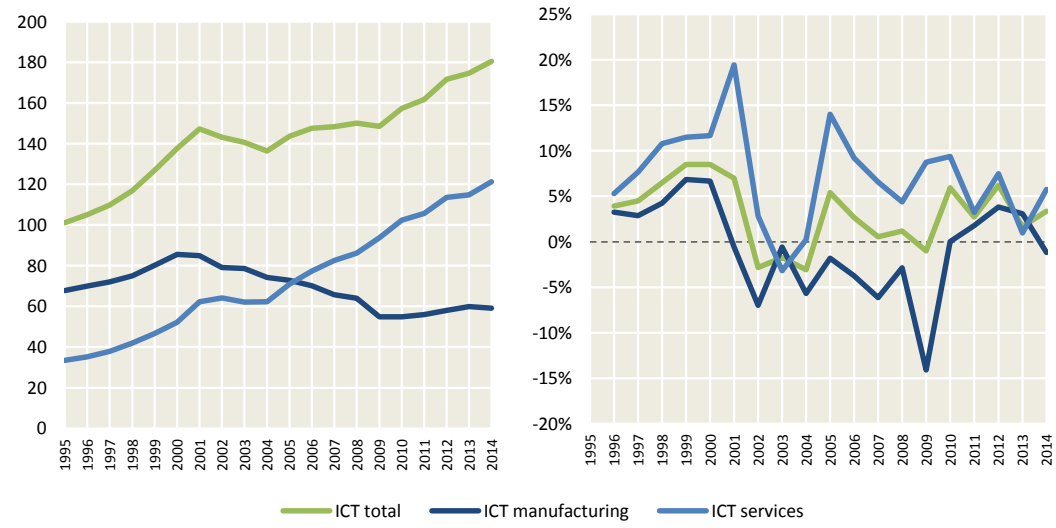
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, there were around 283 thousand full-time equivalent (FTE) EU R&D personnel in the ICT sector, almost double the number in 1995. Growth rates were positive during almost the entire period, the only exception being from 2002-2004. In 1995, ICT manufacturing represented more than 65% of total ICT R&D personnel, but this percentage has fallen continuously since then. R&D personnel in ICT services has grown continuously since 1995 (except for 2003). Since 2006, the weight of the R&D personnel in ICT services was higher than it was in ICT manufacturing. In 2014, ICT services' R&D personnel represented 71.7% of total ICT sector R&D personnel (Figure 6).

Figure 7: ICT sector R&D researchers in the European Union (1995-2014)

a) Thousand full-time equivalent

b) Annual growth rates



Note: ICT sectors correspond to the operational definition of ICT sector.

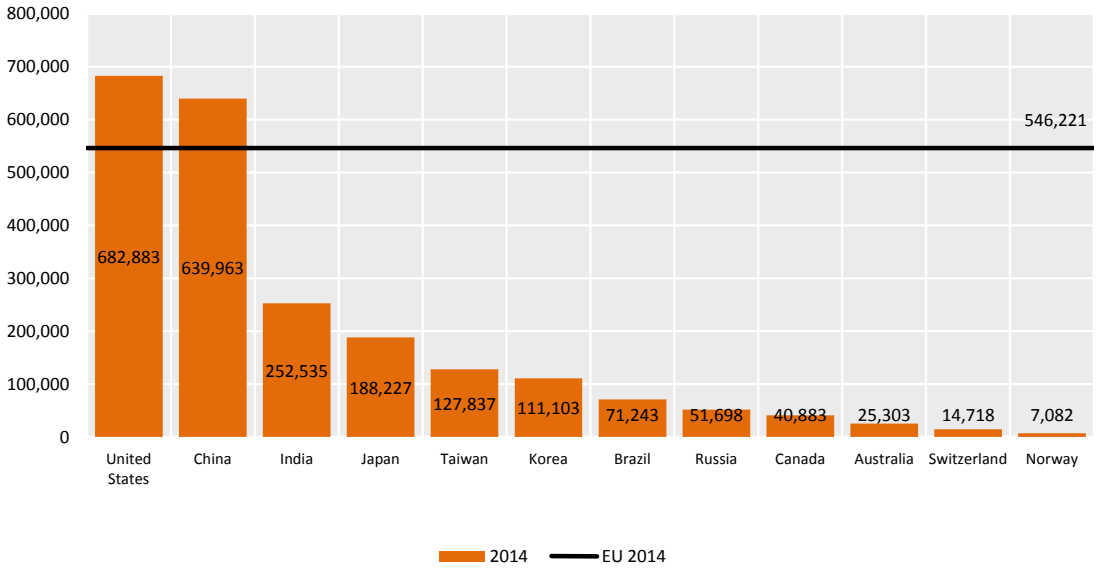
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, there were 180 thousand FTE researchers in the EU ICT sector, 1.8 times more than in 1995. R&D researchers and R&D personnel followed very similar trends in the period, albeit with different intensities. FTE researchers in ICT services represented 33% of the total for the ICT sector in 1995, and this share had doubled by the end of the period, reaching 67.2% (Figure 7).

2 Comparison with other economies

2.1 ICT sector value added

Figure 8: ICT sector VA in the European Union and other non-EU economies (millions of current EUR PPS [Purchase Power Standard], 2014)

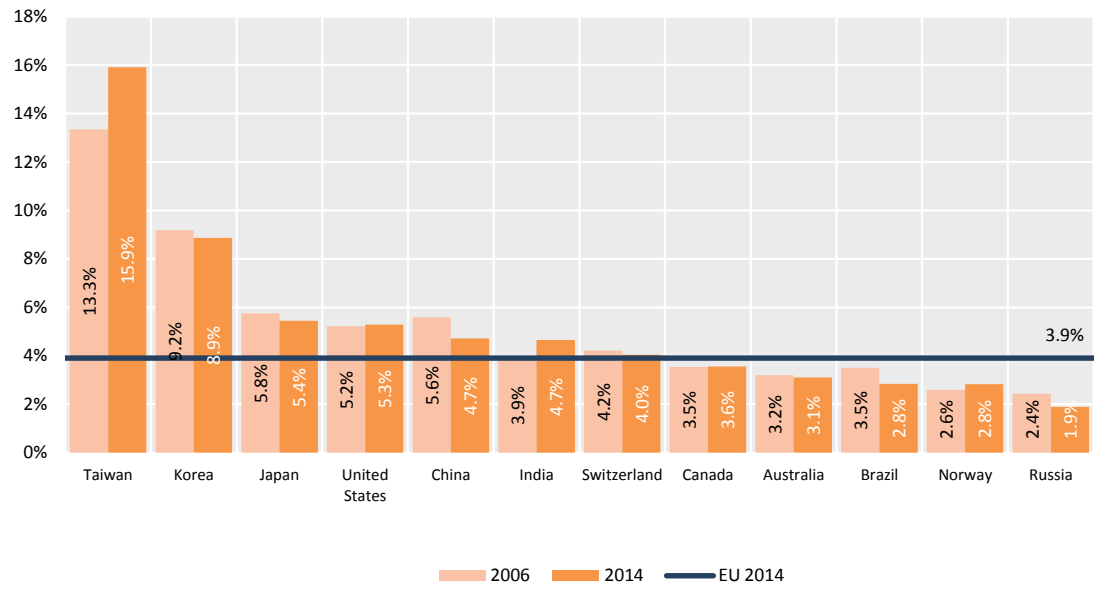


Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the US had the largest ICT sector value added, closely followed by China, both exceeding 600.000 million of current euros PPS. The EU ranked third, a long way from the other Asian countries in the analysed sample. The US, China and the EU together represented two-thirds of total ICT VA for our sample of countries. Australia, Switzerland and Norway were the lowest in the ranking (Figure 8).

Figure 9: ICT sector VA share of GDP in the European Union and other non-EU economies (2006 and 2014)

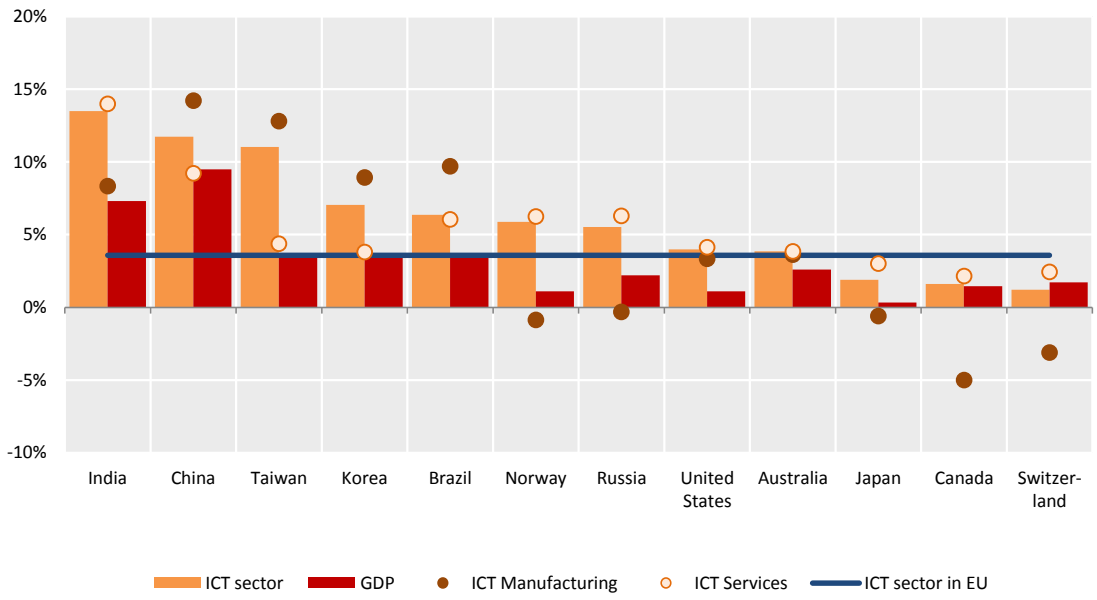


Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The importance of the ICT sector in the countries in our sample varied considerably. The five Asian countries, together with the US, have the highest share of ICT sector VA in their GDP. However, this share decreased in seven of the countries analysed between 2006 and 2014 (Switzerland, South Korea, Japan, China, Australia, Brazil and Russia). By contrast, Taiwan and India experienced the strongest growths. The EU ICT VA share was 3.9% in 2014, which represents an intermediate position among the countries shown (Figure 9).

Figure 10: Mean annual real growth rate of ICT sector VA and GDP in the European Union and other non-EU economies (2006-2014)



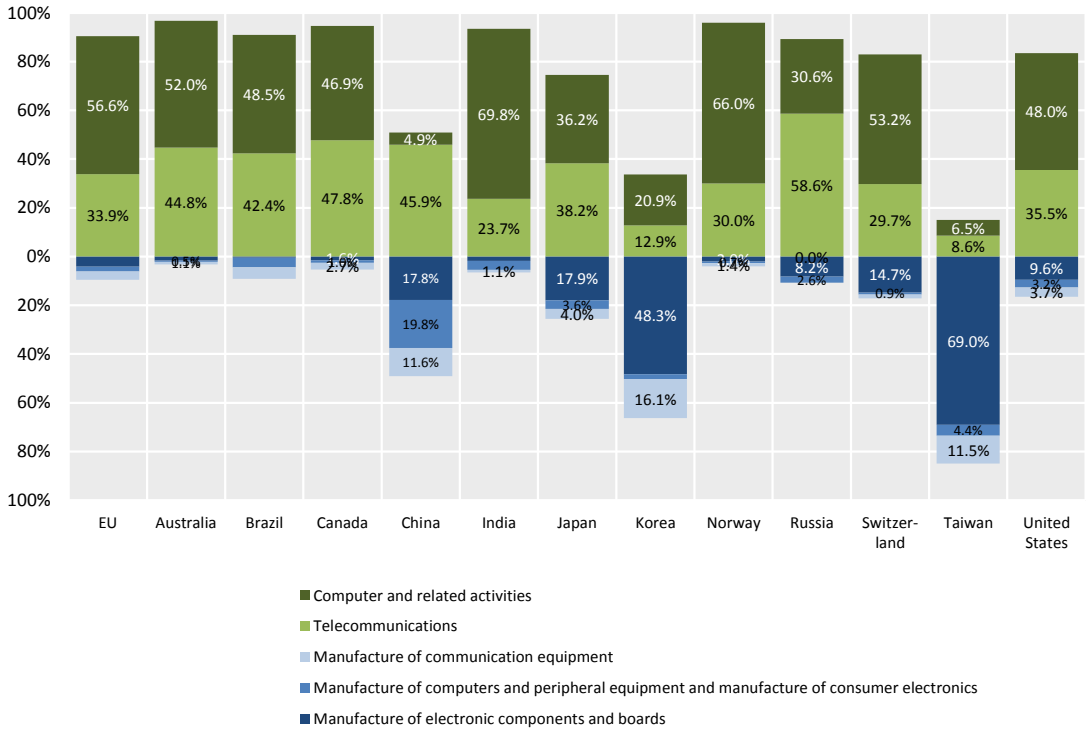
Note: 2006-2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, the Asian countries, with the exception of Japan, led in terms of real growth rates in ICT sector VA (and also GDP). India, China and Taiwan grew sharply, by over 10%, whereas ICT sector growth in Japan, Canada and Switzerland did not exceed 2%. The EU, the United States and Australia had similar growth rates, around 4%. All the countries in the sample had positive ICT sector growth.

All the countries had positive growth rates in ICT services, ranging from 14.0% in India and 9.2% in China to 2.2% in Canada, while the ICT manufacturing sector VA decreased in some of them (Norway, Russia, Switzerland and Canada) (Figure 10).

Figure 11: ICT sector VA by sub-sectors in the European Union and other non-EU economies (2014)

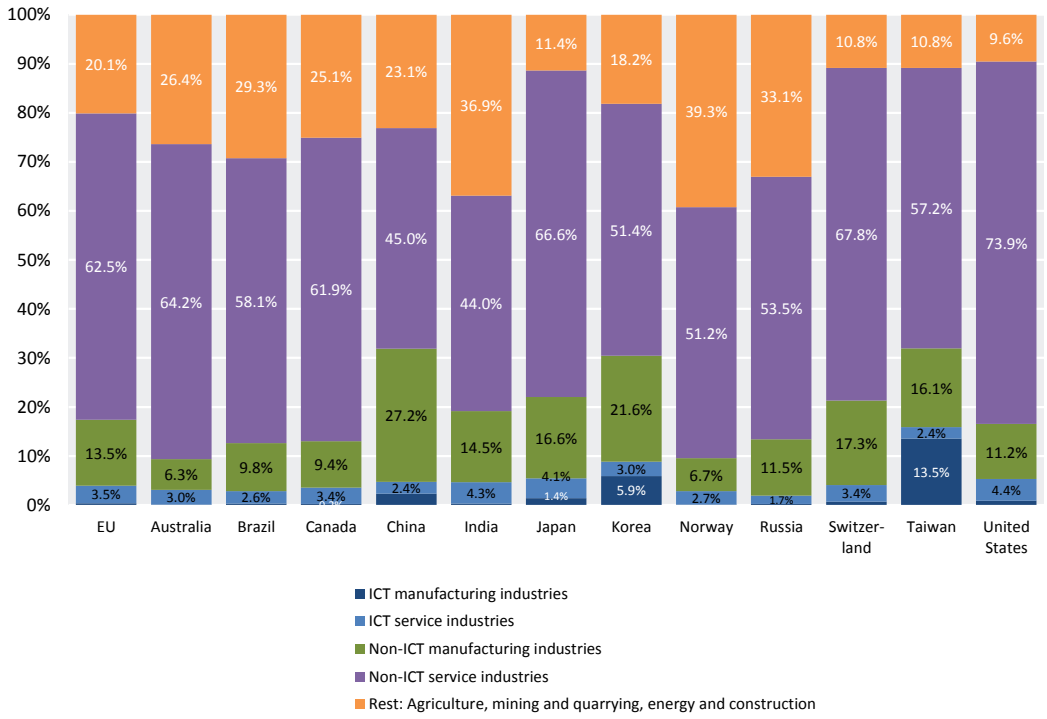


Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Of the five ICT sub-sectors represented in the figure, three stand out: *Manufacture of electronic components and boards; Computer and related activities;* and *Telecommunications.* The first two of them characterize especially China, Japan, South Korea and Taiwan, while EU and the US are characterized by the latter two. The most remarkable difference between the EU and the US is that the EU has a higher share in *Computer and related activities,* and a lower share in *Manufacture of electronic components and boards* (Figure 11).

Figure 12: ICT sector VA share of GDP and comparison with non-ICT economic activities. European Union and other non-EU economies (2014)



Note: 2013 for Canada. Non-ICT service industries include total Trade.

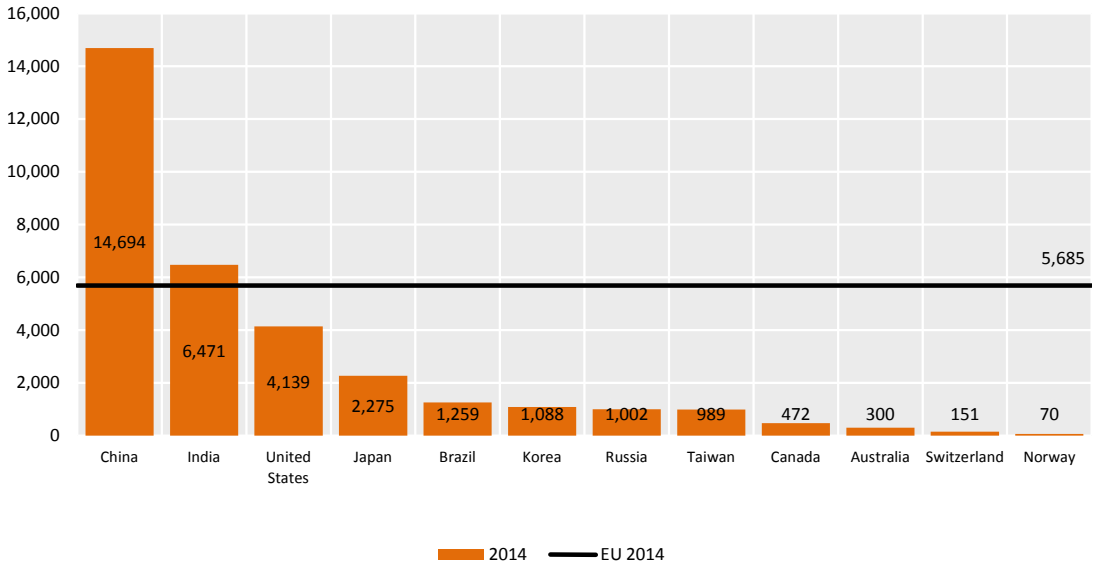
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT manufacturing sectors are relevant in terms of VA for only four Asian countries (Taiwan, South Korea and China), while for the remaining countries their presence was almost nil. The main difference between the EU and the US is that, in the US, the shares of non-ICT services and the ICT sector as a whole are higher (Figure 12).

2.2 ICT employment and ICT sector labour productivity

2.2.1 ICT sector employment

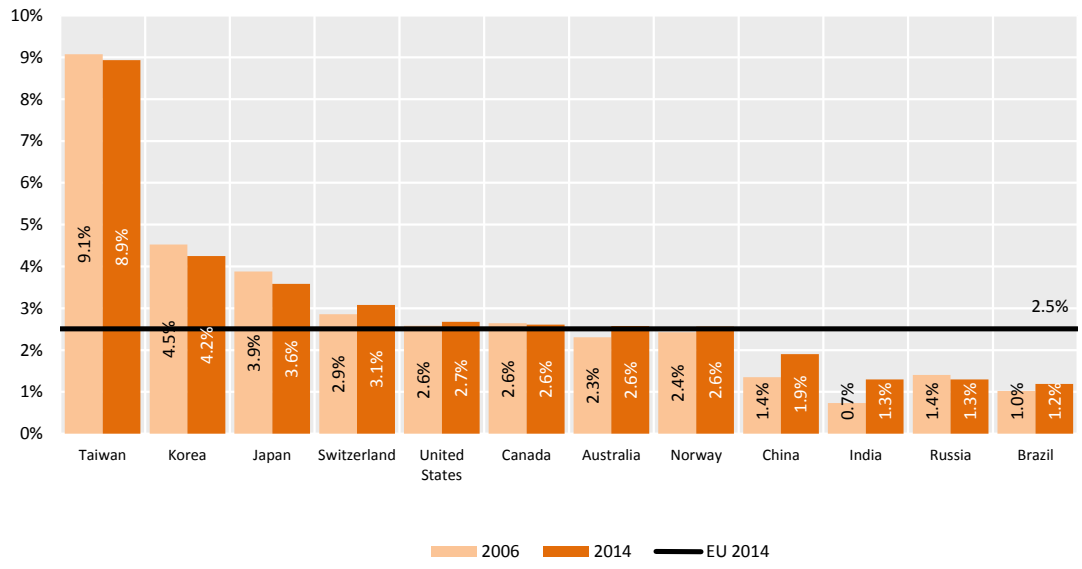
Figure 13: ICT sector employment in the European Union and other non-EU economies (thousand people employed, 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, China was the country with the highest ICT sector employment of the thirteen countries analysed, followed at a large distance by India, the EU and the United States. ICT sector employment in these four countries amounts to 80.3% of ICT sector employment in the whole sample (Figure 13).

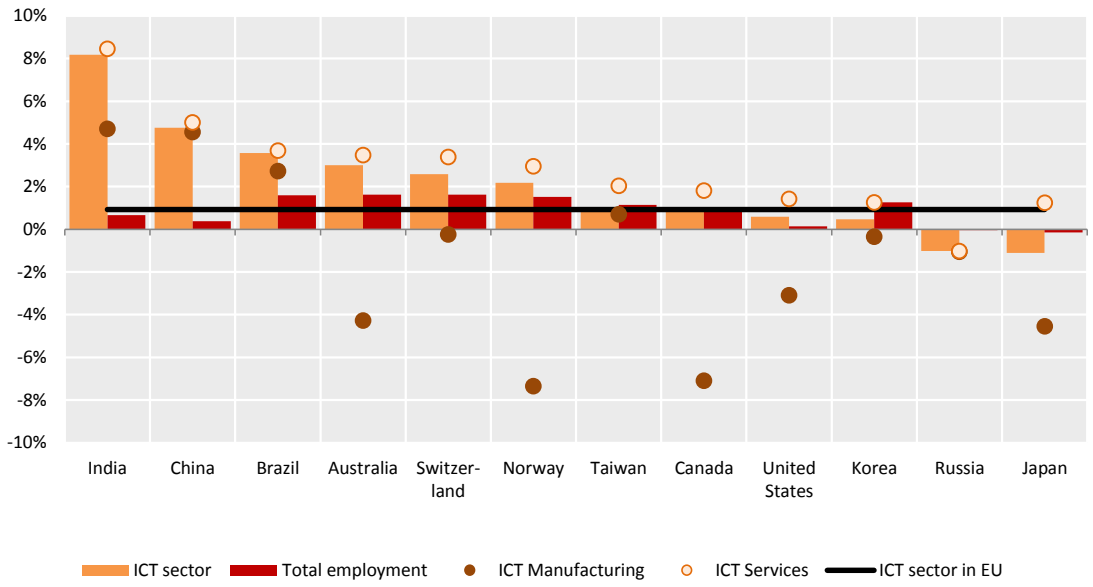
Figure 14: ICT sector employment share of total employment in the European Union and other non-EU economies (2006 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Taiwan, South Korea, and Japan have the highest shares of ICT sector employment. However, in all three countries, this share was less in 2014 than it was in 2006. The EU had a similar share to the United States, Canada and Norway (Figure 14).

Figure 15: Mean annual growth rate of ICT sector and total employment in the European Union and other non-EU economies (2006-2014)

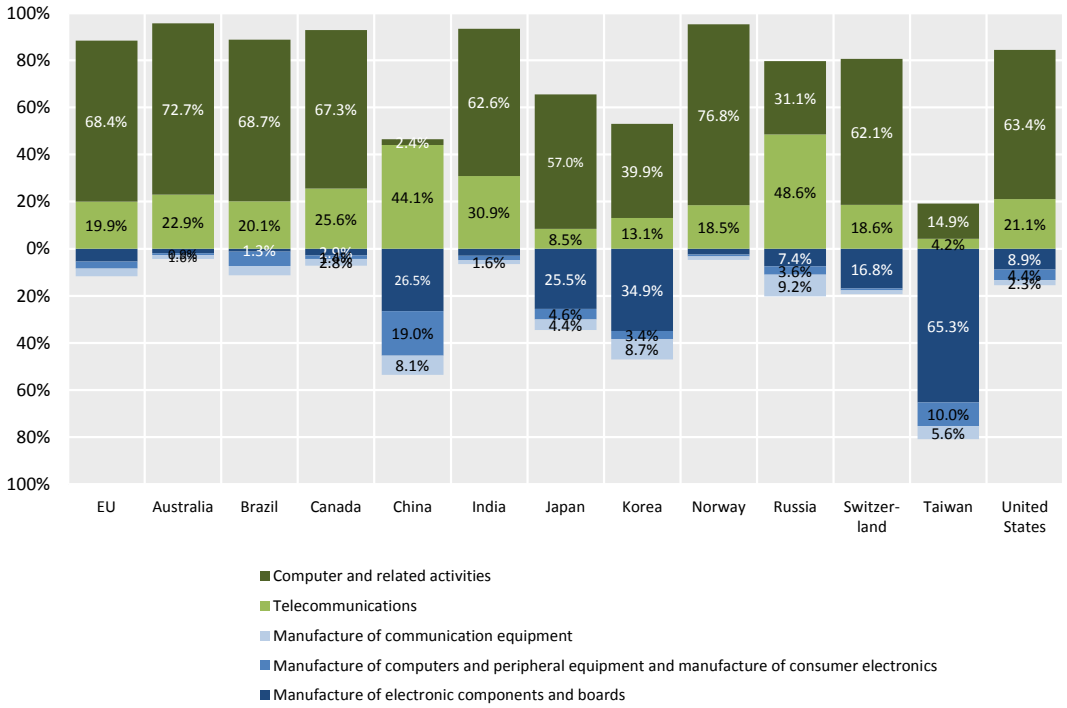


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Most of countries in the sample created employment in the ICT sector between 2006 and 2014. Only Russia and Japan cut back on the number of persons employed in this period. India, China and Brazil had the highest growth rates. The United States and South Korea were the lowest ranking countries with positive growth.

The annual growth rate of ICT services sector employment ranged from 8.4% in India to 1.2% in Japan and South Korea and -1% in Russia. In contrast, ICT manufacturing decreased in the majority of countries analysed, especially in Norway and Canada (by around 7%). Only India, China, Brazil and Taiwan had positive growth rates (Figure 15).

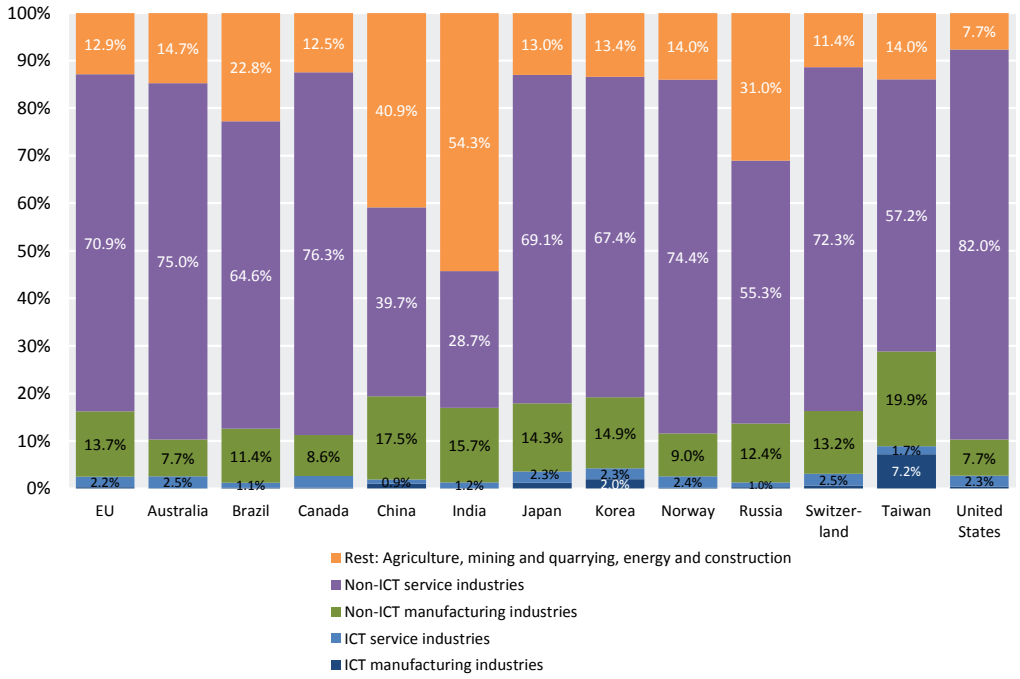
Figure 16: ICT sector employment by sub-sectors in the European Union and other non-EU economies (2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In terms of VA, three ICT sub-sectors had the highest share in total ICT sector employment: *Manufacture of electronic components and boards* (especially relevant for Asian countries: Taiwan, South Korea, China and Japan), *Telecommunications* (especially high in Russia, China and India) and *Computer and related activities* (all except China and Taiwan). The main difference between the EU and the US was that the US had a higher share in *Manufacture of electronic components and boards and Telecommunications* sub-sectors and a lower share in *Computer and related activities* and *Manufacture of communication equipment* (Figure 16).

Figure 17: ICT sector employment share of total employment and comparison with non-ICT economic activities. European Union and other non-EU economies (2014)



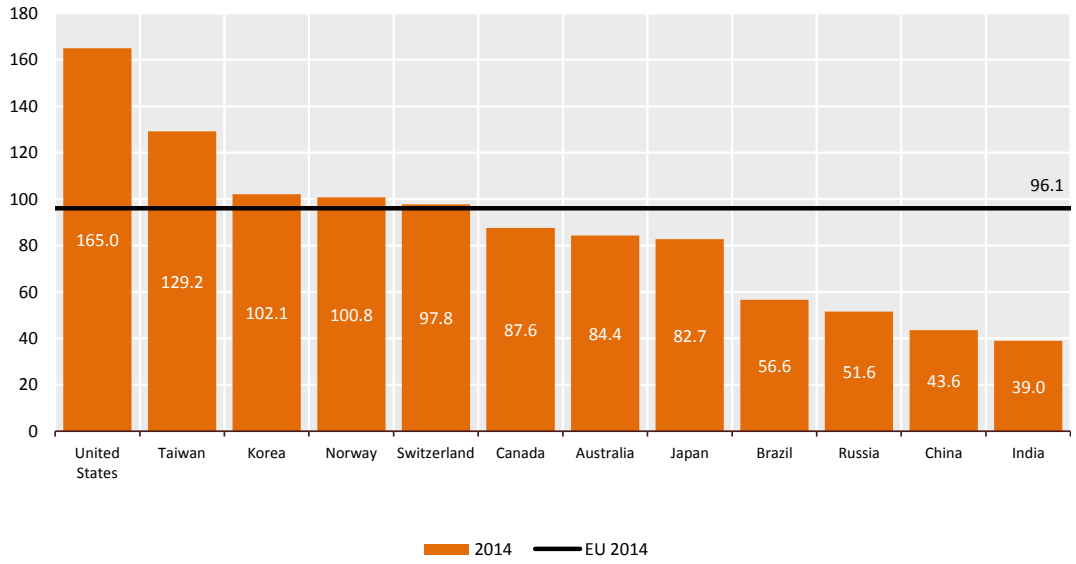
Note: Non-ICT service industries include total Trade.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In general, the contribution of non-ICT services industries VA to total GDP was lower than its contribution to total employment, except in China and India (Figure 12). The most remarkable fact when comparing the EU with the US is that the US had a higher share of non-ICT services industries and a lower share of non-ICT manufacturing industries (Figure 17).

2.2.2 ICT sector productivity per person employed

Figure 18: ICT sector productivity per person employed in the European Union and other non-EU economies (thousand EUR PPS per person, 2014)

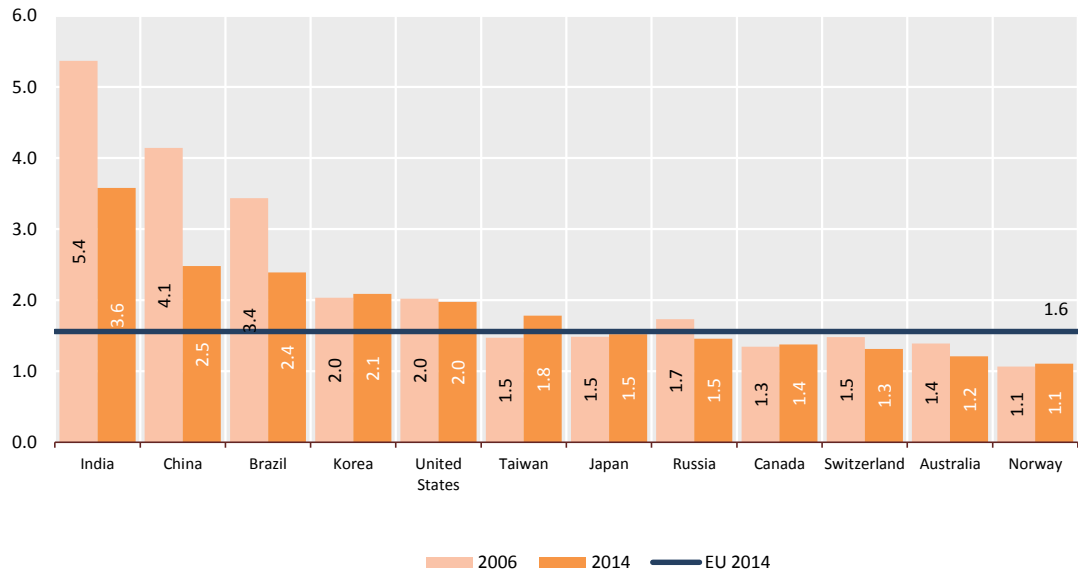


Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the United States had the highest productivity per person employed in the ICT sector. Taiwan came second, followed by South Korea, Norway and Switzerland. Brazil, Russia, China and India were on the opposite end of the spectrum. The EU was sixth, ahead of Canada, Australia and Japan (Figure 18).

Figure 19: ICT sector productivity per person employed ratio over total economy productivity in European Union and other non-EU economies (2006 and 2014)



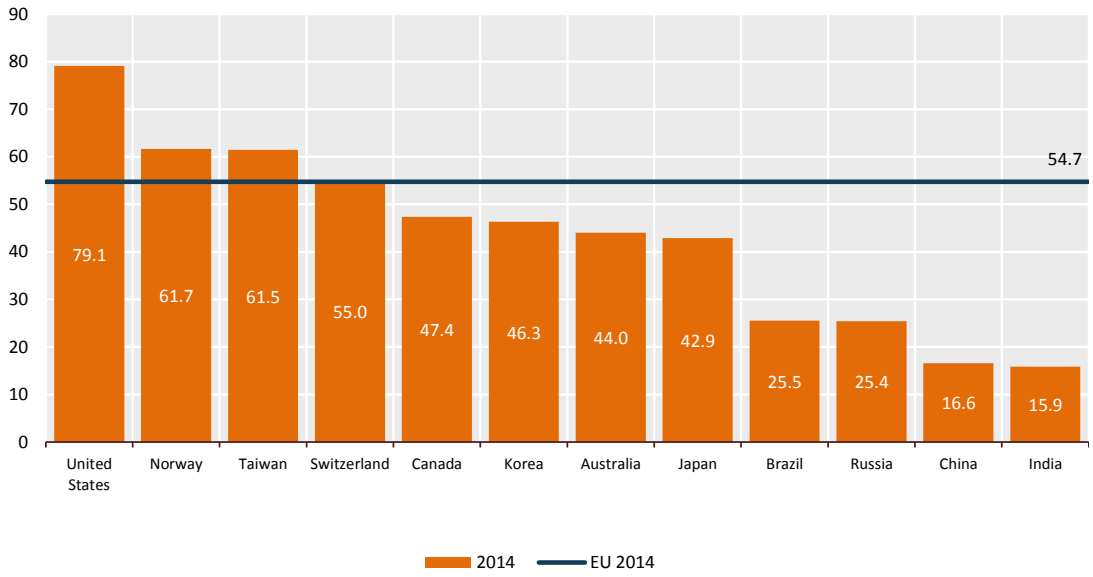
Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, ICT sector productivity per person employed was higher than for total economy productivity in all the countries in the sample. The ratio ICT sector productivity over total economy productivity was 3.6 times higher in India, around 2.5 times higher in China and Brazil, and twice as high in South Korea and the United States. In Switzerland, Australia and Norway, ICT sector productivity was very similar to that of the total economy. The EU came seventh, with a very similar ratio to Japan and Russia. Between 2006 and 2014, the ratio went down for the majority of the countries analysed, especially for the three countries leading in 2014 (Figure 19).

2.2.3 ICT sector productivity per hour worked

Figure 20: ICT sector productivity per hour worked in the European Union and other non-EU economies (current EUR PPS per hour worked, 2014)

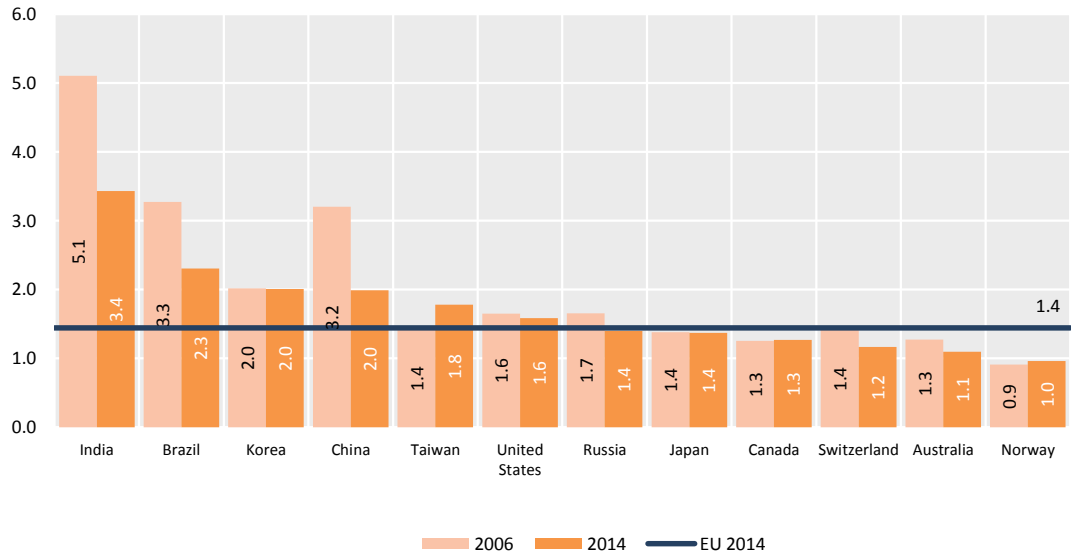


Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The United States led by some distance in ICT productivity per hour worked, as it did in productivity per person. Norway came second in ICT productivity per hour worked, two positions up from its productivity per person employed, followed by Taiwan and Switzerland. The EU came fifth ahead of Canada, South Korea, Australia and Japan, while Brazil, Russia, China and India remained at the lowest end of the productivity ranking (Figure 20).

Figure 21: ICT sector productivity per hour worked ratio over total economy productivity for other non-EU economies (2006 and 2014)



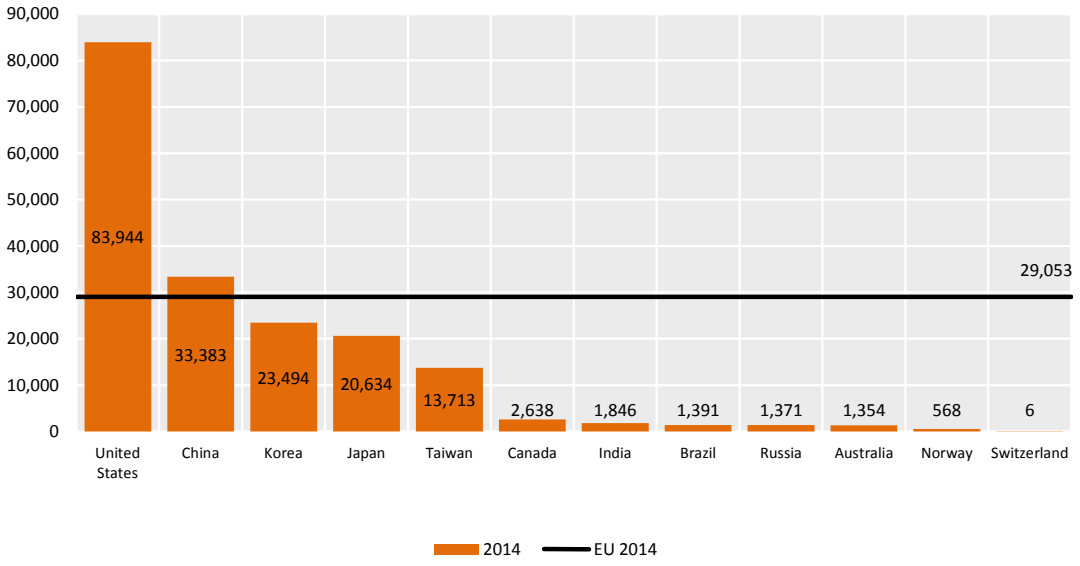
Note: 2013 for Canada.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As in productivity per person employed, productivity per hour worked in the ICT sector was higher than it was in the total economy for all the sample countries. In 2014, India presented the highest ratio ICT sector productivity over total economy (3.4) and Brazil, South Korea and China doubled the total economy levels. However, in Switzerland, Australia and Norway ICT sector productivity was very similar to the total. The EU, which occupies an intermediate position, had a very similar ratio to US, Russia and Japan. The ratio reduced in the majority of the analysed countries with respect to 2006, but mostly in Brazil, India and China, three of the four countries with the highest shares (Figure 21).

2.3 ICT sector business enterprise R&D (BERD) expenditure

Figure 22: ICT sector BERD in the European Union and other non-EU economies (million current EUR PPS, 2014)

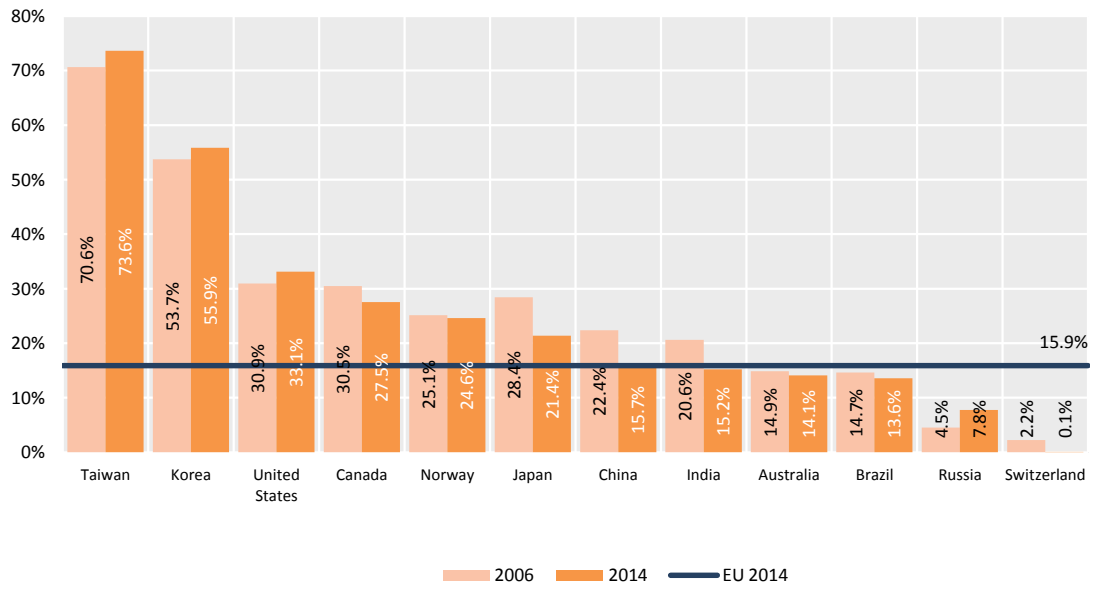


Note: 2013 for Australia, 2012 for India and Switzerland and 2011 for Brazil. ICT sector BERD for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT BERD provides quite a different perspective from the one seen when comparing VA or employment. In 2014, the United States led the countries in the sample in terms of ICT sector BERD, followed at a large distance by the Asian countries and the EU. In third position, the EU was behind China, but ahead of South Korea and Japan. The sum of these five countries represented 89.3% of ICT sector BERD (Figure 22).

Figure 23: ICT sector BERD share of total BERD in the European Union and other non-EU economies (2006 and 2014)

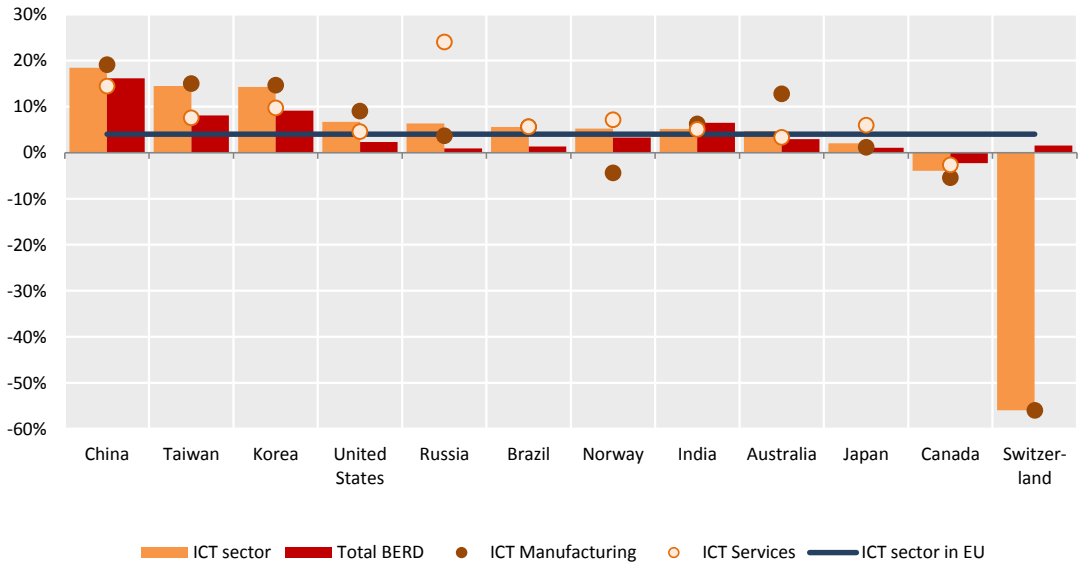


Note: 2008 is the first year for Brazil and Switzerland. 2011 is the last year for Brazil, 2012 for Switzerland and India and 2013 for Australia.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Taiwan and South Korea had the highest share of ICT BERD in their total BERD in 2014, as in the case of value added and employment, followed by the US, Canada and Norway. The EU came eighth, between China and India. Russia and Switzerland had the lowest shares. However, this share decreased in most of the countries in the sample between 2006 and 2014, except in Taiwan, South Korea, Russia and the United States (Figure 23).

Figure 24: Mean annual real growth rate of ICT sector BERD in the European Union and other non-EU economies (2006-2014)



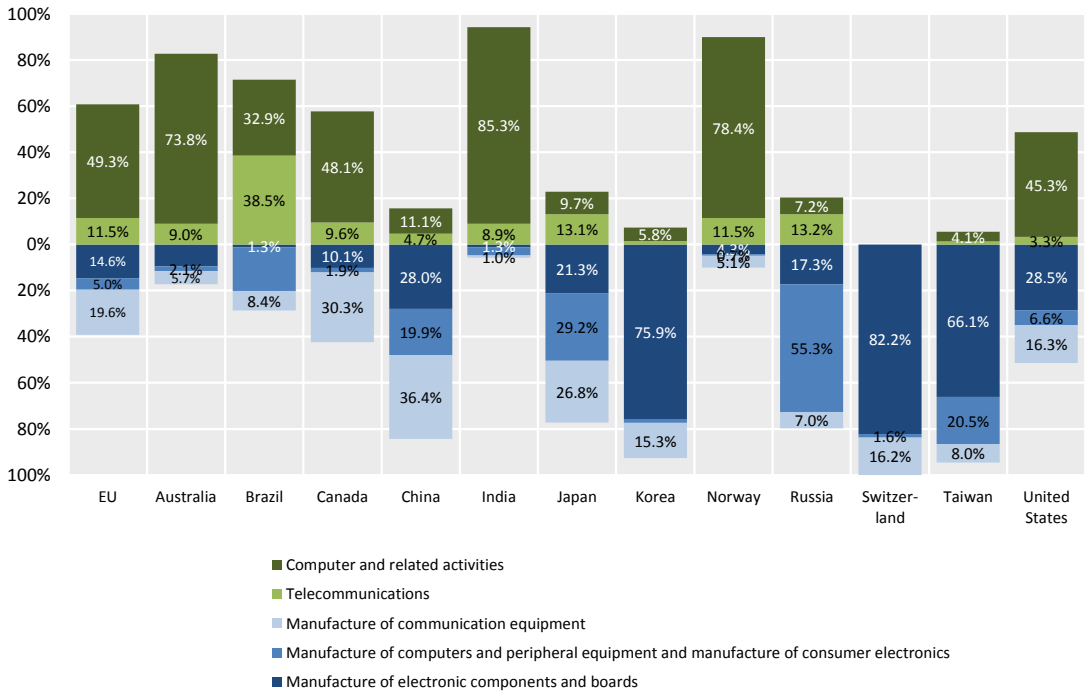
Note: 2006-2013 for Australia and Canada, 2006-2012 for India, 2008-2012 for Switzerland, 2008-2011 for Brazil. ICT sector BERD for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, ICT sector BERD grew rapidly in real terms in three Asian countries: China (18.5%), Taiwan (14.5%) and South Korea (14.3%). The United States and Russia followed at a large distance, both with growth rates over 6%. By contrast, ICT sector BERD decreased in Canada and rather strongly in Switzerland. The EU grew less than most countries in the study, with a mean annual real growth rate of 4.0% between 2006 and 2014.

The annual real growth of ICT services sector BERD ranged from 24.1% in Russia to 3.3% in Australia and a negative rate in Canada (-2.6%). The highest growth rates in ICT manufacturing BERD took place in China, Taiwan and South Korea, and only three countries had negative records: Norway, Canada and Switzerland. Canada was the only country with negative growth rates in all the variables (Figure 24).

Figure 25: ICT sector BERD by sub-sectors for the European Union and other non-EU economies (2014)

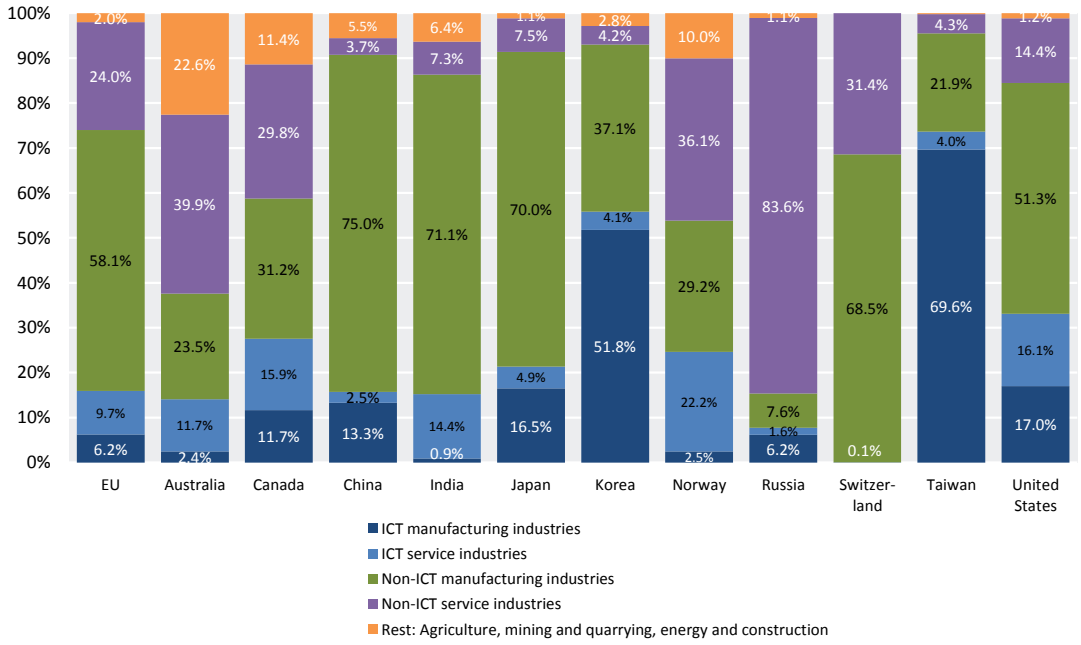


Note: 2013 for Australia, 2012 for India and Switzerland and 2011 for Brazil. ICT sector for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT BERD is more evenly distributed among the ICT sub-sectors than ICT sector VA (Figure 11) or ICT sector employment (Figure 16). The main differences between the EU and the US were that the latter had a much higher share of *Manufacture of electronic components and boards* and a lower share of *Manufacture of communication equipment* and *Telecommunications* (Figure 25).

Figure 26: ICT sector BERD share of total BERD and comparison with non-ICT economic activities. European Union and other non-EU economies (2014)



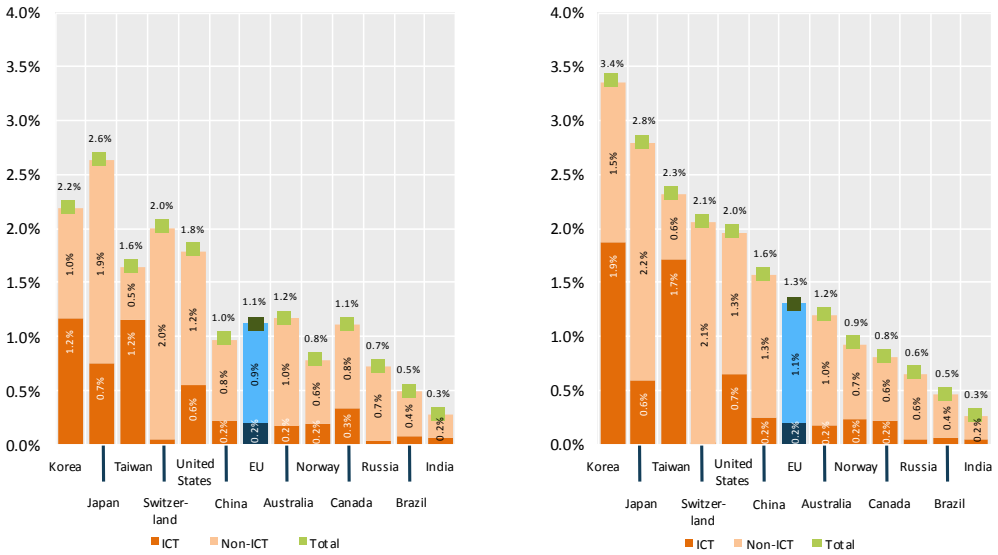
Note: 2013 for Australia and 2012 for India and Switzerland. Non-ICT services industries include total Trade. ICT sector for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

BERD in ICT manufacturing industries was very high in Taiwan and South Korea, and higher in Japan, US, China and Canada than in the other countries. Notably, the US has a lower share of non-ICT industries – both manufacturing and services – than the EU, and a higher share of ICT industries (Figure 26).

Figure 27: Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP). European Union and other non-EU economies (2006 and 2014)

a) 2006 *b) 2014*

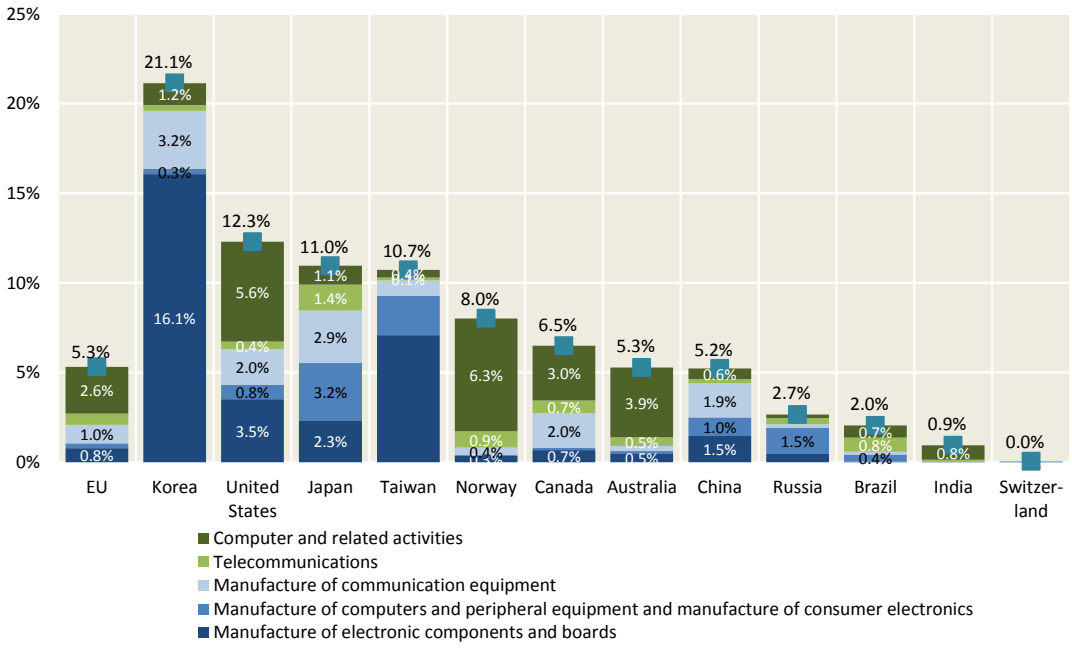


Note: 2008 is the first year available for Brazil and Switzerland. 2013 is the last year for Australia, 2012 for India and Switzerland and 2011 for Brazil.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, South Korea had the highest BERD intensity (3.4%). Four other countries had BERD/GDP ratios above 2%: Japan, Taiwan and Switzerland. For the EU, the corresponding figure was 1.3%. ICT BERD over GDP accounted for 0.2% in the EU, 1.9% in South Korea, 1.7% in Taiwan, 0.7% in the US and 0.6% in Japan. Remarkably, in South Korea and Taiwan, ICT sector BERD intensity was higher than non-ICT sector BERD intensity, and there were important gains in ICT sector BERD intensity between 2006 and 2014 (Figure 27).

Figure 28: Contribution of ICT sub-sectors to ICT sector BERD intensity (ICT sector BERD/ICT sector VA). European Union and other non-EU economies (2014)



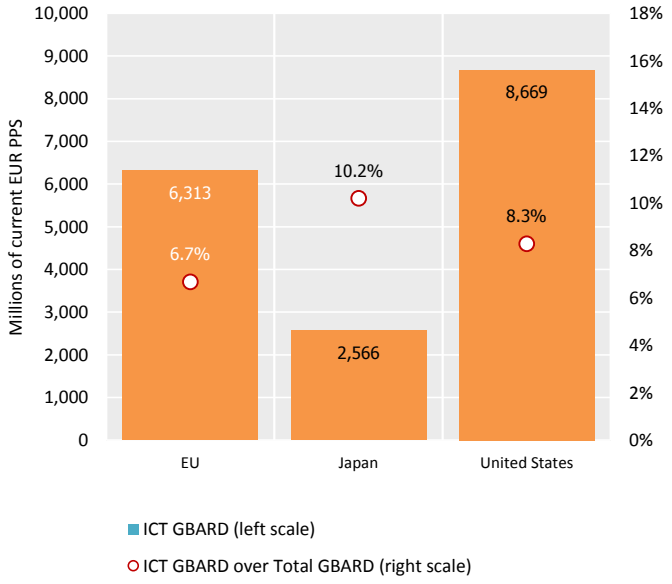
Note: 2013 for Australia and Canada, 2012 for India and Switzerland and 2011 for Brazil. Switzerland includes only ICT manufacturing sub-sectors.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

South Korea also stands out in ICT sector BERD intensity, which reached 21.1% in 2014, followed by the US (12.3%), Japan (11.0%) and Taiwan (10.7%). In South Korea and Taiwan, the ICT sub-sector which made the largest contribution to ICT BERD intensity was *Manufacture of electronic components and boards. Computer and related activities* was the most prominent sub-sector in Norway, the US, Australia and Canada. This sub-sector also makes the highest contribution to ICT BERD intensity in the EU, followed by *Manufacture of communication equipment* (Figure 28).

2.4 Public funding of ICT R&D (ICT GBARD)

Figure 29: ICT GBARD and ICT GBARD share of total GBARD in the European Union and other non-EU economies (2015)



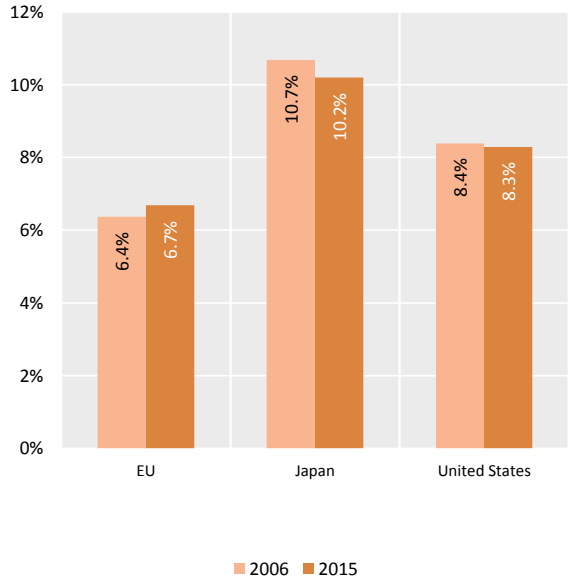
Note: Figures for Japan not fully homogeneous with EU and the United States (see methodological notes).

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2015, the US and the EU led in terms of ICT GBARD[4], followed at a certain distance by Japan. In fact, the US tripled Japan's levels of ICT GBARD. However, regarding the share of ICT GBARD with respect to total GBARD, Japan had the largest share (10.2%), followed by the US (8.3%) and the EU (6.7%) (Figure 29).

[4] ICT GBARD is the part of GBARD (Government budget allocations for R&D) devoted to fund ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector.

Figure 30: ICT GBARD share of total GBARD in the European Union and other non-EU economies (2006 and 2015)

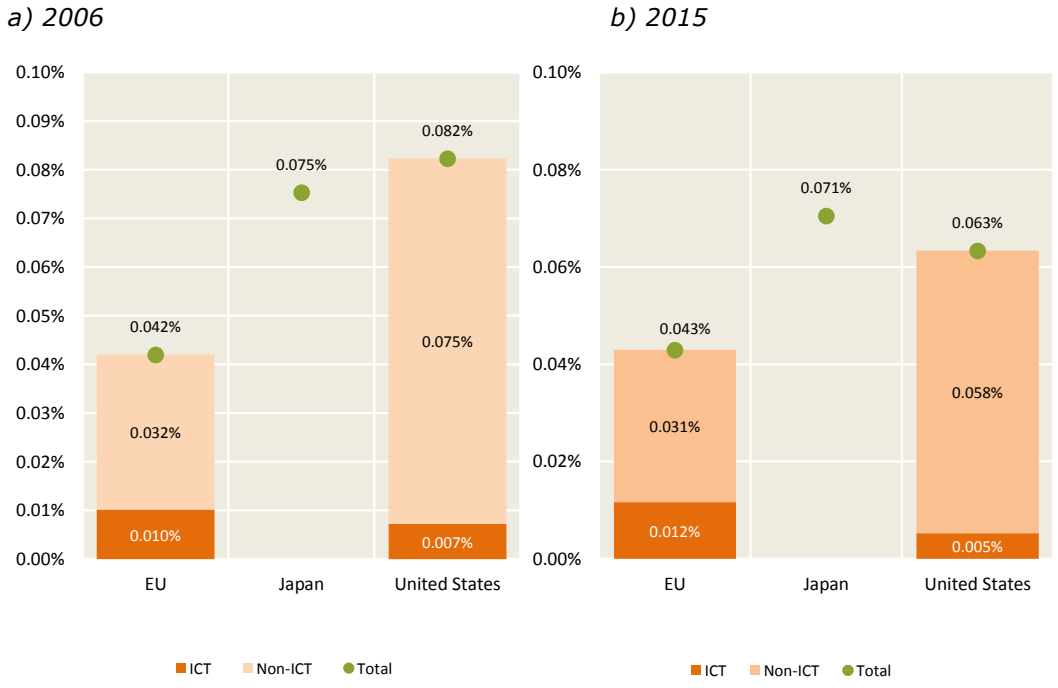


Note: Figures for Japan not fully homogeneous with EU and the United States (see methodological notes).

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, the ratio ICT GBARD over total GBARD for Japan and US fell 0.5 and 0.1 percentage points, respectively. However, during the period this ratio in the EU improved (0.3 percentage points) (Figure 30).

Figure 31: ICT and non-ICT sector ICT GBARD over GDP. European Union and other non-EU economies (2006 and 2015)

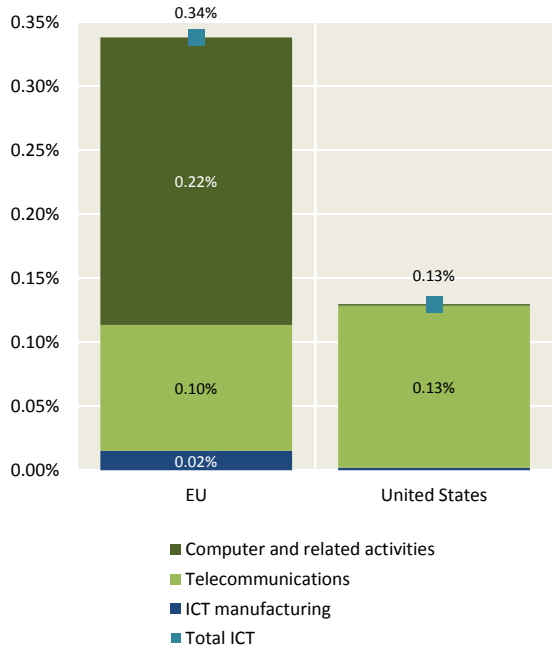


Note: Figures for Japan not fully homogeneous with EU and the United States (see methodological notes).

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2015, Japan had the highest ICT GBARD ratio over GDP (0.071%), followed by the United States (0.063%). This ratio in the EU was 0.043%. In the EU the ICT sector contributes more to this ratio than in the US, in other words, the proportion of public funding of ICT R&D invested in the ICT sector is higher in the EU than in the US (Figure 31).

Figure 32: Contribution of ICT sub-sectors to ICT sector ICT GBARD intensity. European Union and United States (2014)

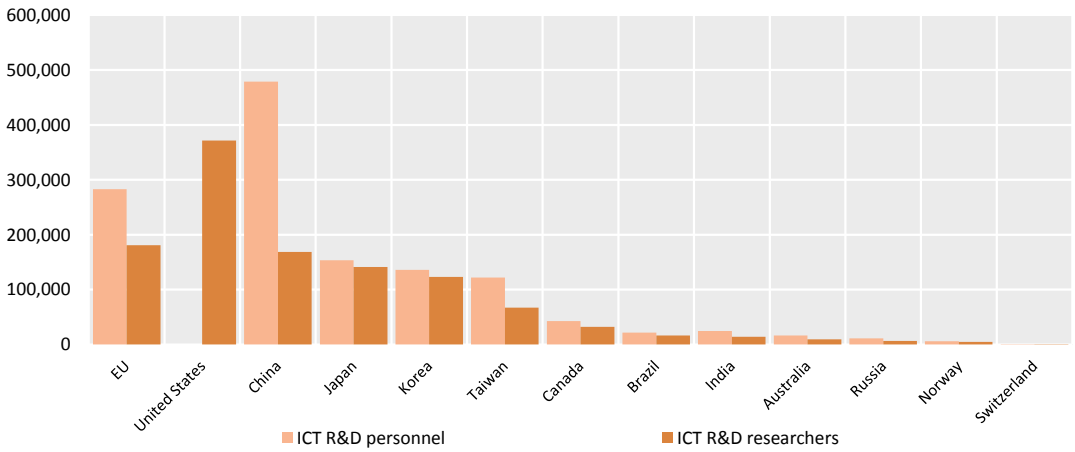


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, ICT GBARD in the ICT sector over ICT sector VA reached 0.34% in the EU. For the US, this intensity was less than half, 0.13%. In the EU, the ICT sub-sector which made the largest contribution to ICT GBARD intensity was *Computer and related activities*, whereas in the US the largest contribution was made by *Telecommunications* (Figure 32).

2.5 ICT sector R&D personnel and researchers

Figure 33: ICT sector R&D personnel and researchers in the European Union and other non-EU economies (2014)



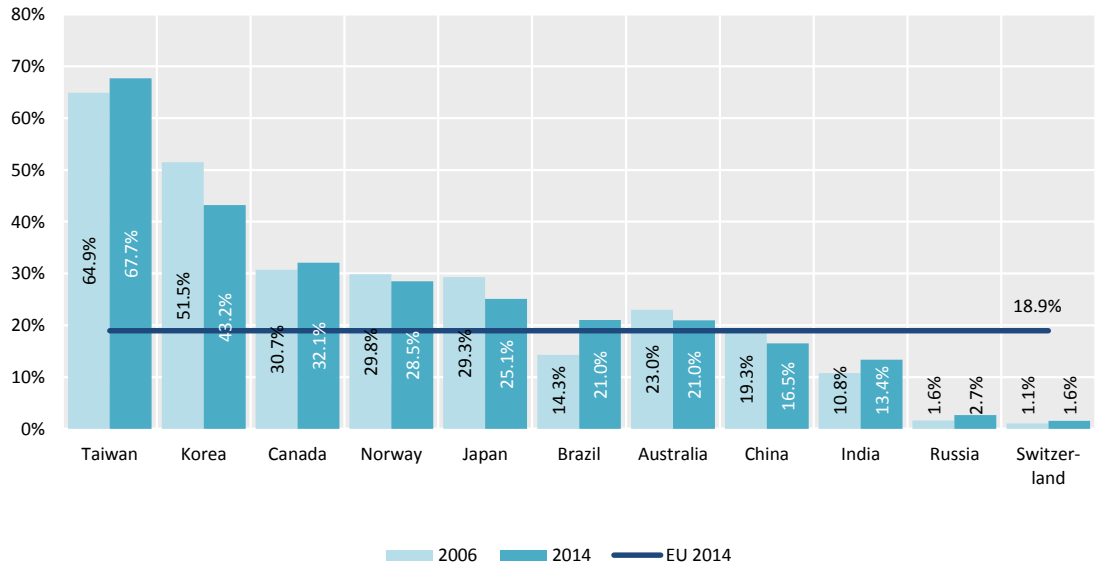
Note: 2013 for Australia and Canada, 2012 for India and Switzerland and 2011 for Brazil. ICT R&D personnel for United States not included because of lack of homogeneous data. The figures for China, India, Russia, and also South Korea should be interpreted with caution since available information is scarce and not fully comparable

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Among the twelve countries considered (excluding the US), China was the largest in terms of ICT sector R&D personnel (almost half a million full-time equivalent workers), followed at a large distance by the EU and the other three Asian countries: Japan, South Korea and Taiwan. In the case of R&D researchers, the leading countries were EU and China, after US.

Regarding R&D researchers in the ICT sector, the US takes the lead, with over 371 thousand researchers, doubling the EU figure in 2014 (Figure 33).

Figure 34: ICT R&D personnel share of total R&D personnel in the European Union and other non-EU economies (based on FTE, 2006 and 2014)

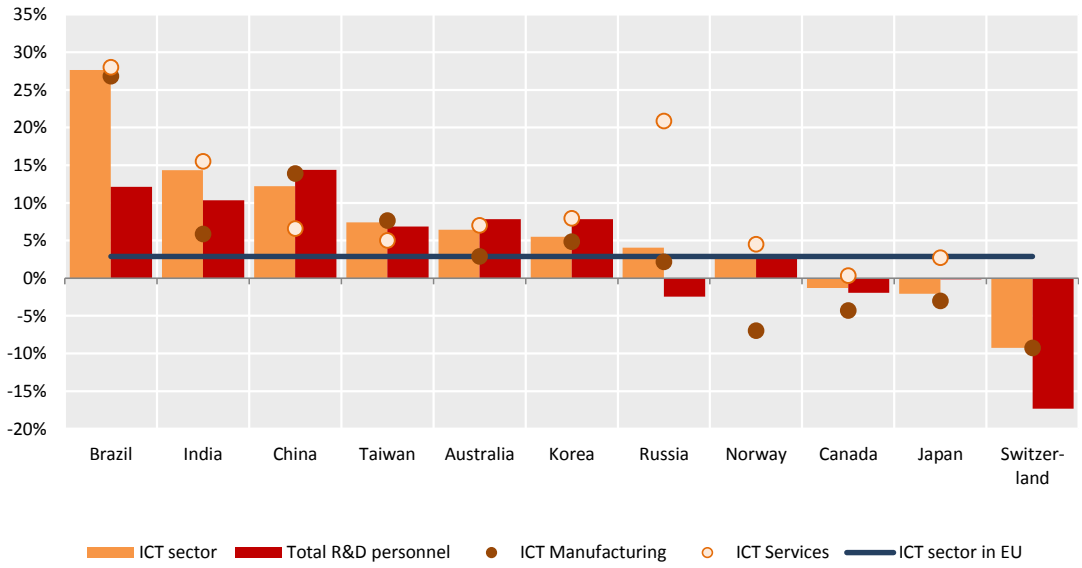


Note: 2008 is the first year for Brazil and Switzerland. 2011 is the last year for Brazil, 2012 for Switzerland and India and 2013 for Australia and Canada. ICT R&D personnel for United States not included because of lack of homogeneous data.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In terms of ICT sector R&D personnel over total R&D personnel, Taiwan and South Korea were the leading countries with a share of more than 40% in 2014. The EU came fifth from the bottom, ahead of China, India, Russia and Switzerland (Figure 34).

Figure 35: Mean annual growth rate of R&D personnel in ICT sector, ICT manufacturing, ICT services and total economy in the European Union and other non-EU economies (2006-2014)



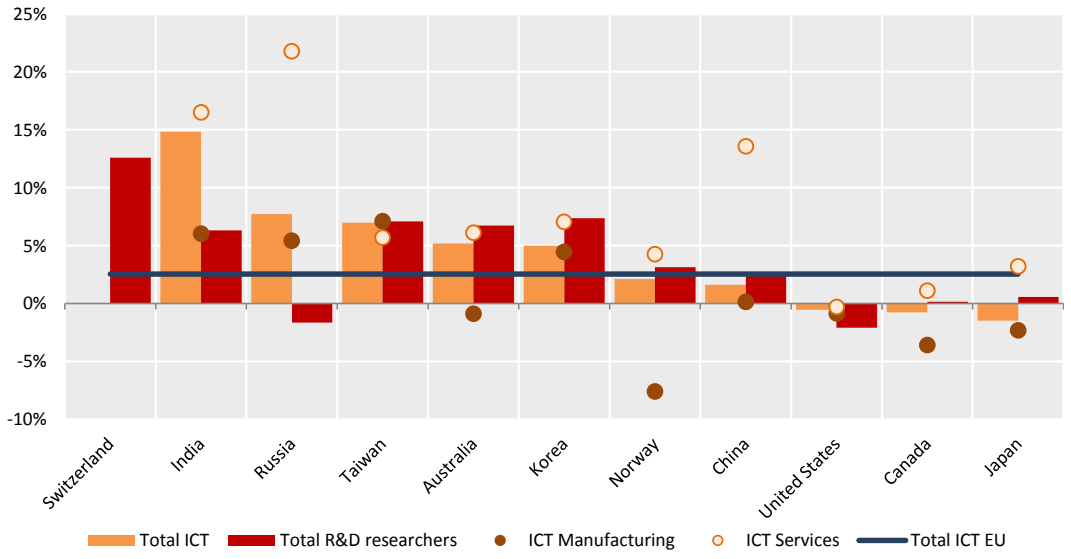
Note: 2006-2013 for Australia and Canada, 2006-2012 for India, 2008-2012 for Switzerland, 2008-2011 for Brazil. ICT sector R&D personnel for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

While, the majority of the countries in the sample created jobs related to R&D in the ICT sector between 2006 and 2014, Canada (-1.3%), Japan (-2.1%) and mainly Switzerland (-9.2%) reduced the number of workers in the ICT sector during this period. In contrast, Brazil, India and China presented two-digit positive growth rates. Of the countries which experienced positive growth, the EU and Norway grew least (around 3%). In addition, the majority of sample countries showed ICT sector growth rates higher than total R&D personnel.

The annual growth of ICT services sector R&D personnel was positive in the thirteen countries analysed and ranged from 28.0% in Brazil and 20.9% in Russia to 0.3% in Canada. The results for ICT manufacturing in the period were not as good, since growth rates for R&D personnel fell in four countries: Norway, Canada, Japan and Switzerland (Figure 35).

Figure 36: ICT sector R&D researchers mean growth rates for European Union and other non-EU economies (2006-2014)



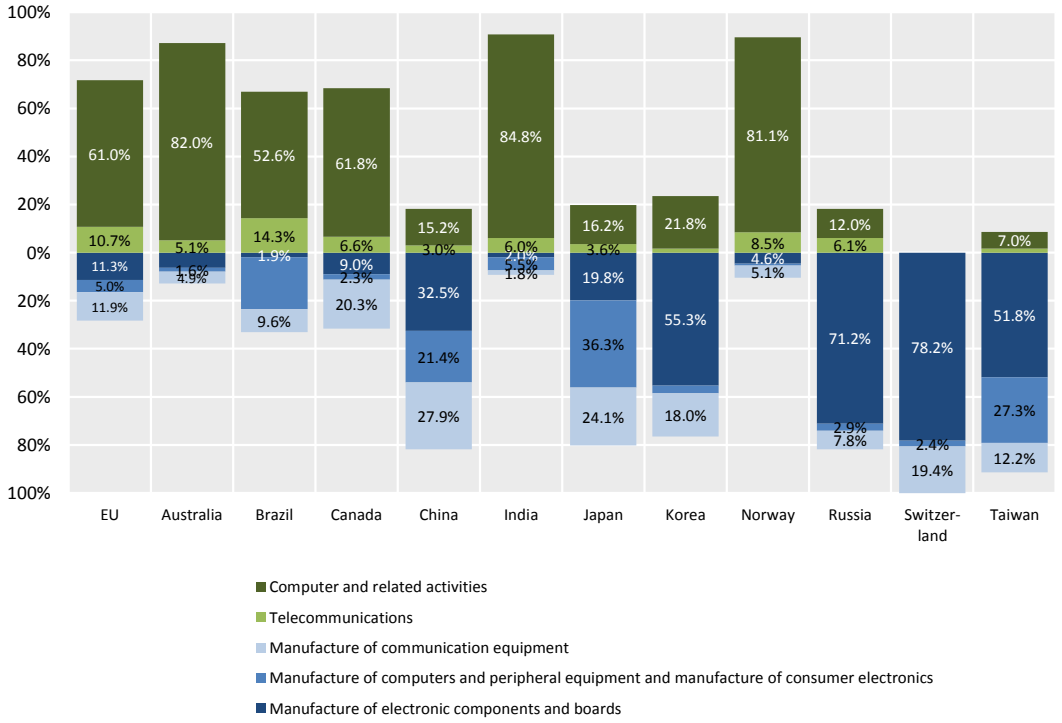
Note: 2006-2013 for Australia and Canada, 2006-2012 for India. Data not available for Brazil. Data for 2008-2012 for Switzerland ICT manufacturing sector R&D researchers is available but has been excluded due to high growth rate (231%).

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As in the case of ICT sector R&D personnel (Figure 35), the majority of the countries in the sample increased the number of researchers in the ICT sector R&D between 2006 and 2014. Concerning the growth of ICT researchers India, Russia, Taiwan and, of course, Switzerland (with an extraordinary three-digit growth) stand out. Only the US (-0.5%), Canada (-0.8%), and Japan (-1.5%) cut workers in this sector during those years. The EU, Norway and China were the lowest ranking countries with a positive growth around 2% (EU 2.5%). However, in most of the countries in the sample, growth rates for R&D researchers in the ICT sector were lower than they were for R&D researchers in the whole economy, that is, considering all economic sectors.

The annual growth of numbers of ICT services sector researchers was positive in twelve countries (i.e. all of them except the US) and ranged from 21.8% in Russia and 16.5% in India to -0.3% in the US. By contrast, the results for ICT manufacturing showed negative growth rates in several countries, since six countries cut their numbers of workers in the period: Norway, Australia, Canada, Japan, US and EU (Figure 36).

Figure 37: ICT sector R&D personnel by sub-sectors in the European Union and other non-EU economies (2014)

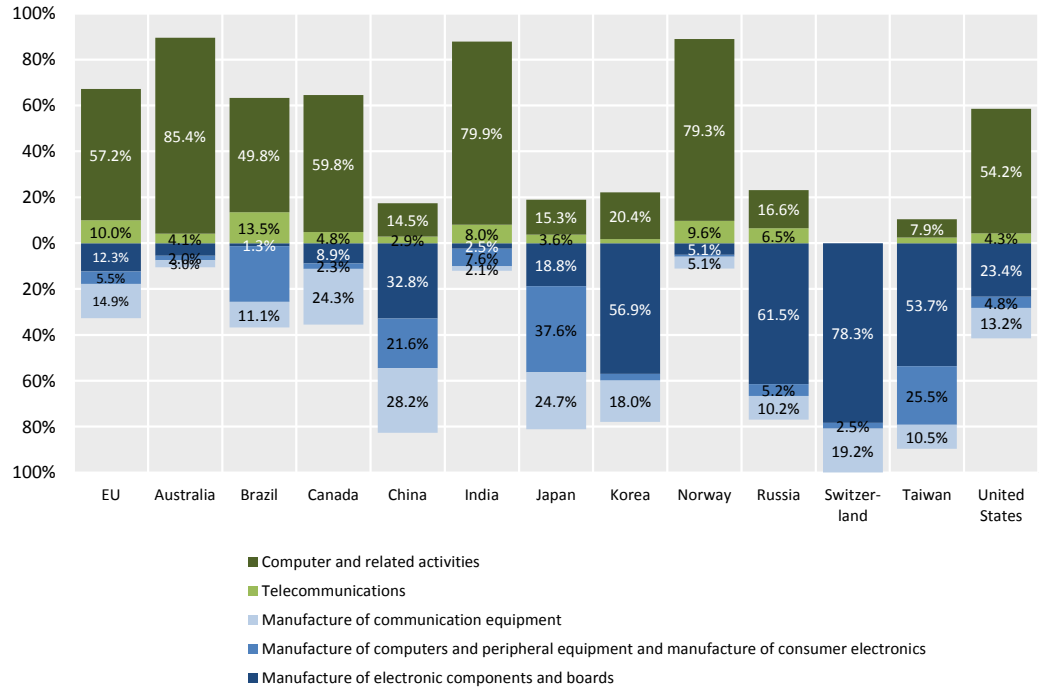


Note: 2013 for Australia and Canada, 2012 for India and Switzerland and 2011 for Brazil. ICT sector for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, mainly two ICT sub-sectors had the highest share in total ICT sector R&D personnel: *Manufacture of electronic components and boards* (especially relevant for Russia, Taiwan, South Korea and China) and *Computer and related activities* (India, Australia, Brazil, Canada, EU and Norway). The weight of ICT manufacturing in Russia and Asian countries was notably high. In the case of Japan, Taiwan and China, the weight of each ICT manufacturing sub-sector surpassed the weight of any individual ICT services sub-sector (Figure 37).

Figure 38: ICT sector R&D researchers by sub-sectors in the European Union and other non-EU economies (2014)



Note: 2013 for Australia and Canada, 2012 for India and Switzerland and 2011 for Brazil. ICT sector for Switzerland includes only ICT manufacturing for the operational sector definition.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As in the case of R&D personnel (Figure 37), two ICT sub-sectors had the highest shares in total ICT sector R&D researchers in 2014: *Manufacture of electronic components and boards* (especially relevant for Russia, South Korea and Taiwan) and *Computer and related activities* (Australia, India, Norway, Canada, the EU, the US and Brazil). ICT manufacturing sub-sectors had relatively high weight in the Asian countries (except India), and Russia.

The main difference between the EU and the US is the highest share of ICT services sub-sectors for EU R&D researchers (Figure 38).

3 Analysis of the ICT sector and sub-sectors and its R&D in the EU and Member States

This section follows the OECD (2007) definition of the ICT sector. Therefore, unlike Sections 1 and 2, it does include the ICT trade industry (NACE Rev. 2 465) and Manufacture of magnetic and optical media (NACE Rev.2 268).

Box 2: The ICT sector (2007 OECD definition). List of NACE Rev. 2 ICT sub-sectors

NACE Rev. 2	Description
261-264, 268, 465, 582, 61, 62, 631, 951	**ICT total**
261-264, 268	**ICT manufacturing industries**
261	Manufacture of electronic components and boards
262	Manufacture of computers and peripheral equipment
263	Manufacture of communication equipment
264	Manufacture of consumer electronics
268	Manufacture of magnetic and optical media
465, 582, 61, 62, 631, 951	**ICT total services**
465	**ICT trade industries**
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
582, 61, 62, 631, 951	**ICT services industries**
61	Telecommunications
582, 62, 631, 951	Computer and related activities
582	Software publishing
62	Computer programming, consultancy and related activities
631	Data processing, hosting and related activities; web portals
951	Repair of computers and communication equipment

3.1 ICT sector value added

Figure 39: ICT sector VA and annual real growth rates of ICT sector VA and GDP. European Union (2007-2014)

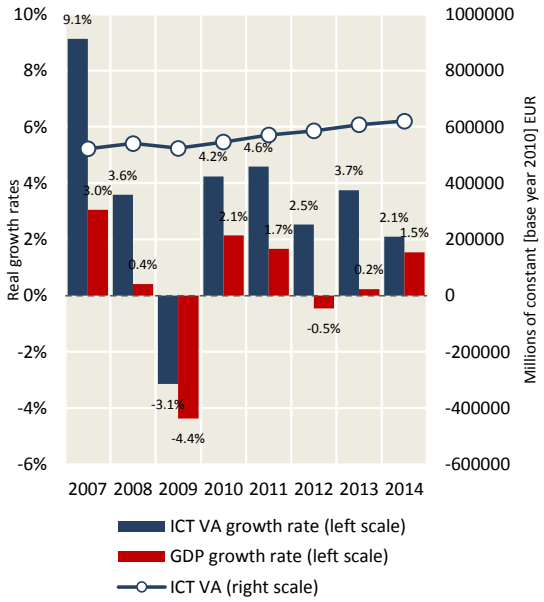
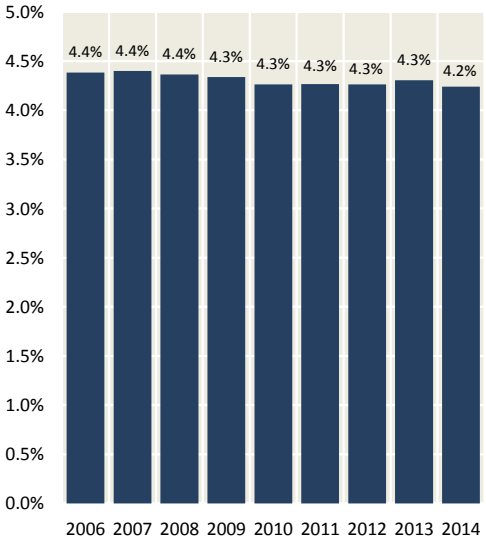


Figure 40: ICT sector VA share of GDP. European Union (2006-2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT VA and GDP growth rates followed relatively similar trends, albeit with different intensities, except in 2012, when ICT sector value added grew 2.5% and GDP growth was negative (-0.5%). In 2014, VA produced by the EU ICT sector reached 620,464 million of euros.

In 2014, the EU ICT sector VA represented around 4.2% of total GDP. This share fell slightly from 2006 to 2014 (-0.2 percentage points) (Figures 39 and 40).

Figure 41: VA in ICT manufacturing, ICT services, MC and RS sectors. European Union (million constant [base year 2010] EUR; 2006-2014)

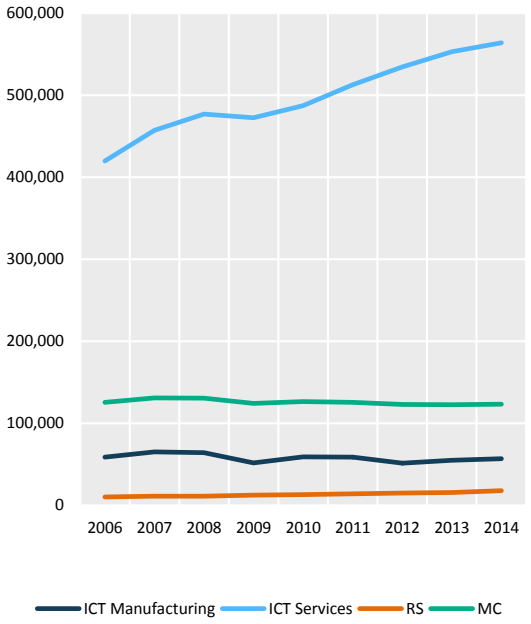
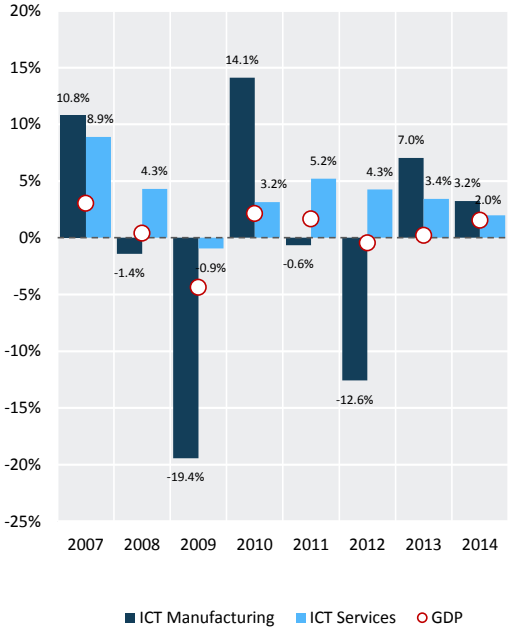


Figure 42: Annual real growth rates of VA in ICT manufacturing, ICT services and GDP. European Union (2007-2014)



Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet.

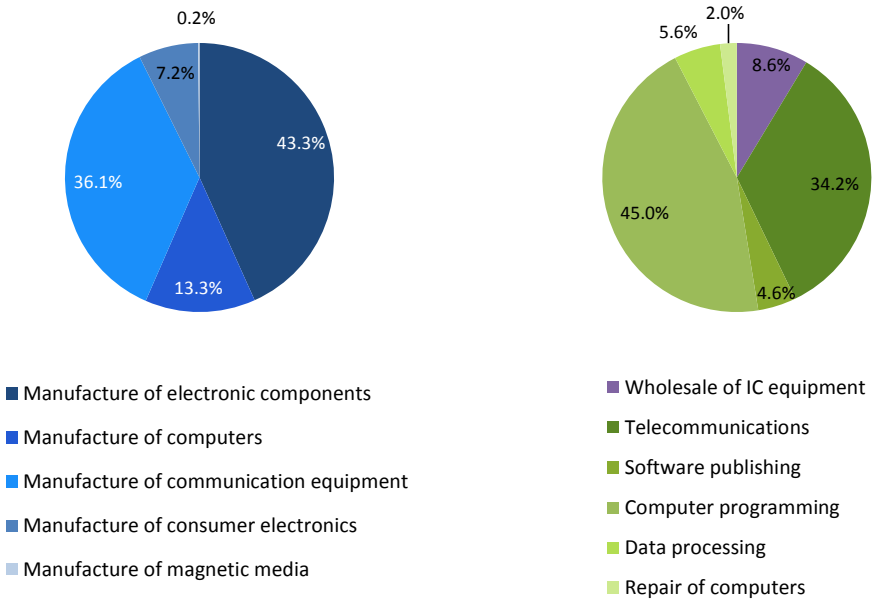
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, ICT sector VA was concentrated in the ICT services sectors (563,852 million constant euros), while VA produced by ICT manufacturing reached 56,612 million. VA obtained in the Media and Content sector doubled the VA of ICT manufacturing sector (123,077 million). The sector with the lowest VA is Retail Sales, hardly reaching 18 million euros.

Since 2007, ICT manufacturing recorded four years with negative real growth rate, two of which with very intense negative values (-19.44% in 2009 and -12.28% in 2012). Since 2013, this negative trend has been reversed and there has been a higher real rate of growth in ICT manufacturing than in ICT services and GDP (Figures 41 and 42).

Figure 43: ICT manufacturing and ICT services VA by sub-sectors (%). European Union (2014)

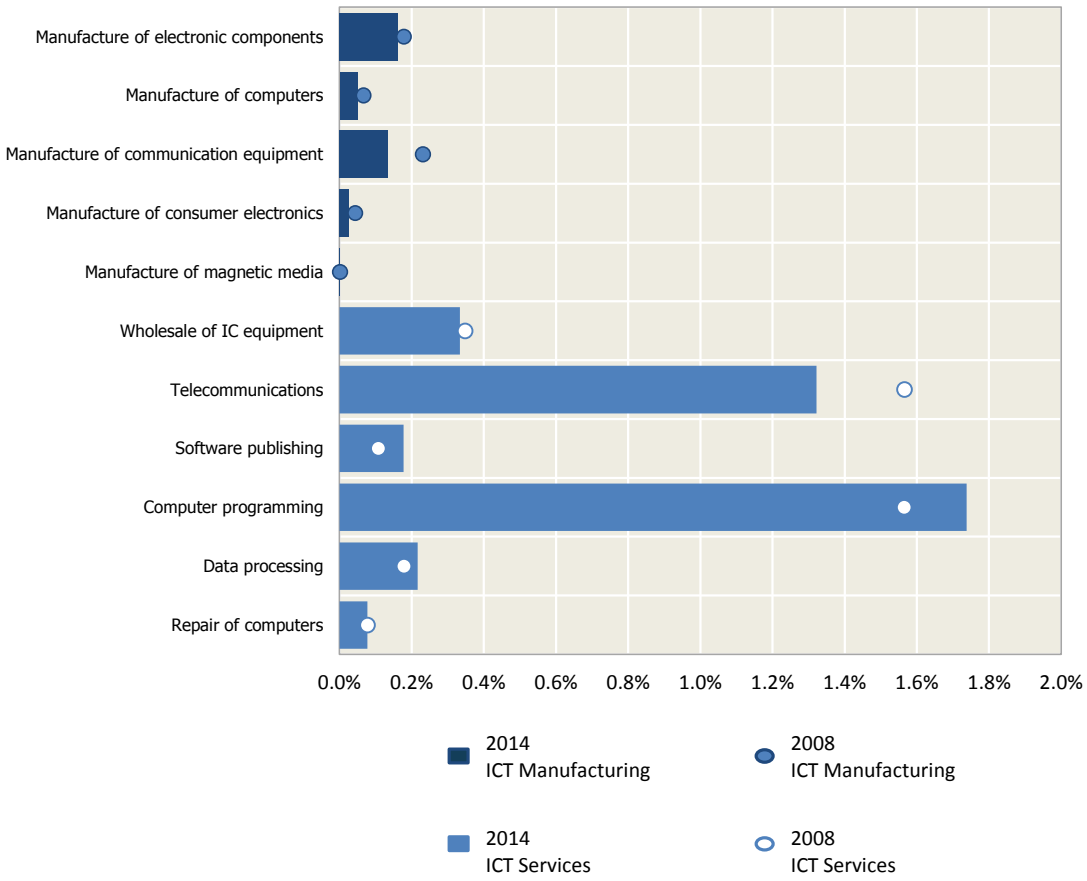
a) ICT manufacturing *b) ICT services*



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The two largest ICT manufacturing sub-sectors in the EU, *Manufacture of electronic components* and *Manufacture of communication equipment*, represented 79.4% of the total VA produced by the aggregate ICT manufacturing sector in 2014. Also in the case of ICT total services, VA is concentrated in two sub-sectors, *Telecommunications* and *Computer programing, consultancy and related activities*, which together represent 79.2% of the aggregate ICT services (Figure 43).

Figure 44: ICT sector VA share of GDP by sub-sector. European Union (2008 and 2014)

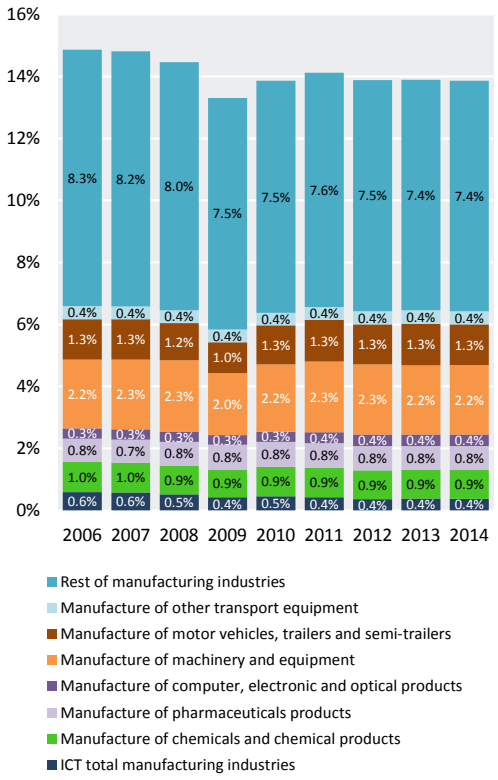


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

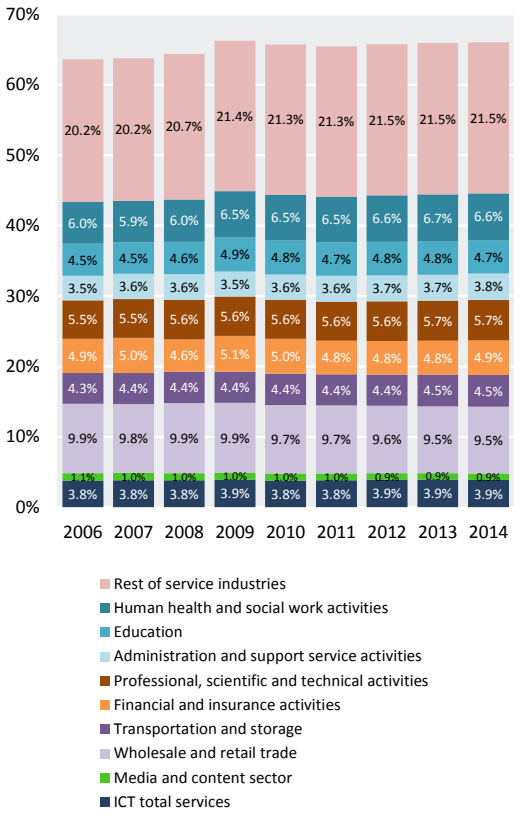
The two largest services sub-sectors in the EU, *Telecommunications* and *Computer programing, consultancy and related activities*, represented more than 72% of the total VA produced by the ICT sector in 2014. In terms of share over total economy VA (GDP), these sectors represented 1.3% and 1.7%, respectively. Moreover, VA created in ICT manufacturing in 2014 was similar to VA produced in the *Wholesale of IC equipment*. The share over GDP in all *ICT manufacturing sub*-sectors and two ICT services sub-sectors, *Wholesale of IC equipment* and *Telecommunications*, fell in the 2008-2014 period (Figure 44).

Figure 45: ICT sector value added share of GDP and comparison with non-ICT economic activities. European Union (2006-2014)

a) Manufacturing



b) Services

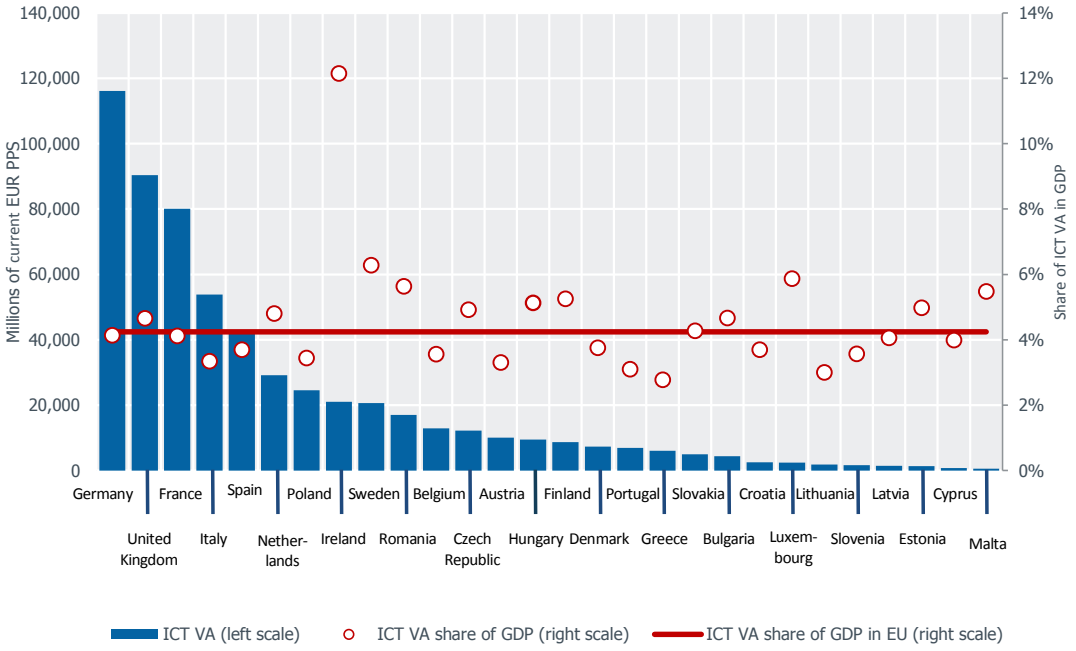


Note: The following economic activities are not included neither in manufacturing nor in services industries: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; Construction.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2006, ICT manufacturing sectors represented 0.6% of total GDP. Their shares decreased during the years up to 2014, when they represented 0.4% of total GDP. ICT services sectors accounted for 3.9% of total GDP in 2014, this share having increased from 2006. The non-ICT services sectors *Wholesale and retail trade, repair of motor vehicles and motorcycles*, *Human health and social work activities* and *Professional, scientific and technical activities* represented the highest shares of GDP. The *Media and Content sector* represented 0.9%-1.1% of total GDP, having lost weight since 2006 (Figure 45).

Figure 46: ICT sector VA and ICT sector VA share of GDP. EU Member States (2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

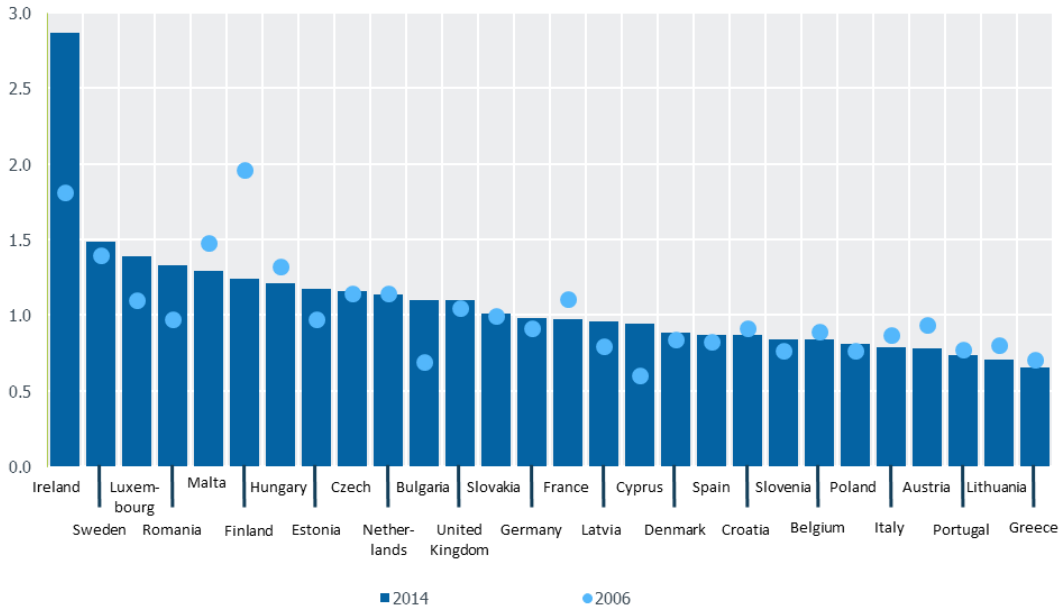
As expected, in 2014, the largest EU economies in terms of ICT value added produced together the 64.9% of the EU ICT VA (Germany 19.7%, UK 15.3%, France 13.5%, Italy 9.1 and Spain 7.3%). Overall, the 13 countries that joined the EU from 2004 (henceforward EU13[5]) contributed 11% to the total EU ICT VA.

ICT VA share of GDP ranged from 12.1% for Ireland, down to 3.0% for Lithuania and 2.8% for Greece. It is worth noting that among the largest EU economies, only the UK had a ratio of ICT VA to GDP higher than the EU average. Out of the 15 Member States which were part of the EU prior to the 2004 enlargement (EU15[6]), 9 have ratios below the EU average, while 7 of the EU13 States are above (Figure 46).

[5] EU13: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia; and Croatia, which acceded in July 2013.

[6] EU15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

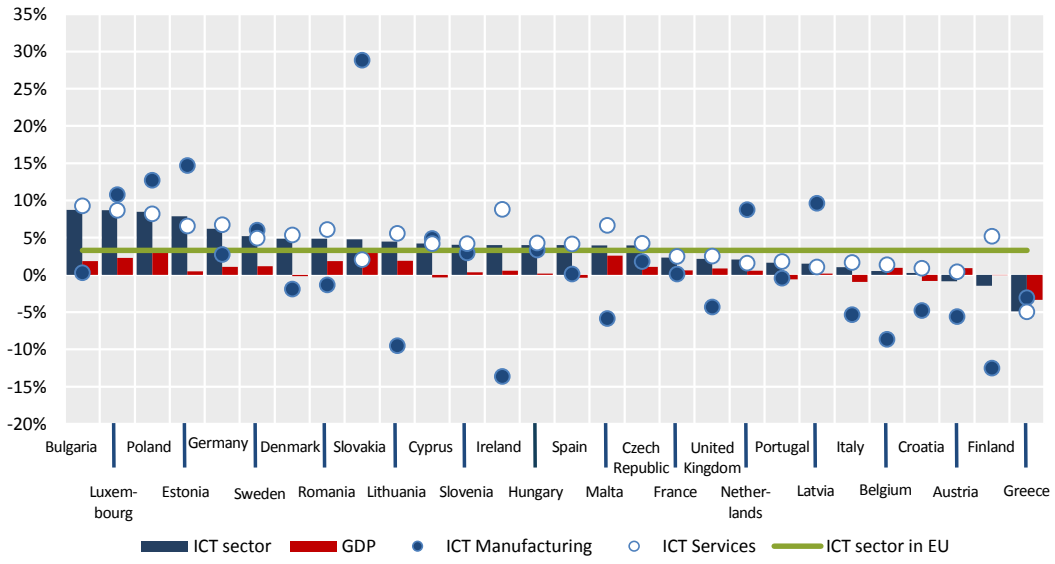
Figure 47: Ratio of ICT sector VA share of GDP over EU ICT sector VA share of GDP. EU Member States (2006 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, the weight of the ICT sector in GDP increased most in Bulgaria, Ireland, Cyprus and Romania. By contrast, it fell most sharply in France, Malta, Austria and especially Finland. In 2006, Finland was the country with the largest ratio, doubling EU levels, followed by Ireland. In 2014, Ireland's ratio almost tripled EU levels, leading the ranking (Figure 47).

Figure 48: Mean annual real growth rate of VA in ICT sector, ICT manufacturing, ICT services and GDP. EU Member States (2006-2014)

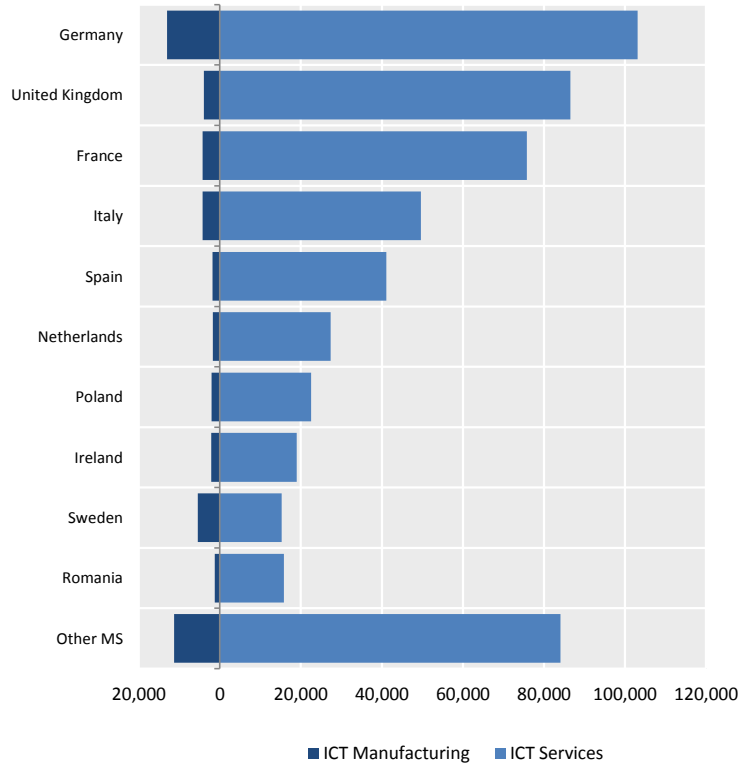


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The average real growth rate of ICT sector VA between 2006 and 2014 ranged from around 8% in Luxembourg and in three of EU13 States (Bulgaria, Poland, Estonia), to negative rates in Austria (-0.8%), Finland (-1.4%) and Greece (-4.9). VA growth rates in the ICT sector widely exceeded the rates observed in GDP for the majority of European countries, increasing therefore their share of GDP.

ICT manufacturing had negative real growth rates in thirteen countries, the highest being in Ireland (-13.6%) and Finland (-12.5%). By contrast, ICT services increased in all the countries, with the only exception of Greece (-4.9%) (Figure 48).

Figure 49: ICT manufacturing and ICT services VA in the ten largest EU Member State contributors (million current EUR PPS [Purchase Power Standard], 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The ten Member States with highest ICT VA produced 83.9% of total ICT sector VA in the EU, 77.9% of ICT manufacturing VA and 84.4% of ICT services VA. Germany dominated the total ICT sector, ICT manufacturing and ICT services: it produced VA, both in ICT manufacturing and in ICT services, higher than the sum of ICT VA overall produced by the 19 smaller countries.

The ICT sector in the EU Member States is clearly dominated by ICT services. The 91.3% of the overall ICT VA of EU Member States was produced by ICT Services sectors. Almost all Member States with the largest ICT VA had a share higher than 90%. Among these, Sweden had the highest share of ICT Manufacturing (26.2%). (Figure 49).

3.2 ICT employment and ICT sector labour productivity

3.2.1 ICT sector employment

Figure 50: ICT sector employment and annual growth rates of ICT sector employment and total employment. European Union (2006-2014)

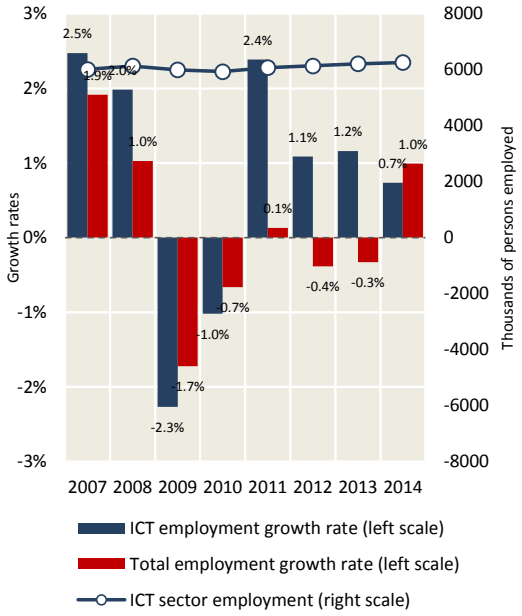
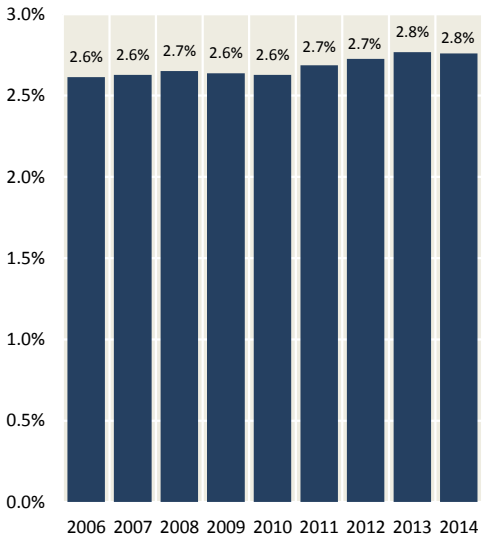


Figure 51: ICT sector employment share of total employment. European Union (2006-2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the ICT sector's share of total EU employment (2.8%) is lower than that of VA (4.2% of GDP, Figure 40), a percentage that has slightly increased since 2006. ICT sector employment was more volatile than total employment. After a contraction in 2009-2010, ICT sector employment recovered. In 2011-2013, even if Total employment growth rate had very low, or negative, values, ICT employment rate had always positive ones (Figures 50 and 51).

Figure 52: Employment in ICT manufacturing, ICT services, MC and RS sectors. European Union (thousand persons employed; 2006-2014)

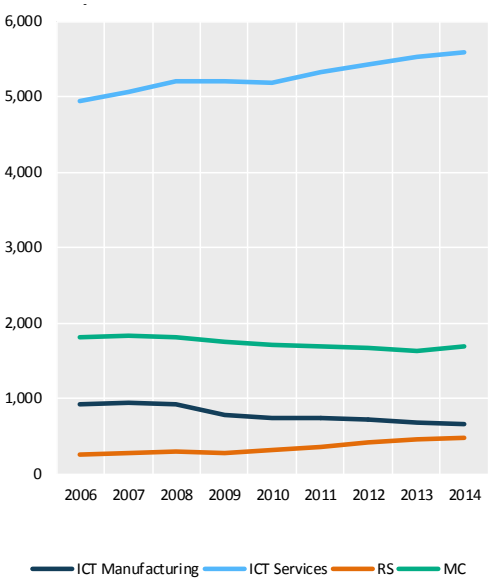
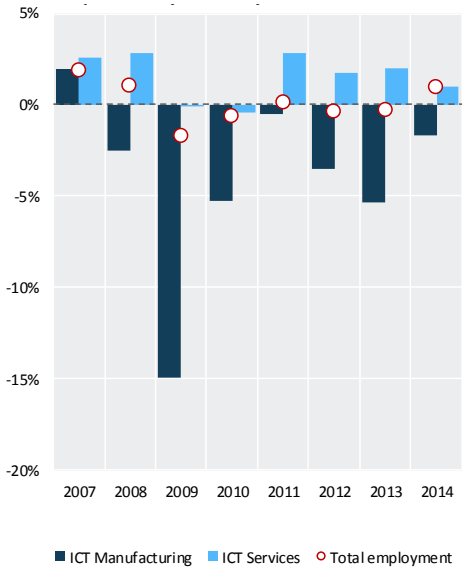


Figure 53: Annual real growth rates of employment in ICT manufacturing, ICT services and total economy. European Union (2007-2014)



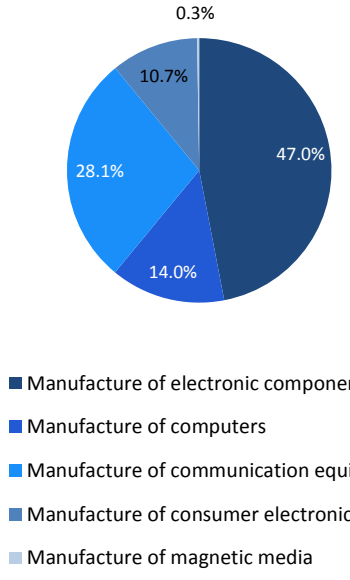
Note: MC: Media and Content; RS: Retail sale via mail order houses or via Internet.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

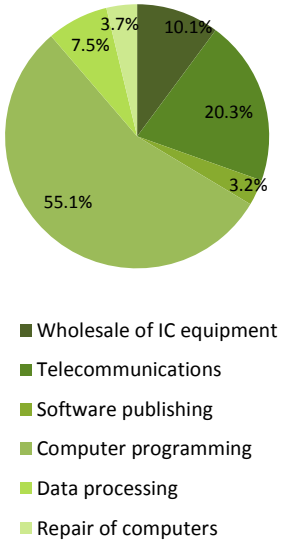
Employment in the ICT services was more resilient during the period and did not suffer the adverse effects of the first stages of the economic crisis (2008-2010) to the same extent as ICT manufacturing employment. Moreover, since 2011 ICT services generated employment in each year despite the second recession, whereas the ICT manufacturing sector reduced employment continuously up to 2014 (Figures 52 and 53).

Figure 54: ICT manufacturing and ICT services employment by sub-sectors (%). European Union (2014)

a) ICT Manufacturing



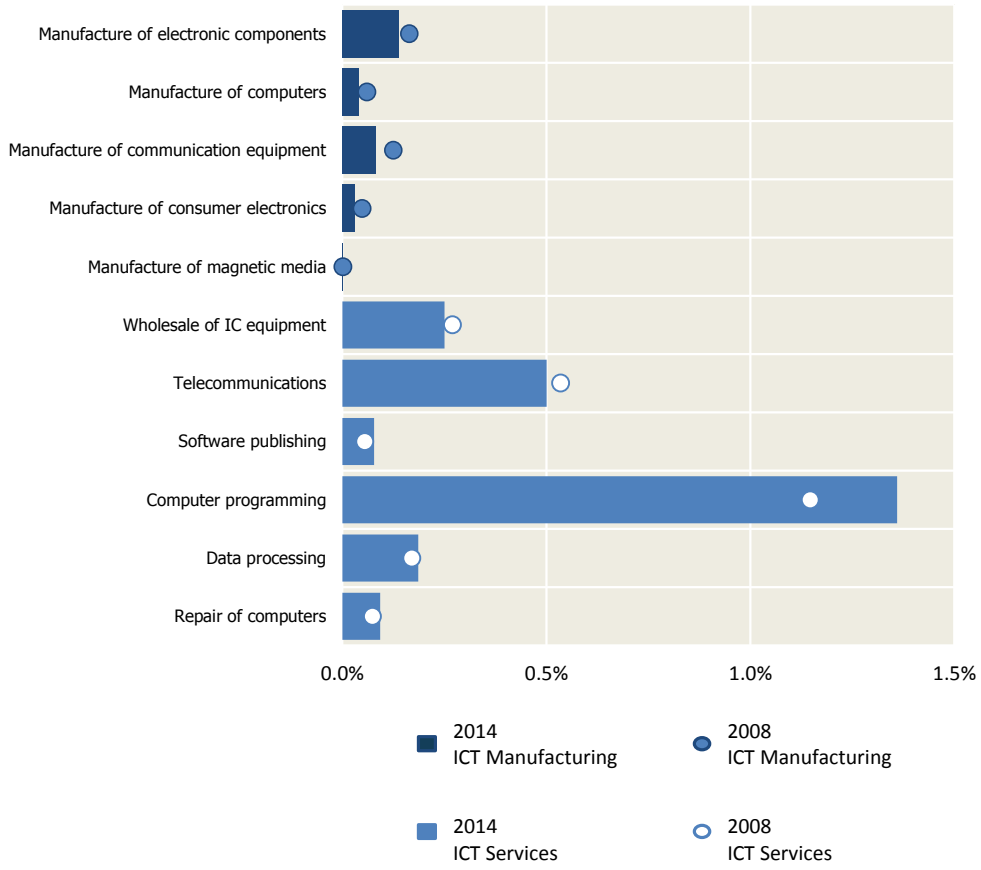
b) ICT Services



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, as in the case of VA (Figure 43), the employment in ICT manufacturing sector is concentrated in two sub-sectors, *Manufacture of electronic components* and *Manufacture of communication equipment*, which accounted for three quarters of the total employment in this sector. Also with regard to ICT total services, the two major sectors, *Telecommunications* and *Computer programing, consultancy and related activities* accounted for 75% of total ICT services employment (Figure 54).

Figure 55: ICT sector employment share of total employment by sub-sector. European Union (2008 and 2014)

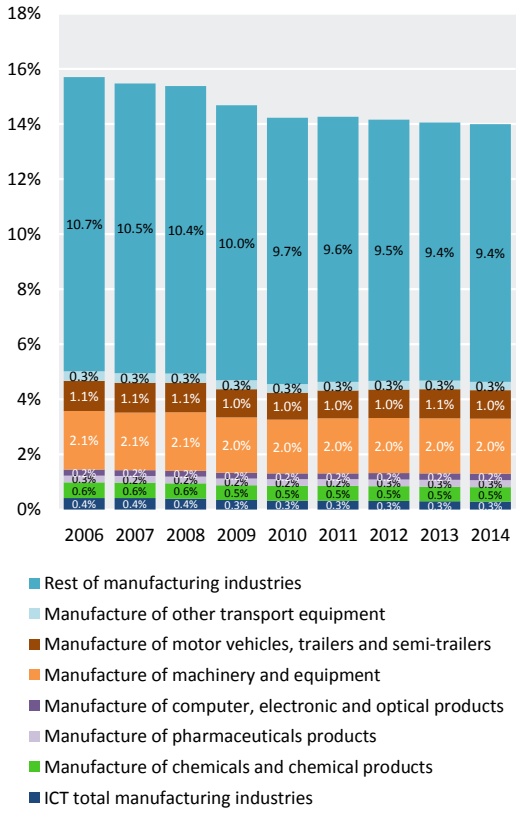


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

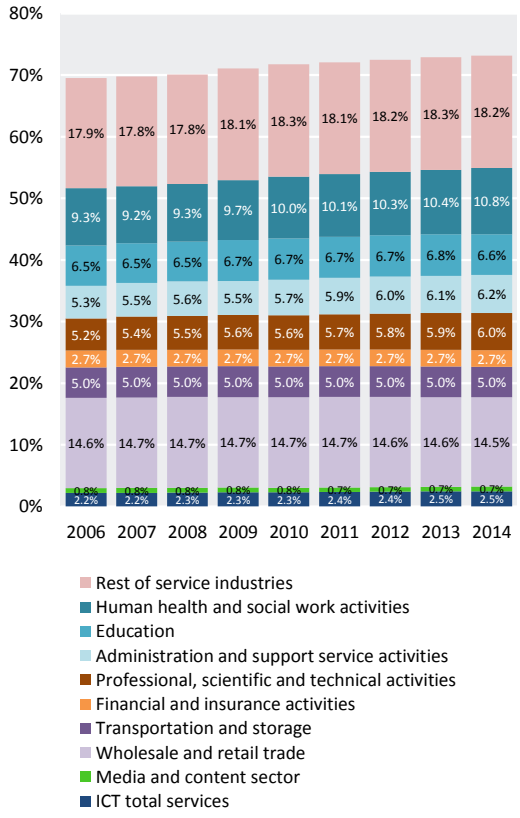
In 2014, a large part (67.4%) of total ICT sector employment was concentrated in two service sectors, *Telecommunications* and *Computer programing, consultancy and related activities*. These sectors accounted for 0.5% and 1.4% of total economy employment, respectively. Between 2008 and 2014, the shares of employment of all the ICT manufacturing sub-sectors and two ICT services sub-sectors, *Wholesale of IC equipment* and *Telecommunications,* fell (Figure 55).

Figure 56: ICT sector employment share of total employment and comparison with non-ICT economic activities. European Union (2006-2014)

a) Manufacturing



b) Services



Note: The following economic activities are not included neither in manufacturing nor in services industries: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; Construction.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, ICT manufacturing sectors accounted for 0.3% of total employment, and the ICT service sectors for approximately 2.5%. Of the sectors that are closely related to ICT/R&D, the following show the highest shares in terms of employment: *Wholesale and retail trade, repair or motor vehicles and motorcycles, Human health and social work activities, Education, Administration and support services activities* and *Professional, scientific and technical activities* (Figure 56).

Figure 57: ICT sector employment and ICT sector employment share of total employment. EU Member States (2014)

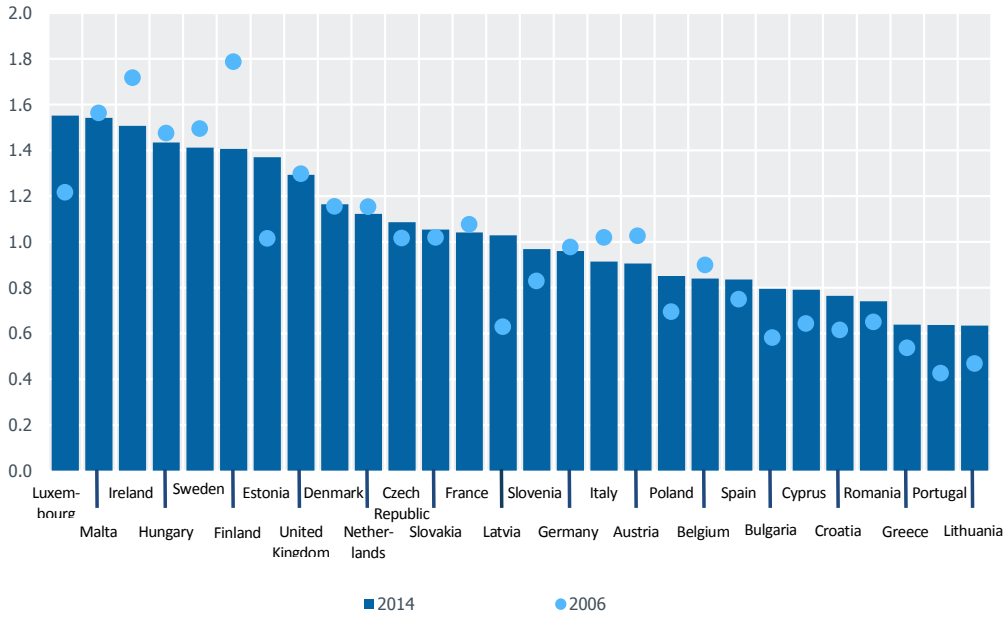
Note: Greece, Luxembourg, Croatia and especially Malta lack official data, therefore their results should be taken with caution.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Employment in the EU ICT sector was concentrated in the five largest EU economies in terms of VA: Germany (18.0%), UK (17.4%), France (12.5%), Italy (9.8%) and Spain (6.6%), overall representing 64.3% of EU ICT sector employment in 2014. Other EU countries with high shares of ICT sector employment in relation to their economic size were Poland (5.9%), Romania (2.8%) and Hungary (2.7%). Newer Member States contributed 13.7% to ICT sector employment.

Ireland Hungary and Sweden had the highest ICT sector employment shares with ratios around 4%. In contrast, Portugal and Lithuania had the lowest shares, as none of them exceeded 2% (Figure 57).

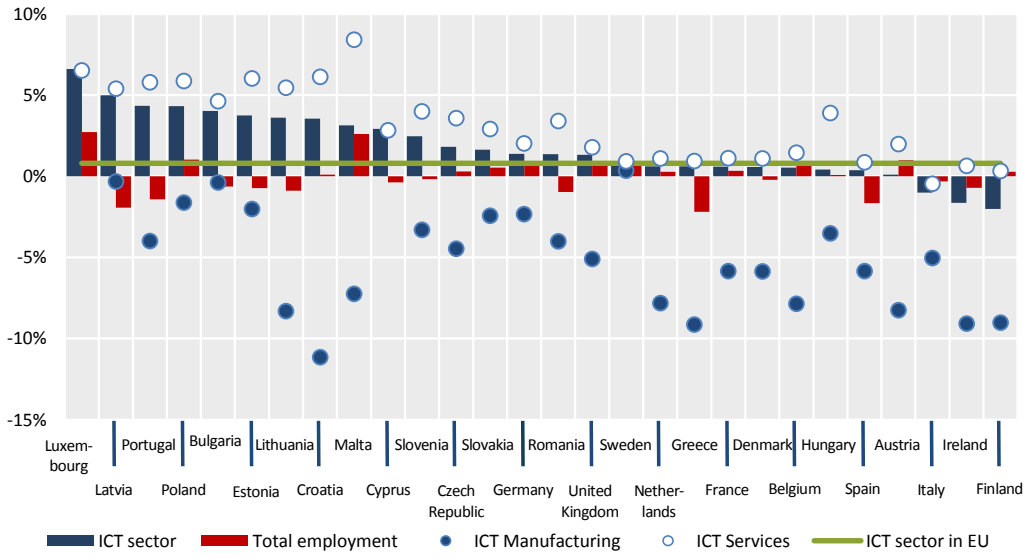
Figure 58: Ratio of ICT sector employment share of total employment over EU ICT sector employment share of total employment. EU Member States (2006 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, Latvia, Portugal, Bulgaria, Lithuania and Estonia had the largest increases in their ICT sector's share in total employment. By contrast, the employment shares of the ICT sector in Finland, Ireland, Austria, Italy and Belgium dropped sharply. In terms of VA, Finland's ratio was almost twice (1.78) as much as the EU levels at the beginning of the period. In 2014, Luxembourg, Malta, Ireland, Hungary and Sweden overtook Finland, presenting ratios more than 1.4 times as much as the EU levels (Figure 58).

Figure 59: Mean annual real growth rate of employment in ICT sector, ICT manufacturing, ICT services and Total employment. EU Member States (2006-2014)

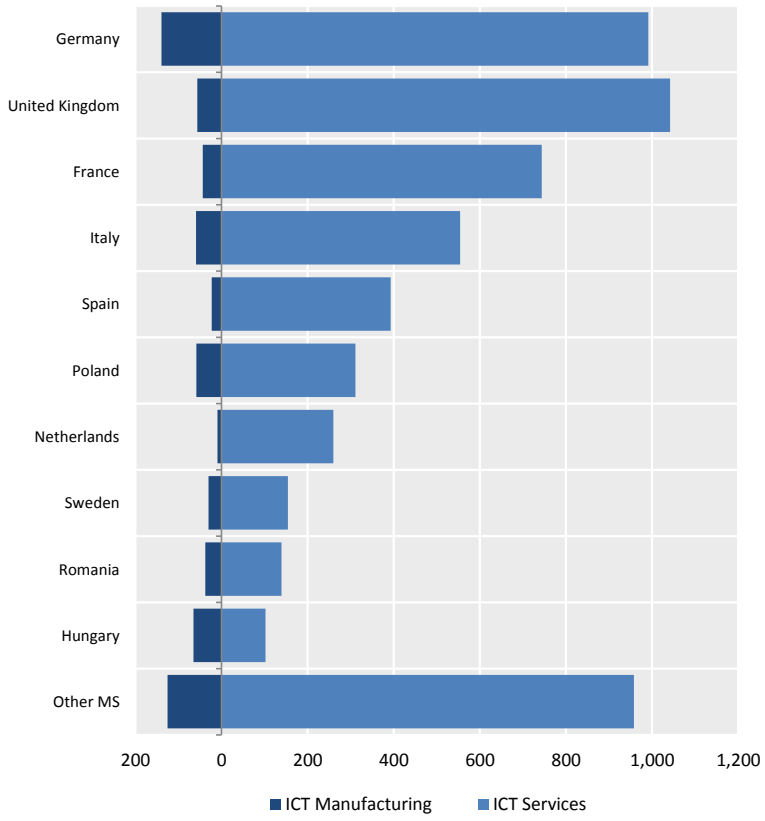


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The average growth of ICT sector employment between 2006 and 2014 ranged from 6.6% in Luxembourg or above 4% in Latvia, Portugal, Poland and Bulgaria, to negative rates in three Member States: Italy (-1.0%), Ireland (-1.6%) and Finland (-2.0%). However, the total employment suffered the effects of the economic crisis more than the employment in the ICT sector. Half of the Member States showed negative records, outstanding Portugal, Spain, Latvia and Greece.

ICT manufacturing sector employment had negative growth rates in all the EU countries, except Sweden (+0.34%). In contrast, ICT services sector employment increased in all the countries, with the exception of Italy (-0.5%) that presented negative values in all the variables (Figure 59).

Figure 60: ICT manufacturing and ICT services employment in the ten largest EU Member State contributors (thousand persons employed, 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In terms of employment, the ICT sector in the EU Member States was clearly dominated by ICT services, although there was considerable variation in the distribution of employment between the two sub-sectors (manufacturing and services). Many EU13 States are relatively important ICT manufacturing countries when considering the numbers of people employed in this sector: Hungary, Estonia and Romania among others. The 19.9% of employment in the ICT sector was concentrated in the ICT manufacturing in EU13 States. This share was lower (8.8%) in the EU15 States.

The ten largest Member States accounted for 82.8% of total ICT sector employment, 80.7% of ICT manufacturing employment and 83% of ICT services employment. Germany dominated total ICT sector employment and ICT manufacturing employment. In ICT services, the United Kingdom and Germany employed the highest number of people (Figure 60).

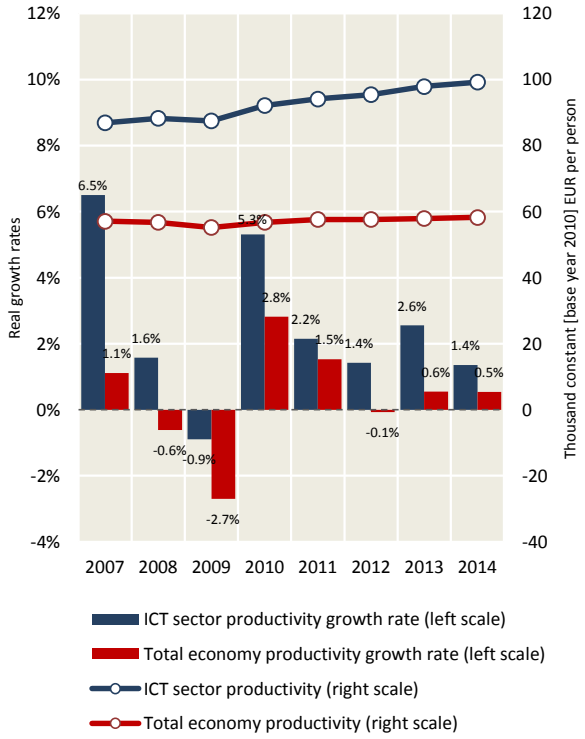
3.2.2 ICT sector productivity per person employed

Box 3. Definition of productivity per person employed

Productivity per person employed

Productivity is defined as Value added per person employed. It measures how efficiently labour input is combined with other factors of production and how it is used in the production process. Labour input is defined as the total number of people engaged in production. Labour productivity only partially reflects the productivity of labour in terms of the personal capacities of workers, or the intensity of their effort, as it depends on the use of other production factors, e.g. physical capital.

Figure 61: ICT sector and total productivity per person employed. Levels and annual real growth rates. European Union (2007-2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity per person employed in the ICT sector was 70.4% higher than it was in the total economy. Additionally, labour productivity growth in the ICT sector was systematically higher than it was for the total economy over the period 2006-2014. As a result, the gap between ICT sector productivity and total economy productivity widened (Figure 61).

Figure 62: Productivity per person employed in ICT manufacturing, ICT services, MC and RS sectors. European Union (thousand constant [base year 2010] EUR per person; 2006-2014)

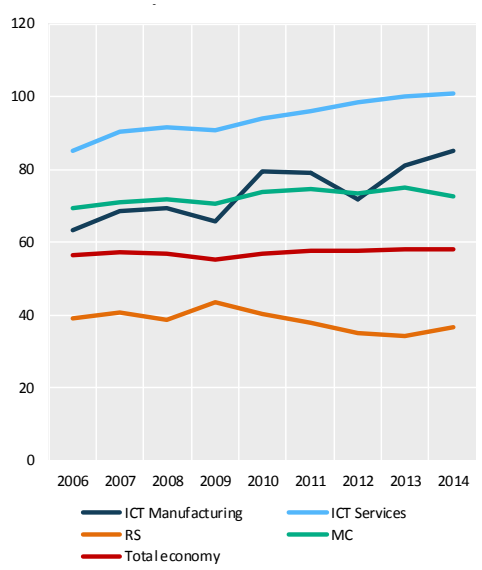
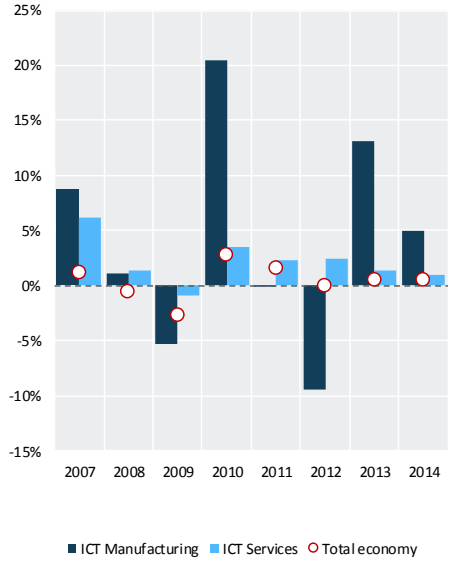


Figure 63: Annual real growth rates of productivity per person employed in ICT manufacturing, ICT services and total economy. European Union (2007-2014)



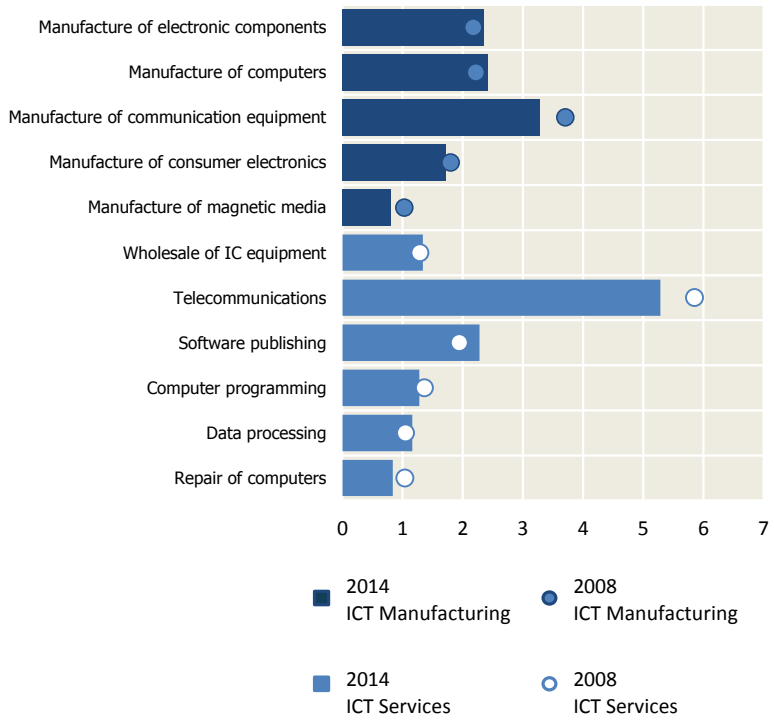
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity per person employed was higher in ICT services, ICT manufacturing and the Media and Content sector than in the total economy (73.2%, 46.4% and 24.4% higher, respectively). In contrast, labour productivity in Retail Sales sector was 36.8% lower than the productivity of the total economy.

Since 2010, ICT services productivity always had positive growth rates and a less cyclical pattern than ICT manufacturing. On the other hand, the growth of ICT manufacturing productivity fell sharply in 2012 (-9.4%), but then grew again in 2013 (13.1%) and 2014 (5.0%) (Figures 62 and 63).

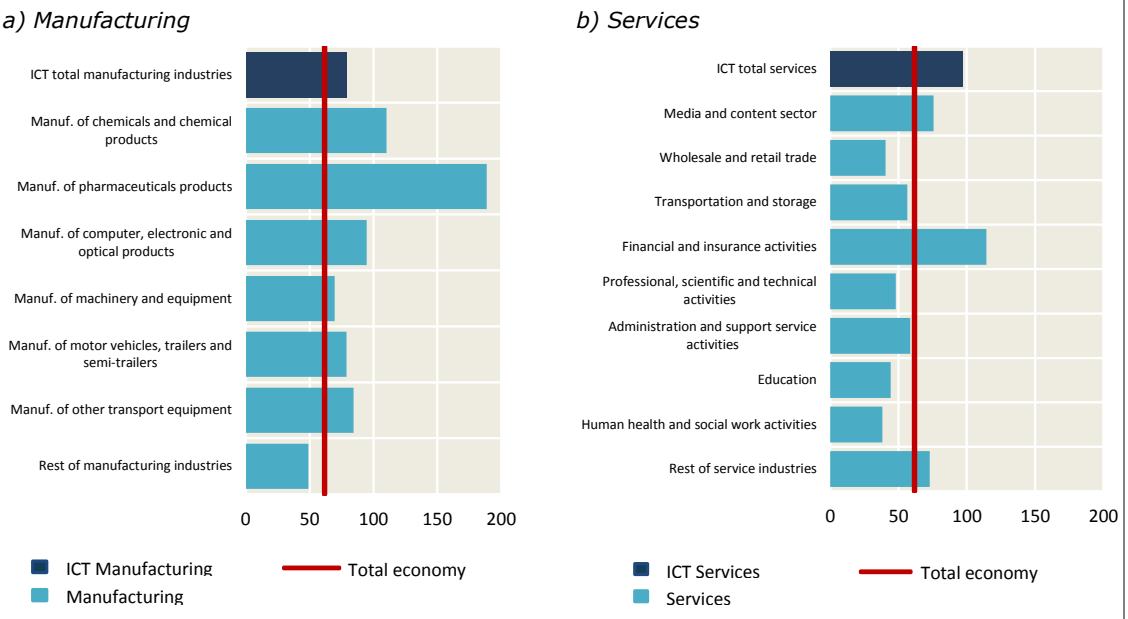
Figure 64: ICT sector productivity per person employed ratio over productivity in total economy by sub-sector. European Union (2008 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity of most ICT sub-sectors was higher than that of the total economy (values higher that 1 in the graph), except in *Manufacture of magnetic media* and *Repair of computers*. The productivity of *Telecommunications* was 5.3 times higher than total productivity. The gap in productivity between the ICT sub-sectors and total productivity has increased between 2008 and 2014 in some sub-sectors and decreased in others. In *Software publishing* the productivity per person in 2014 was 2.3 times the total productivity, increasing from 1.9 in 2008. On the other hand, *Manufacture of magnetic media* was aligned with total productivity in 2008, but its productivity decreased to become only 0.8 of total productivity in 2014 (Figure 64).

Figure 65: ICT sector productivity per person employed and comparison with non-ICT economic activities. European Union (thousand current EUR per person; 2014)



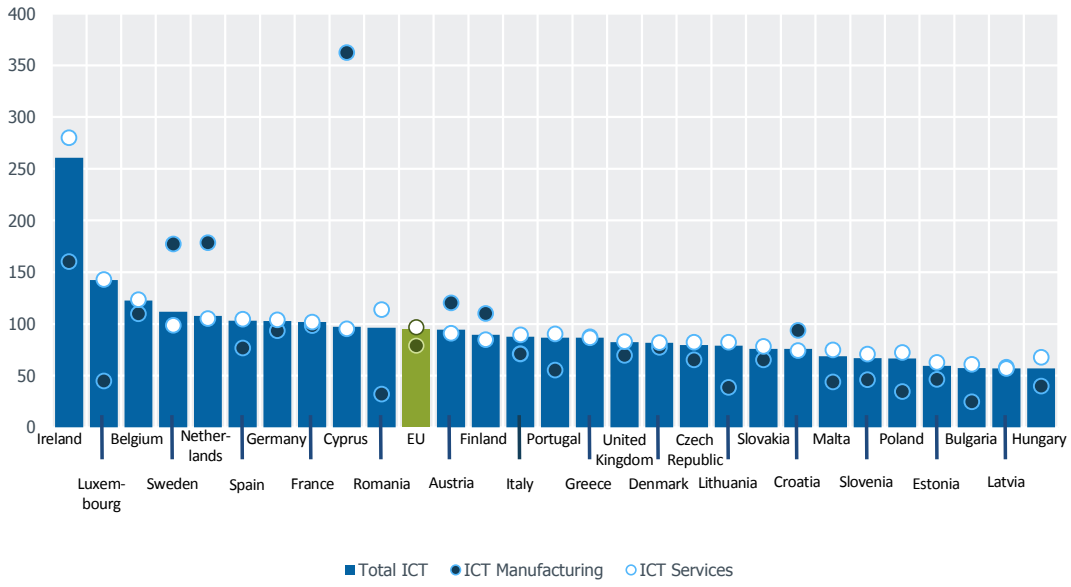
Note: The following economic activities are not included neither in manufacturing nor in services industries: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; Construction.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity per person employed in the EU in all the manufacturing sectors was higher than the total economy, except for *Rest of manufacturing industries*. The sub-sector with the highest productivity was *Manufacture of pharmaceutical, medicinal, chemical and botanical products*, followed by *Manufacture of chemical and chemical products* and *Manufacture of computer, electronic and optical products non ICT*.

A few of the service sectors included in PREDICT had labour productivity levels above the total economy's levels, especially *Financial and insurance activities* and *ICT total services.* (Figure 65).

Figure 66: ICT productivity per person employed. EU Member States (thousand current EUR PPS [Purchase Power Standard] per person, 2014)



Note: Greece, Luxembourg, Croatia and, especially, Malta lack official data, therefore these results should be considered with caution.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Ireland had the highest level of productivity per person employed in the ICT sector in 2014, followed by Luxembourg, Belgium, Sweden, the Netherlands and Spain, while the majority of the EU13 States (except Romania, Cyprus and, to a lesser extent, Czech Republic and Lithuania) had the lowest levels. ICT services had a higher labour productivity than total in almost all the countries (20 out of 28) (Figure 66).

Figure 67: ICT sector productivity per person employed over total economy productivity. EU Member States (2006 and 2014)

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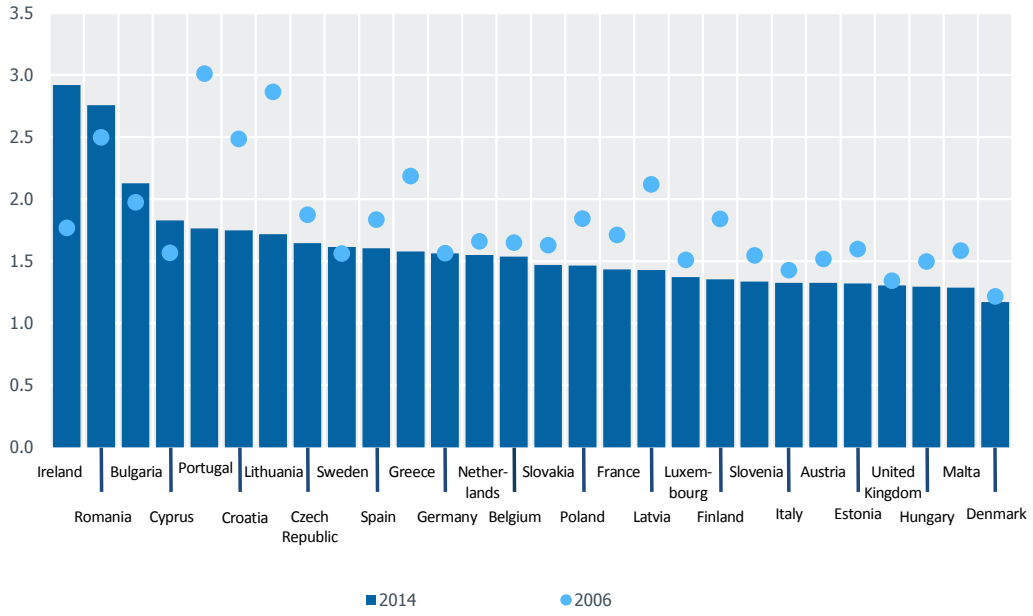


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT sector productivity per person employed exceeded total economy productivity in all Member States (all ratios in the graph are above 1). Ireland and Romania had the highest ratios with productivity in the ICT sector almost 3 times higher that their total productivities. Other countries with high ratios were Bulgaria, Cyprus and Portugal. In contrast, Denmark, Malta and Hungary had the lowest ratios with productivity levels that were only 17% higher than those of the total economy in the case of Denmark (Figure 67).

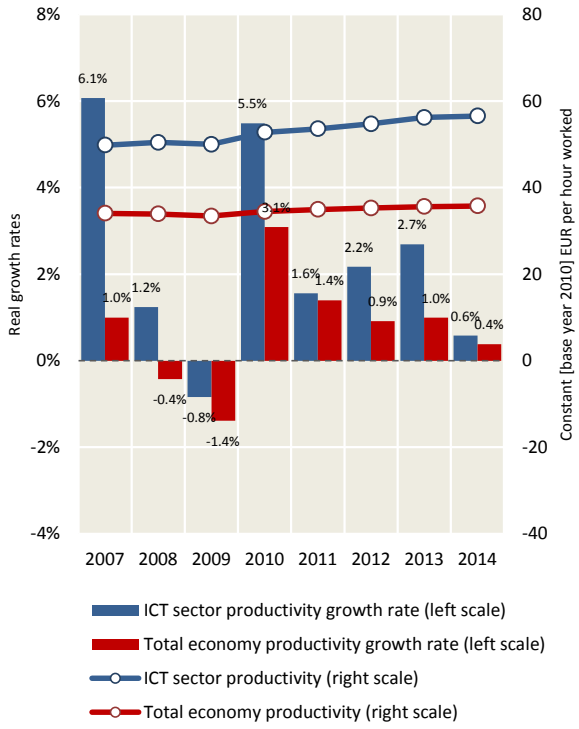
3.2.3 ICT sector productivity per hour worked

Box 4: Definition of productivity per hour worked

Productivity per hour worked

Productivity per hour worked is a measure of labour productivity and is defined as value added per hour worked. It measures how efficiently labour input is combined with other factors of production and how it is used in the production process. Labour input is defined as total hours worked by all persons engaged in production. Labour productivity only partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their effort.

Figure 68: ICT sector and total productivity per hour worked. Levels and annual real growth rates. European Union (2007-2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, productivity per hour worked in the ICT sector was 58.1% higher than it was in the total economy. Similarly to productivity per person employed, the growth of productivity per hour worked in the ICT sector over the period 2006-2014 was always higher than it was in the total economy, especially in 2007 and 2010 (Figure 68).

Figure 69: Productivity per hour worked in ICT manufacturing, ICT services, MC and RS sectors. European Union (constant [base year 2010] EUR per hour worked; 2006-2014)

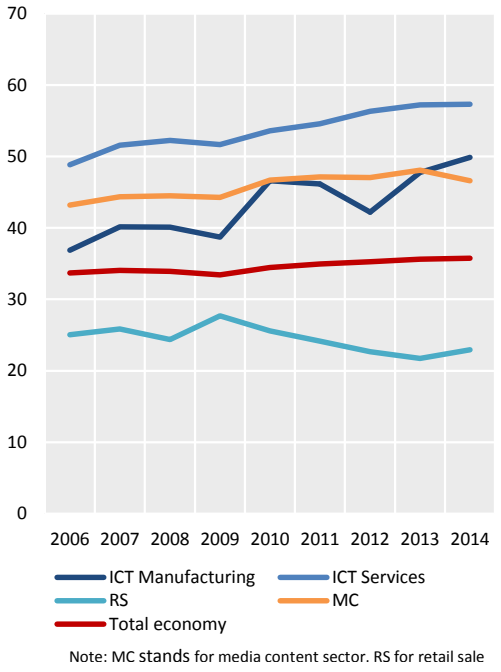
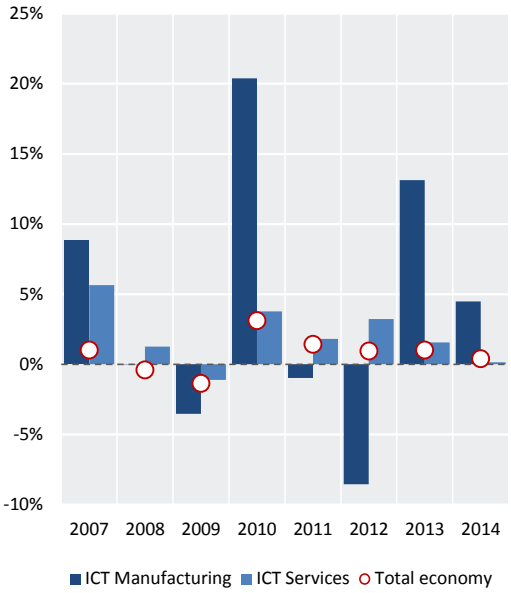


Figure 70: Annual real growth rates of productivity per hour worked in ICT manufacturing, ICT services and total economy. European Union (2007-2014)



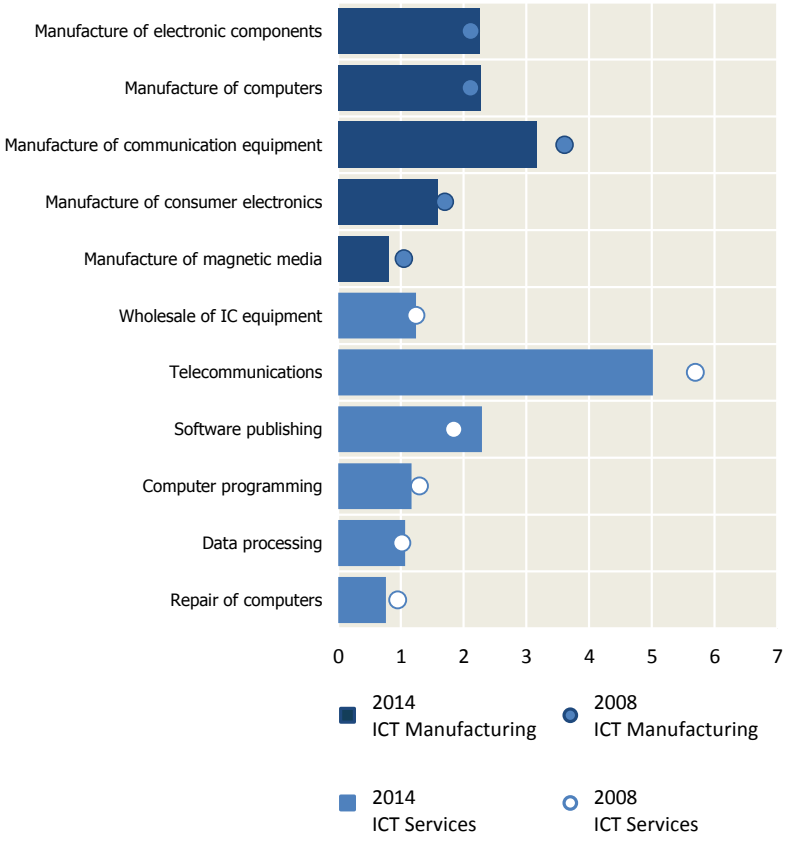
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

ICT services had the highest levels of productivity per hour worked over the entire period 2006-2014, followed by the Media and Content sector and ICT manufacturing, all of them above total economy. In contrast, labour productivity in the Retail Sales sector represented only 64.2% of the total economy in 2014.

Since 2010, ICT services productivity has always presented positive growth rates and a less cyclical pattern than ICT manufacturing. In contrast, ICT manufacturing productivity growth fell sharply in 2012 (-8.5%) but then grew in 2013-2014 (Figure 69 and 70).

Figure 71: ICT sector productivity per hour worked ratio over productivity in total economy by sub-sector. European Union (2008 and 2014)

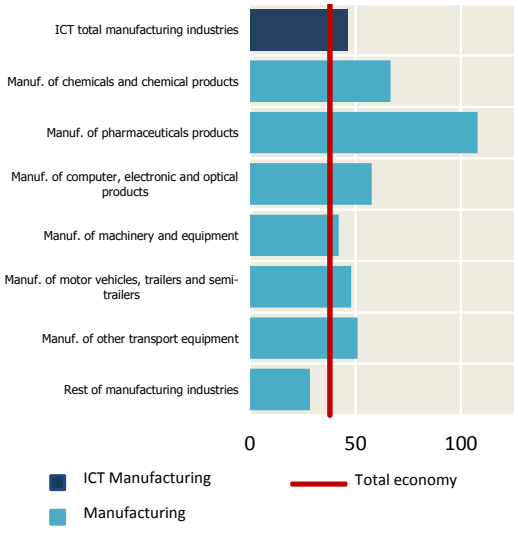


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

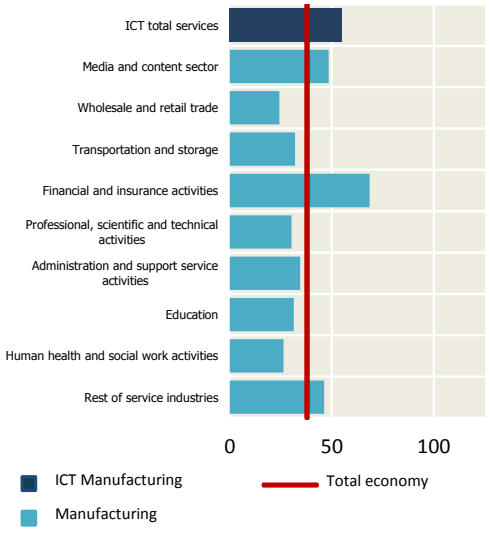
As in productivity per person (Figure 64), most ICT sub-sectors had a higher productivity per hour than that of the total economy (values higher that 1 in the graph). The exceptions are again *Manufacture of magnetic media* and *Repair of computers*. The productivity per hour of *Telecommunications* was 5 times higher than total productivity, but reducing its gap from 5.7 in 2008. The gap in productivity between the ICT sub-sectors and total productivity has increased between 2008 and 2014 particularly in Software publishing, from 1.8 to 2.3 (Figure 71).

Figure 72: ICT sector productivity per hour worked and comparison with non-ICT economic activities. European Union (current EUR per hour worked; 2014)

a) Manufacturing



b) Services



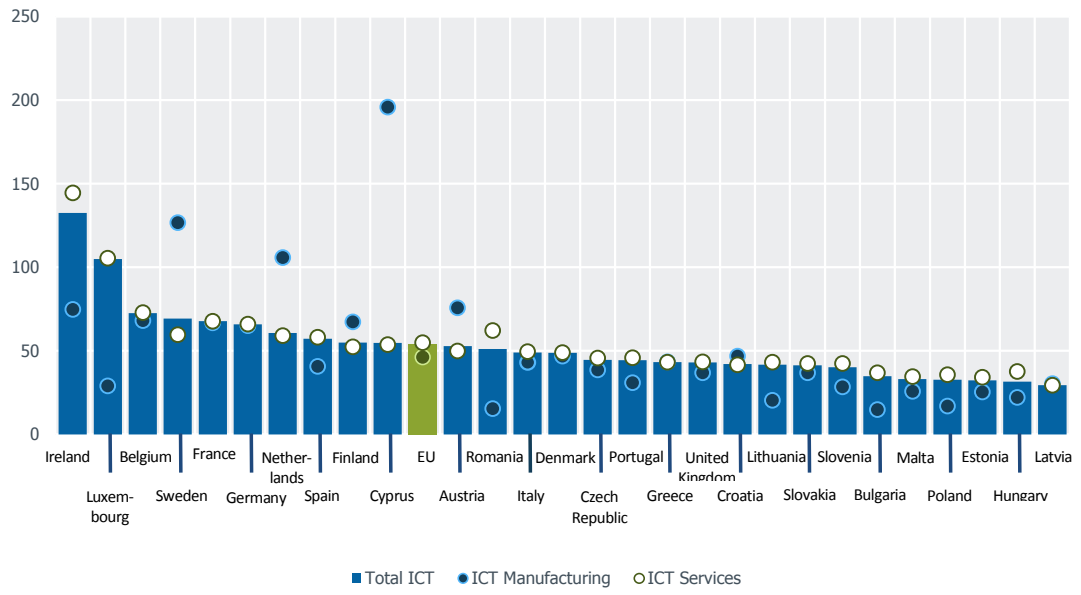
Note: The following economic activities are not included neither in manufacturing nor in services industries: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; Construction.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As in productivity per person employed (Figure 65), manufacturing sectors had higher productivity per hour worked than the total economy, except for *Rest of manufacturing industries*. *Manufacture of pharmaceutical, medicinal chemical and botanical products,* followed by *Manufacture of chemical and chemical products* and *Manufacture of computer, electronic and optical products non ICT,* had the highest levels of productivity.

The majority of services sectors did not reach the total economy levels. *Financial and insurance activities,* followed by *ICT total services* and the *Media and Content sector,* were the most productive services sector in 2014 (Figure 72).

Figure 73: ICT productivity per hour worked. EU Member States (current EUR PPS [Purchase Power Standard] per hour, 2014)

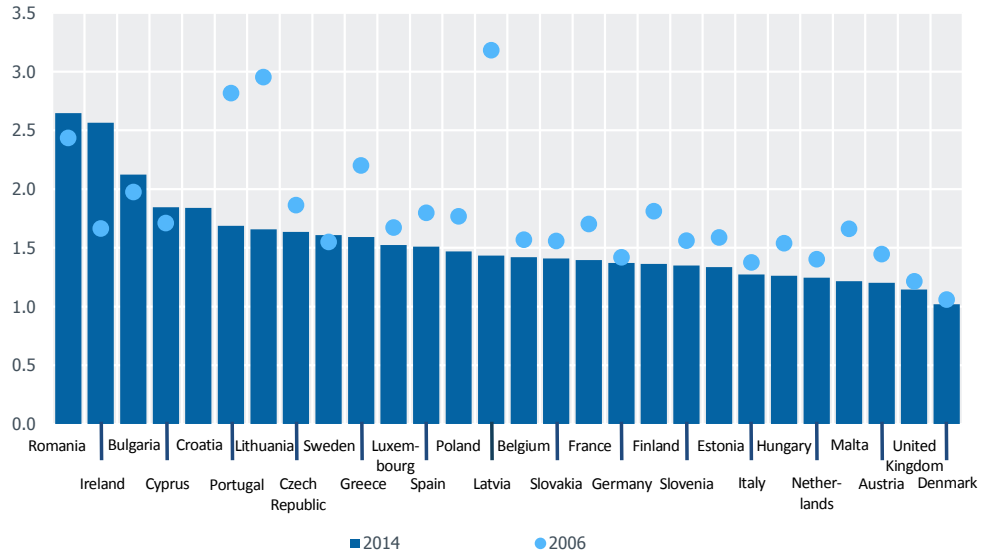


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As it did with productivity per person employed (Figure 66), Ireland had the highest level of productivity per hour worked in the ICT sector in 2014. It was followed by Luxembourg, Belgium, Sweden and France, which significantly improved its position in the ranking when using hours worked instead of persons employed.

Productivity per hour worked in the majority of the EU13 States, except Romania, Cyprus and, to a lesser extent, Czech Republic and Croatia, was the lowest of the EU countries. ICT services sector productivity per hour worked was higher than productivity in the total ICT sector for almost all countries (20 out of 28) (Figure 73).

Figure 74: ICT sector productivity per hour worked over total economy productivity. EU Member States (2006 and 2014)



Note: Data not available for Croatia for ICT productivity per hour worked in 2006.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In the case of productivity per hour worked, the EU ICT sector productivity was 42.6% higher than total economy productivity in 2014. ICT sector productivity ratio over total economy productivity of Romania, Ireland and Bulgaria broadly doubled the EU levels, with ICT sector productivity per hour in Romania being 165% higher than total productivity in its economy. Other countries with a high ratio were Cyprus, Croatia and Portugal. By contrast, Denmark, the UK and Austria came last in the ranking (Figure 74).

3.3 ICT sector business enterprise R&D (BERD) expenditure

Figure 75: ICT sector BERD and annual real growth rates of ICT sector BERD and total BERD. European Union (2007-2014)

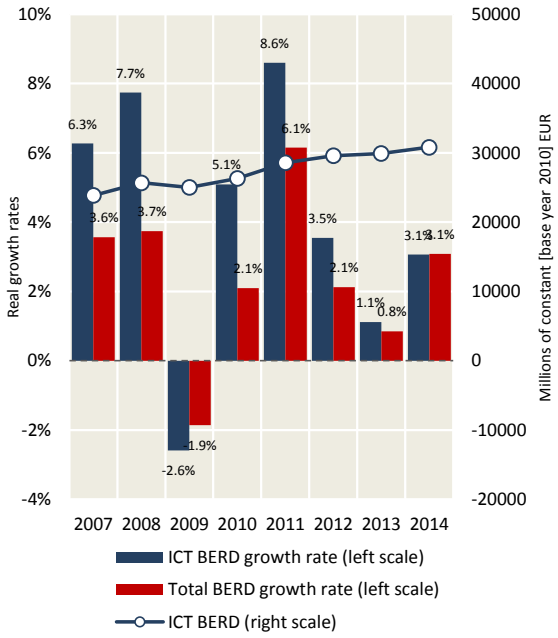
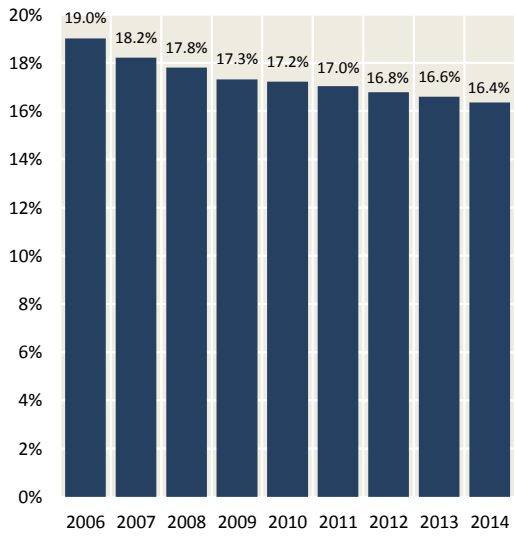


Figure 76: ICT sector BERD share of total BERD. European Union (2006-2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The evolution of ICT BERD was very similar to the one of total BERD, although showing slightly higher growth rates: positive growth rates for the whole period except for 2009, in which a decrease was observed.

ICT sector BERD concentrated the 19.0% of total BERD in 2006, but experienced an important reduction during the period (almost 3 percentage points). In 2014, ICT sector BERD represented 16.4% (Figures 75 and 76).

Figure 77: Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP). European Union (2006-2014)

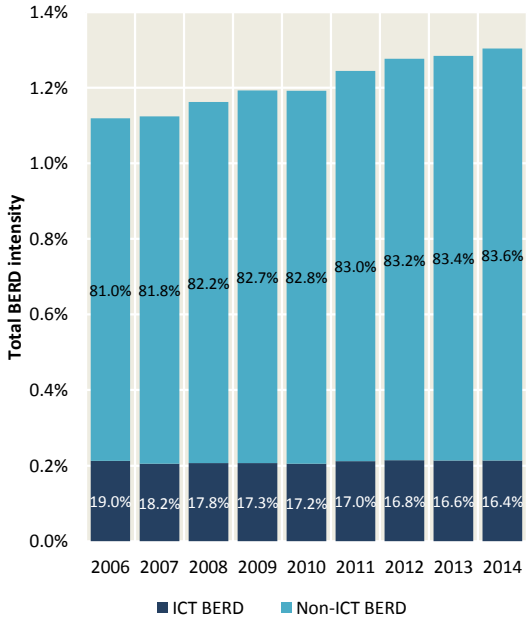
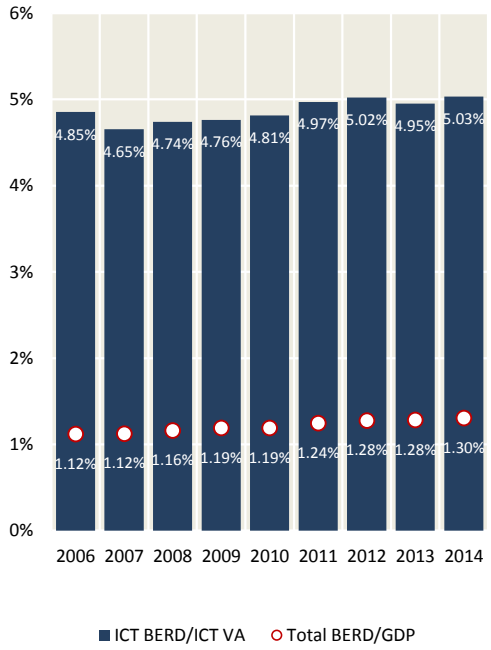


Figure 78: ICT BERD intensity and Total BERD intensity. European Union (2006-2014)

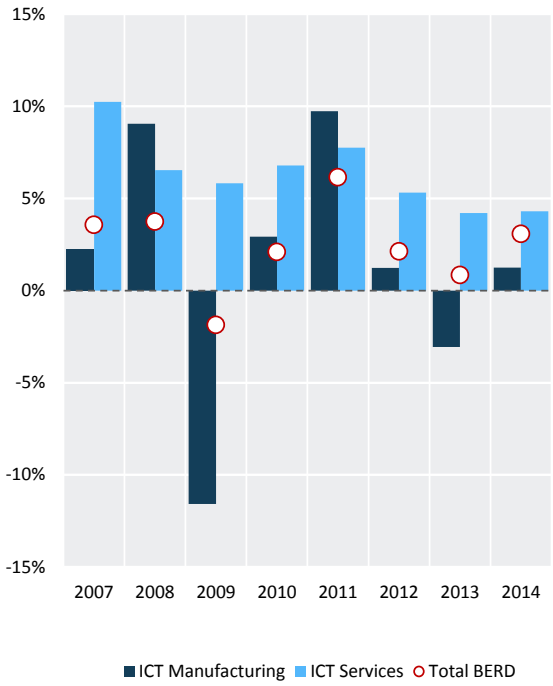


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The weight of BERD on GDP – or BERD intensity (BERD/GDP) – rose for five consecutive years since 2010, reaching 1.3% in 2014. In the same year, ICT sector concentrated 16.4% of the total R&D expenditure in the business sector (BERD).

ICT BERD intensity in the EU was around 4.9% over the period 2006-2014, a ratio on average 4 times the one of the total economy. It increased slightly since 2007, reaching a maximum in the last four years of 5.0% (Figures 77 and 78).

Figure 79: Annual real growth rates of BERD in ICT manufacturing, ICT services and total economy. European Union (2007-2014)

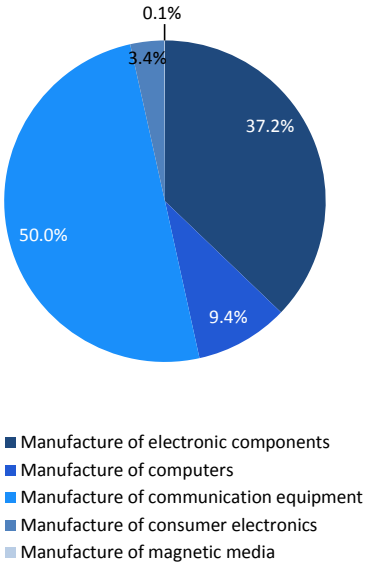


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

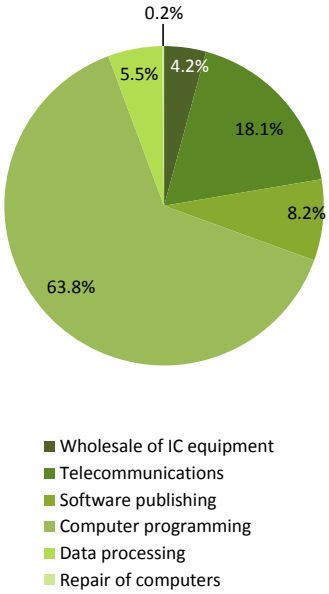
ICT services BERD did not suffer the effects of the economic crisis to the same extent as both total BERD and ICT manufacturing. It has continuously risen since 2006, presenting growth rates higher than the 4% for all the period. By contrast, as for the rest of the variables, ICT manufacturing presented a more volatile trajectory, with growth falling sharply in 2009 (-11.6%) and moderately in 2013 (-3.1%) (Figure 79).

Figure 80: ICT manufacturing and ICT services BERD by sub-sectors. European Union (2014)

a) ICT manufacturing



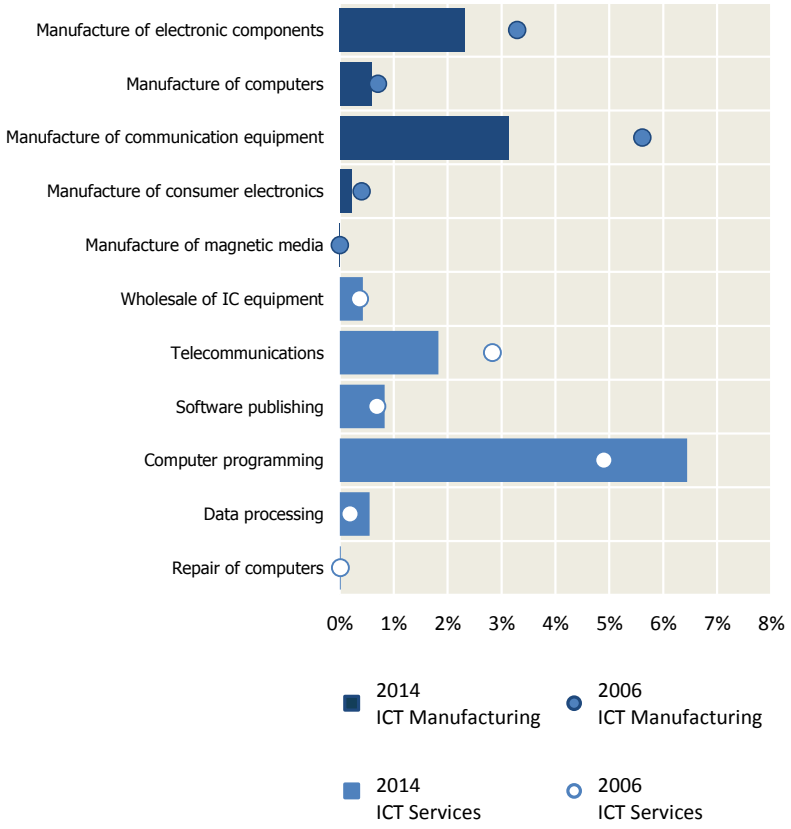
b) ICT services



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, *Manufacture of electronic components* and *Manufacture of communication equipment* were the two largest ICT manufacturing sub-sectors in the EU, representing 87.1% of the total BERD. Concerning ICT services, *Computer programing, consultancy and related activities* almost concentrated two thirds of the total BERD, followed by *Telecommunications*, together accounting for 81.9% (Figure 80).

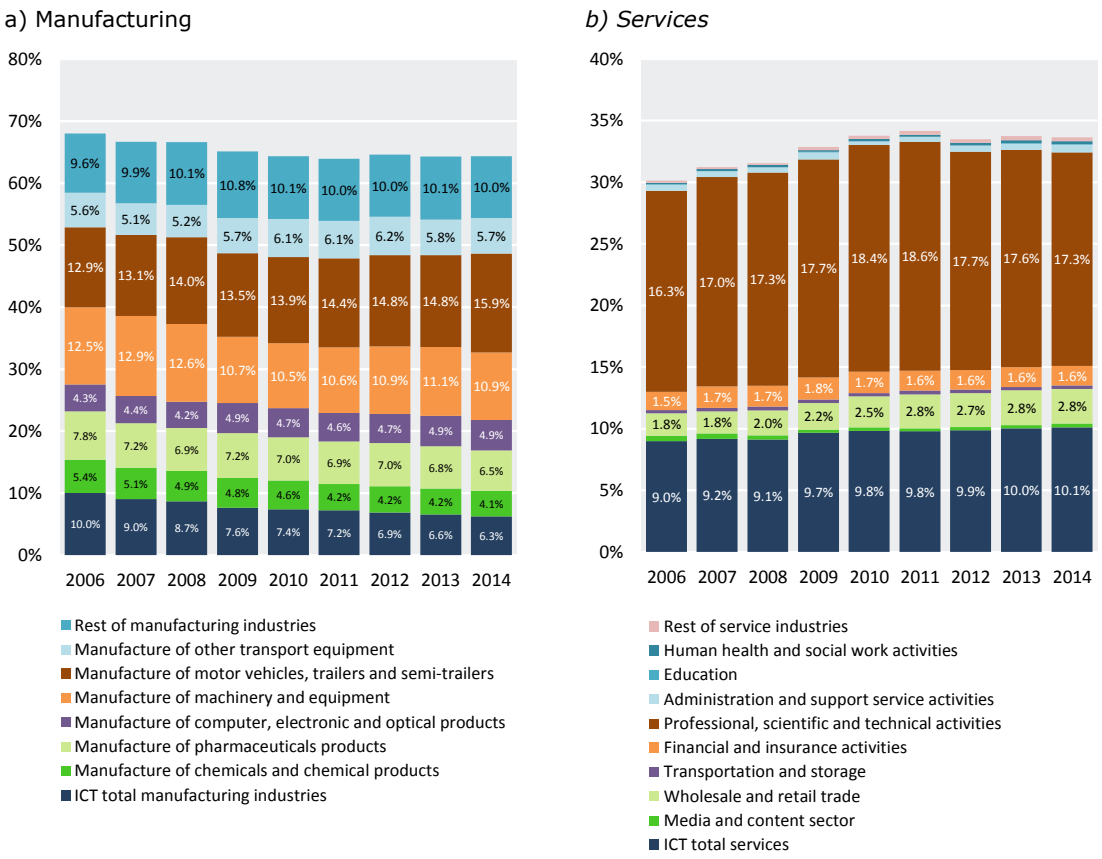
Figure 81: ICT sector BERD share of total BERD by sub-sector. European Union (2006 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Analysis of ICT BERD across ICT sub-sectors provides quite a different perspective from the one observed when comparing VA or employment. In 2014, half of ICT manufacturing BERD was invested in *Manufacture of communications equipment*. However, the highest shares among all sub-sectors correspond to *Computer programing, consultancy and related activities*. Between 2006 and 2014, the shares reduced in the majority of ICT manufacturing sub-sectors and, within ICT services sub-sectors, in *Telecommunications* (Figure 81).

Figure 82: ICT sector BERD share on total BERD and comparison with non-ICT economic activities. European Union (2006-2014)

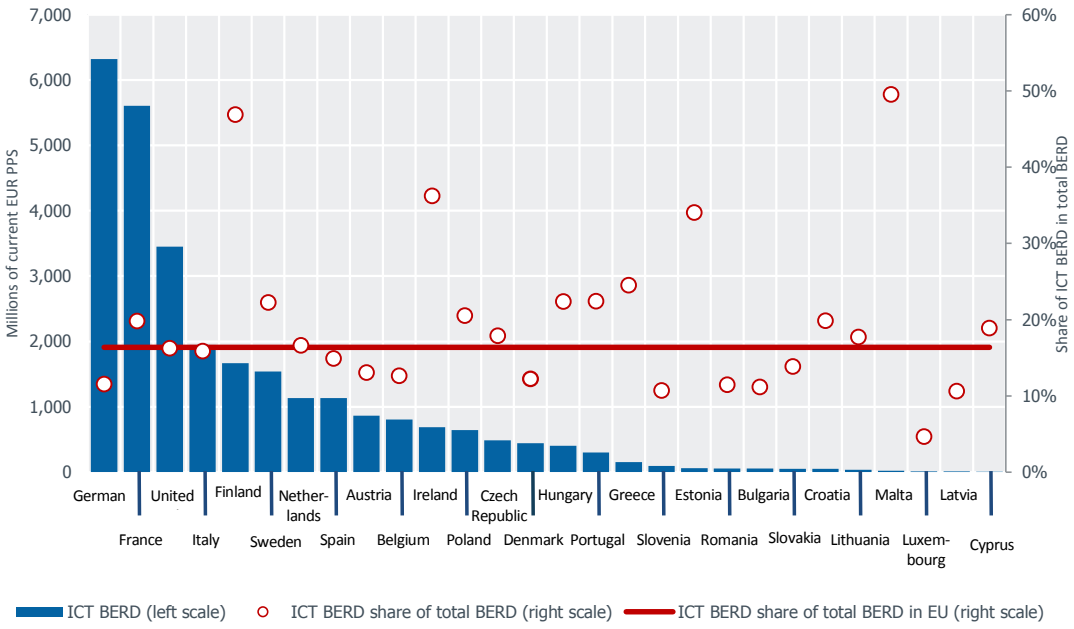


Note: The following economic activities are not included neither in manufacturing nor in services industries: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply, sewerage, waste management and remediation activities; Construction.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

While manufacturing represented around 14% in terms of VA (Figure 45) and employment (Figure 56), it accounted for around 64% in terms of BERD since 2010. However, this share was lower than in 2006. In addition to ICT sectors, the non-ICT sectors with the highest share of total BERD are *Professional, scientific and technical activities, Manufacture of motor vehicles, trailers and semi-trailers* and *Manufacture of machinery and equipment* (Figure 82).

Figure 83: ICT sector BERD and ICT sector BERD share of total BERD. EU Member States (2014)

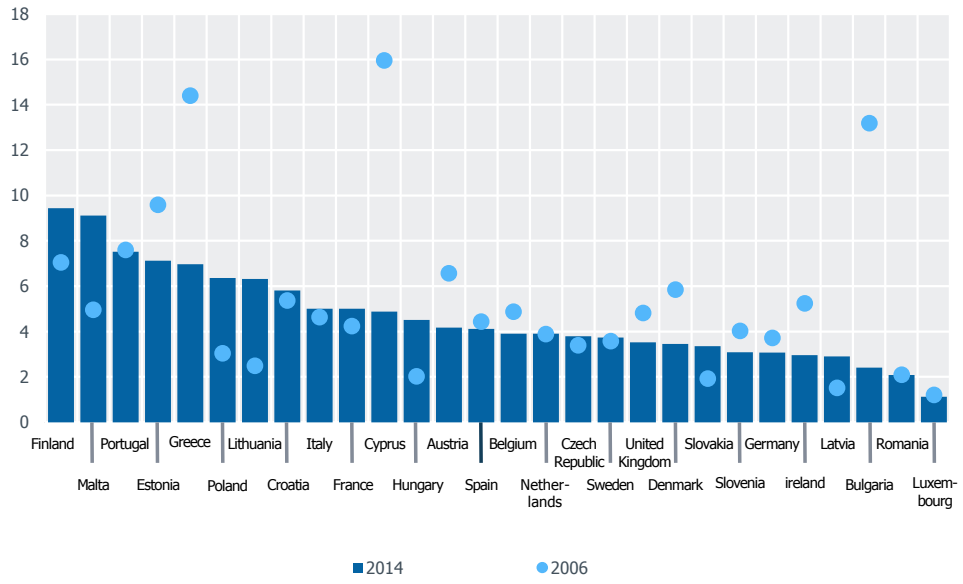


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the largest contributors to EU ICT sector BERD were Germany (22.6%) and France (20.0%). These two countries alone constituted 42.6% of total EU ICT sector BERD. They were followed, albeit at a certain distance, by UK (12.3%), Italy (7.0%), Finland (5.9%) and Sweden (5.5%). These six countries together spent 73.3% of total EU ICT sector BERD in 2014.

The EU13 States had a smaller contribution to EU aggregate (7.0%) than when compared with ICT sector VA (Figure 46) and employment (Figure 57). The ICT sector share on total BERD ranged from 49.5% for Malta and 46.9% for Finland to 4.7% for Luxembourg (Figure 83).

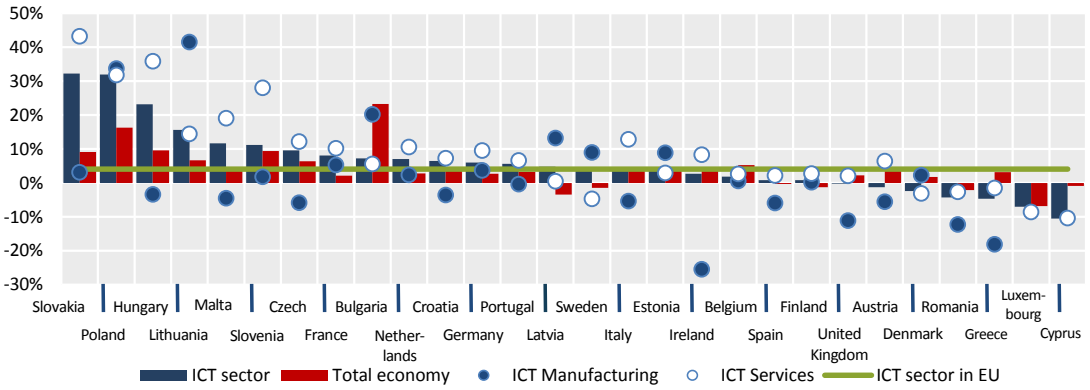
Figure 84: Ratio of ICT sector BERD intensity (ICT sector BERD/ICT sector VA) over total economy BERD intensity. EU Member States (2006 and 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the ICT sector had a higher BERD intensity than total economy in all Member States (ratios above 1 in the graph), as it was the case in 2006. In 2014, Finland and Malta showed the highest ratios, with ICT BERD intensity being more than 9 times that of the total economy. The gap in BERD intensity between the ICT sector and the total economy reduced considerably since 2006 in Cyprus, Greece and Bulgaria. On the other hand, this gap increased in many countries, most notably in Lithuania, Hungary, Poland and Malta (Figure 84).

Figure 85: Mean annual real growth rate of BERD in ICT sector, ICT manufacturing, ICT services and Total BERD. EU Member States (2006-2014)

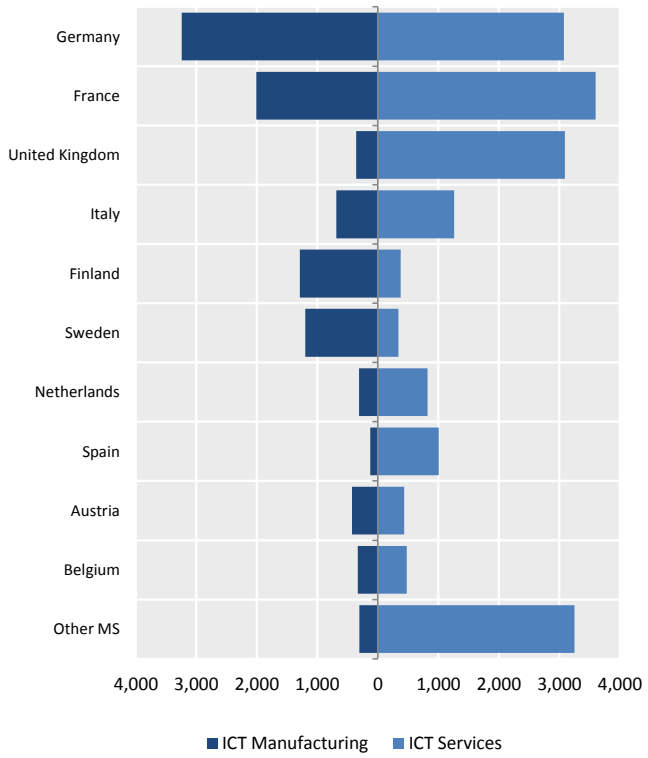


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, the average real growth rate of ICT sector BERD oscillated from over the 30% in Slovakia (32.2%) and in Poland (31.9%), to negative rates in seven MS. The reduction in ICT BERD was especially intense in Luxembourg (-7.0%) and Cyprus (-10.5%). These last countries, along with Romania Finland, Latvia, Spain and Sweden, also showed negatives growth rates in total economy BERD.

Twelve countries showed negative growth rates in ICT manufacturing BERD, highlighting Ireland (-25.4%) and Greece (-18.0%), whereas ICT services BERD increased in the majority of MS (Figure 85).

Figure 86: ICT manufacturing and ICT services BERD in the ten largest EU Member State contributors (million current EUR PPS [Purchase Power Standard], 2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The ten largest MS produced almost the entire ICT manufacturing sector BERD (97.0%), 81.7% of ICT services sector BERD and 87.3% of total ICT sector BERD. Germany dominated total ICT sector and ICT manufacturing BERD. In ICT services sector, the BERD was concentrated in Germany, France and in the United Kingdom (Figure 86).

3.4 Public funding of ICT R&D (ICT GBARD)

Figure 87: ICT GBARD and annual real growth rate of ICT GBARD and total GBARD. European Union (2007-2015)

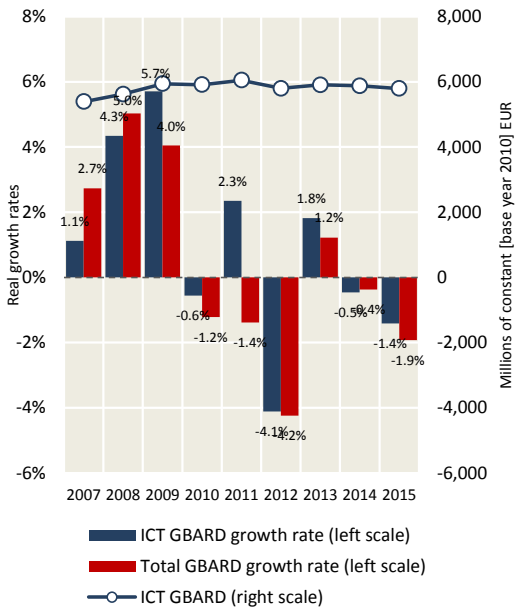
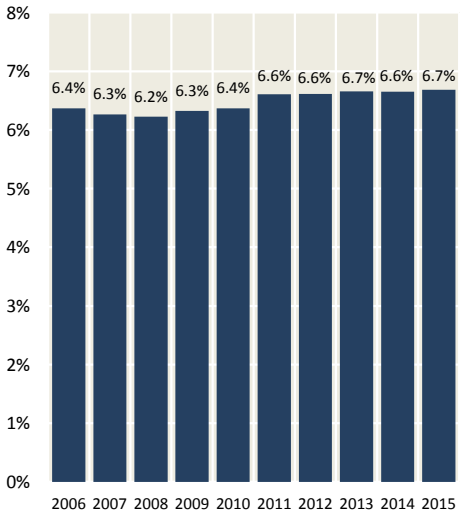


Figure 88: ICT GBARD share of total GBARD. European Union (2006 -2015)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The share of ICT GBARD[7] in total GBARD amounted to 6.7% in 2015, 0.3 percentage points more than in 2006 (6.4%). Both variables, ICT GBARD and total GBARD, followed similar paths: positive growth rates from 2007 to 2009, and in 2013, with negative records from 2010 to 2012 (except ICT GBARD in 2011) and again from 2014 to 2015 (Figures 87 and 88).

[7] ICT GBARD is the part of GBARD (Government budget allocations for R&D) devoted to fund ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector.

Figure 89: Contribution of ICT and non-ICT GBARD to total GBARD intensity (GBARD/GDP). European Union (2006-2015)

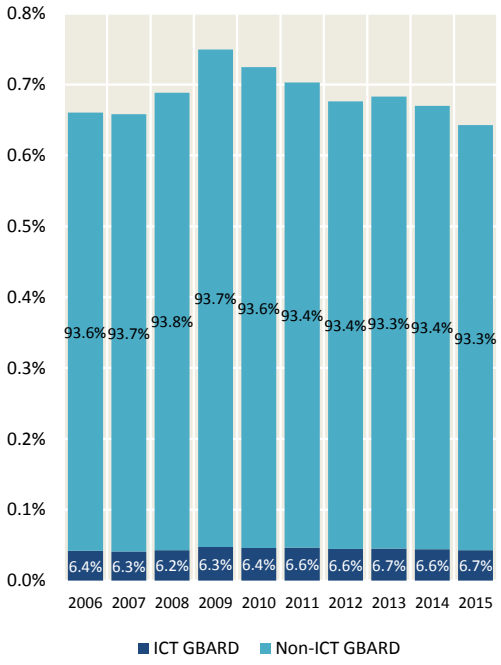
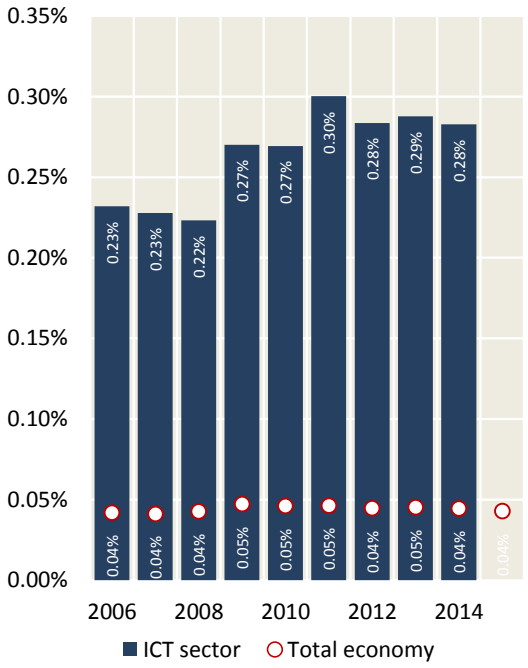


Figure 90: ICT GBARD intensity in ICT sector and total economy. European Union (2006-2015)

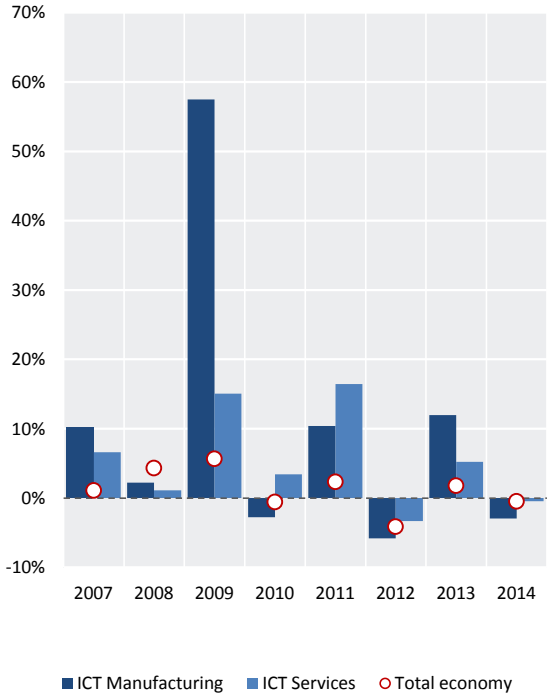


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The GBARD intensity (GBARD/GDP) in EU dropped in 2015 after a slight increase in 2013, continuing the downward trend since 2009, and reaching 0.64% in 2015. ICT GBARD (public funding of ICT assets in all industries of the economy) concentrated 6.7% of GBARD in 2015.

In 2014, the ICT GBARD intensity (ICT GBARD/ICT VA) in the ICT sector was 0.28%, a ratio on average 6 times higher than the total ICT GBARD in the whole economy. It reached a maximum in 2011 (0.30%), decreasing afterwards until 2014 (Figures 89 and 90).

Figure 91: Annual real growth rate of ICT GBARD in ICT manufacturing, ICT services and total economy. European Union (2007-2014)

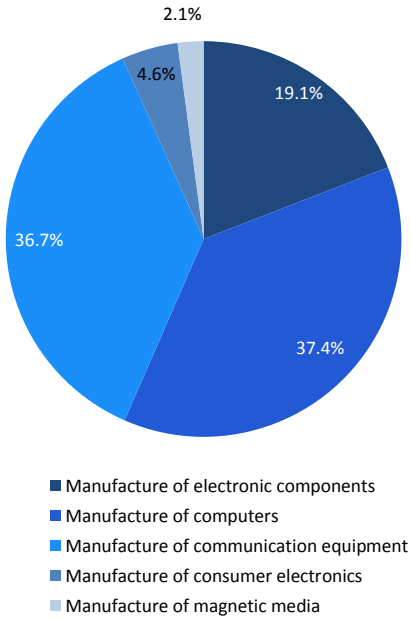


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

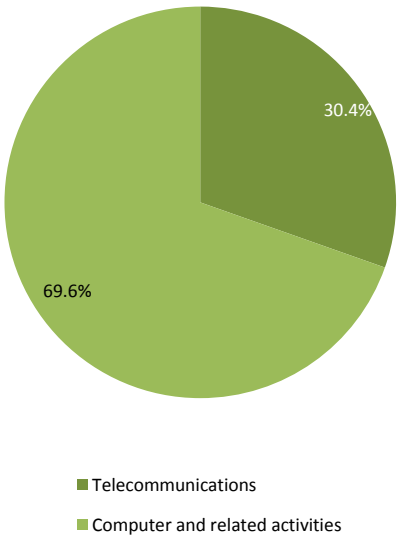
ICT GBARD growth rates in the ICT services were negative only in 2012 (-3.3%) and in 2014 (-0.4%). ICT manufacturing and total ICT GBARD presented negative growth rates also in 2010. In 2009 and 2011 ICT GBARD showed two-digit real growth rates both in the ICT Manufacturing and in the ICT Services (Figure 91).

Figure 92: ICT GBARD in ICT manufacturing and ICT services by sub-sectors (%). European Union (2015)

a) ICT manufacturing



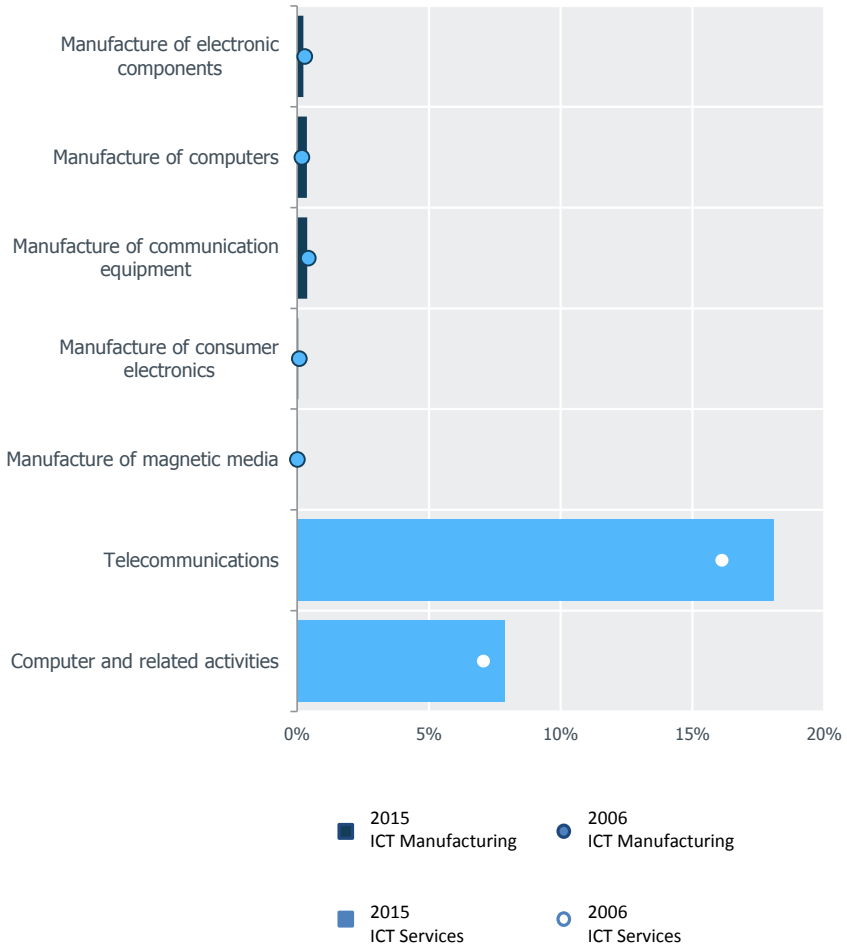
b) ICT services



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2015, *Manufacture of computer and peripheral equipment* and *Manufacture of communication equipment* were the two largest ICT manufacturing sub-sectors in the EU, representing together the 74.2% of the ICT GBARD of ICT Manufacturing sector. In the case of ICT services, *Computer and related activities* concentrated 69.6% of the total and *Telecommunications* accounted for the remaining 30.4% (Figure 92).

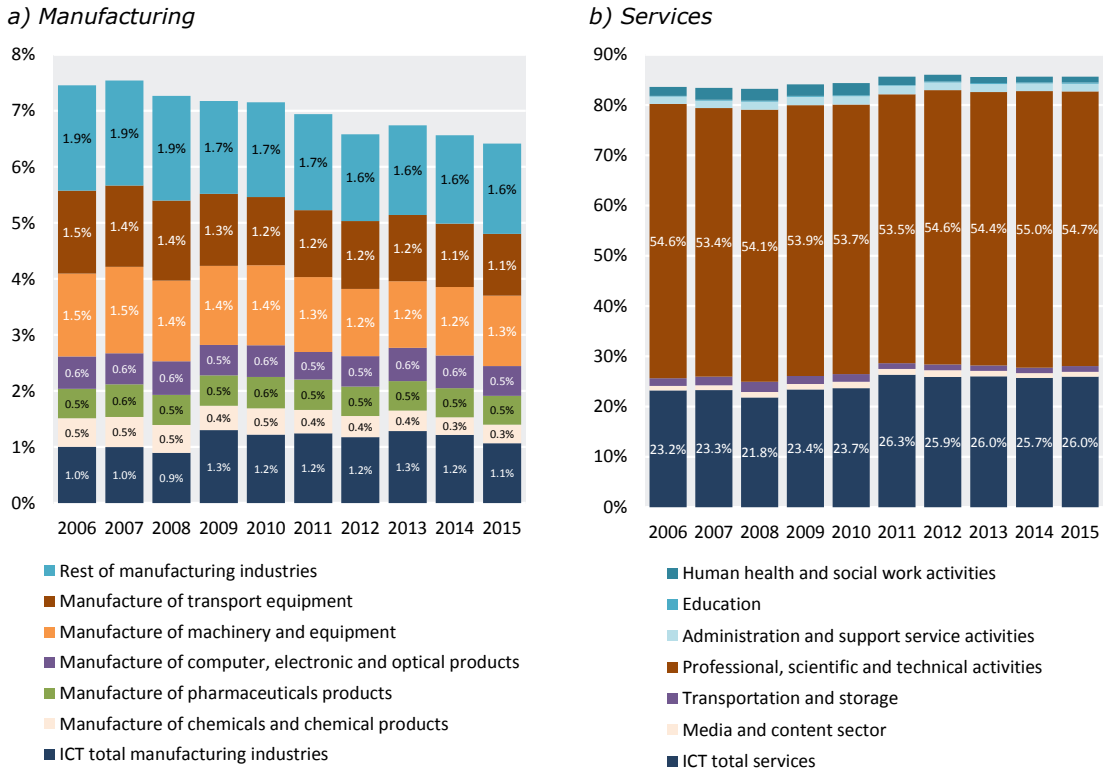
Figure 93: ICT GBARD share of total ICT GBARD in ICT sub-sectors. European Union (2006 and 2015)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The ICT manufacturing sub-sectors showed low weights in ICT GBARD in the total economy. Jointly considered, they represented only 1.1%. The two ICT services sub-sectors, *Telecommunications* and *Computer and related activities*, accounted for 18.1% and 7.9% of total ICT GBARD, respectively, improving their shares with respect to 2006 (Figure 93).

Figure 94: ICT GBARD in ICT sector and in non-ICT sectors. European Union (2006-2015)

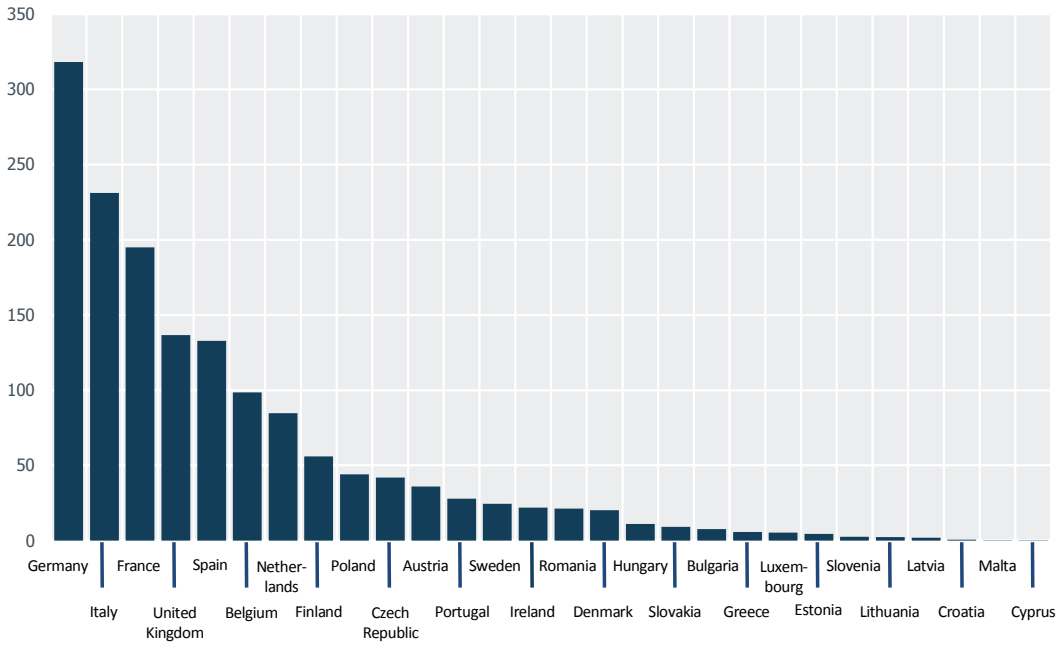


Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction not included neither in manufacturing nor in services industries.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In average ICT manufacturing sectors represented 1.1% of total ICT GBARD, with a maximum share of 1.3% in 2009. Also the non-ICT manufacturing sectors had a small share of GDP. *Professional, scientific and technical activities* (54.7%) and ICT services (26.0%) had the highest shares of ICT GBARD in 2015 (Figure 94).

Figure 95: ICT sector ICT GBARD. EU Member States (million current EUR PPS, 2015)

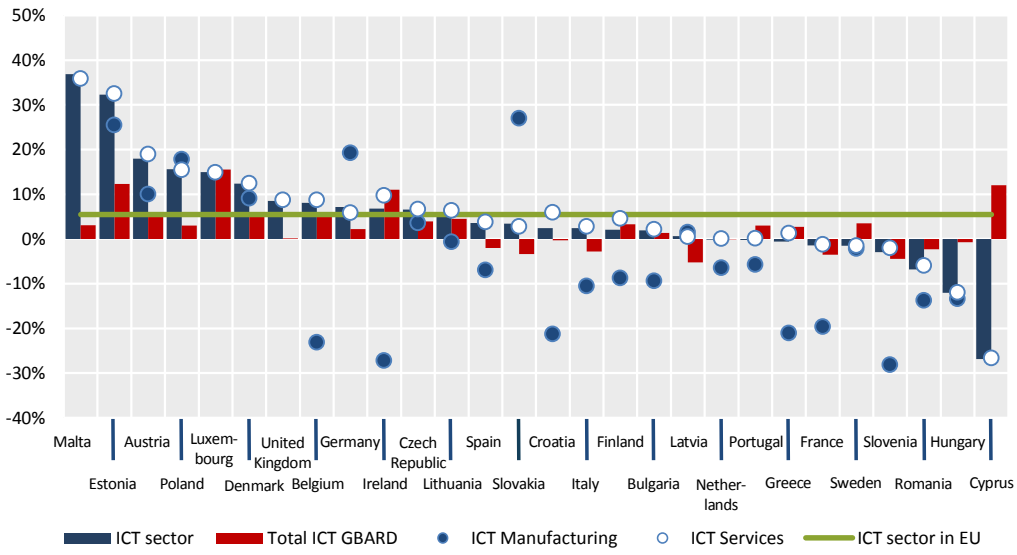


Note: 2014 for Luxembourg.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the five largest economies in the European Union in terms of value added, Germany (20.7%), Italy (15.0%), France (12.6%), United Kingdom (8.9%) and Spain (8.6%), along with Belgium, accounted for the largest contributions to ICT sector ICT GBARD (72.2%) in the EU. The EU13 States together made up around the 10% of the total ICT sector, in line with their economic weight (Figure 95).

Figure 96: Mean annual real growth rate of ICT GBARD in ICT sector, ICT manufacturing, ICT services and total economy. EU Member States (2006-2014)



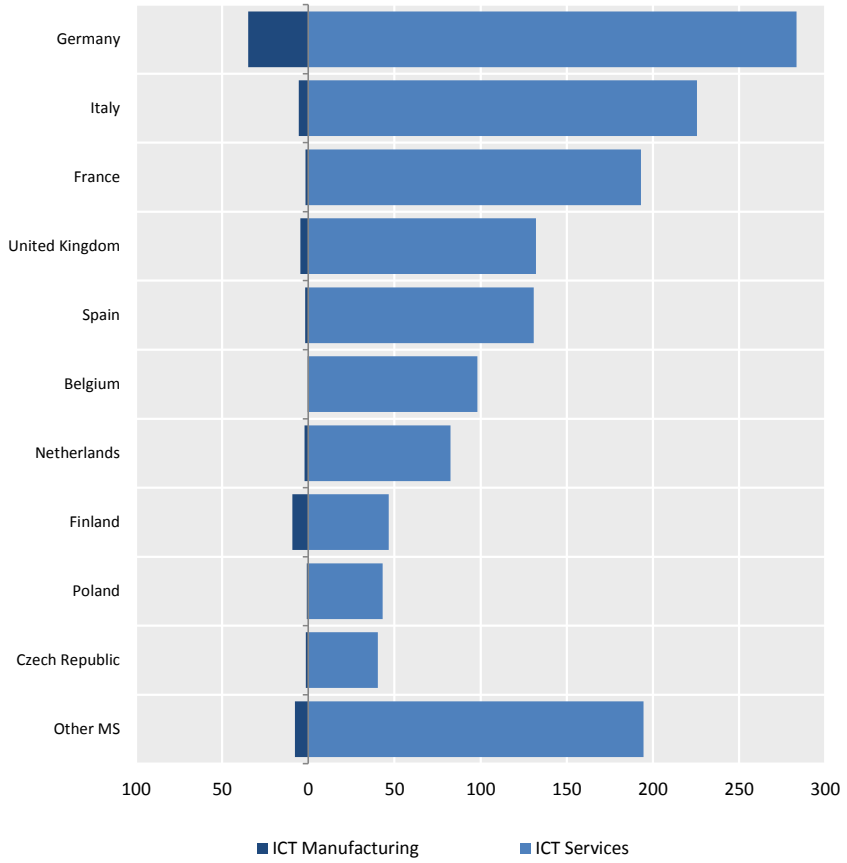
Note: 2008-2014 for Croatia.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The growth rates between 2006 and 2014 of ICT GBARD in the ICT sector presented important differences among European countries. Malta and Estonia experienced the strongest growth (both over 30%), while nine countries reduced their ICT R&D public funding in the total ICT sector. Hungary (-12.0%) and Cyprus (-26.9%) showed the highest reductions.

In the majority of countries, ICT sub-sectors followed the pattern observed in other indicators: ICT manufacturing sector decreased in size and ICT services sector increased in their ICT GBARD. France, Sweden, Slovenia, Romania and Hungary showed negatives values in all the variables (Figure 96).

Figure 97: ICT manufacturing and ICT services ICT GBARD in the ten largest EU Member State contributors (million current EUR PPS [Purchase Power Standard], 2015)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

The ten largest MS contributing to ICT GBARD in the EU, which include two EU13 States (Poland and Czech Republic), produced around 90% of ICT manufacturing. ICT services and total ICT sector ICT GBARD. Germany was the country with the highest ICT GBARD, and the one with the highest share of ICT manufacturing, concentrating alone more than half of the European ICT GBARD of this sector. Finland, Italy and United Kingdom were the other largest contributors to ICT manufacturing ICT GBARD. Total ICT sector and ICT services sector were concentrated in the five largest EU economies (Figure 97).

3.5 ICT sector R&D personnel and researchers

Figure 98: ICT sector employment, ICT R&D personnel and ICT R&D researchers. Levels and annual growth rates. European Union (2007-2014)

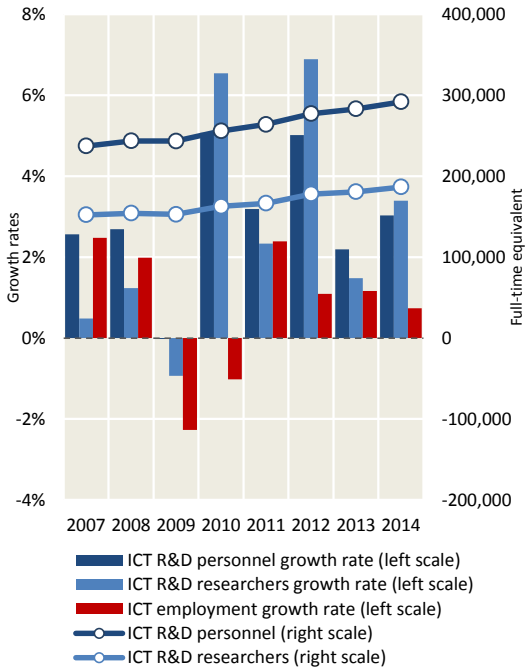
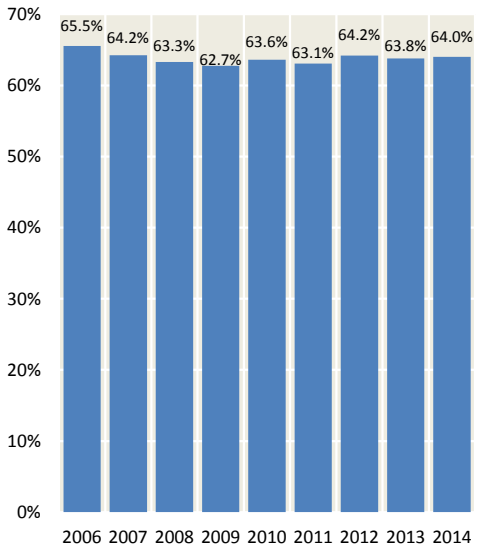


Figure 99: ICT R&D researchers share on ICT R&D personnel. European Union (2006-2014)



Note: The statistics available for all the countries provide data for personnel in full-time equivalent [FTE] terms, while employment is measured in terms of headcounts.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

R&D personnel in the ICT sector accounts for around 4.3% of total ICT sector employment. This share increased from 3.9% in 2006 to 4.7% in 2014. In the last year with available data there were 60,580 more R&D workers than in 2006, reaching 292 thousand in 2014. The share of ICT sector R&D researchers in ICT R&D personnel was 64.0% in 2014. This percentage maintained steady around 63%-65% over the period (Figures 98 and 99).

Figure 100: ICT R&D researchers share of total R&D researchers and ICT R&D personnel share of total R&D personnel. European Union (2006-2014)

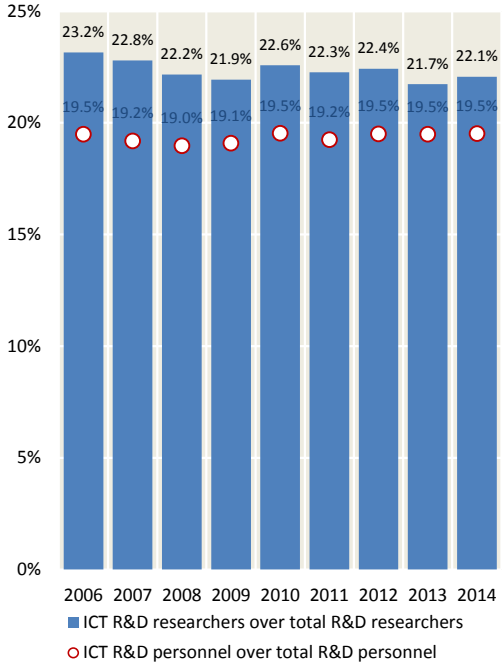
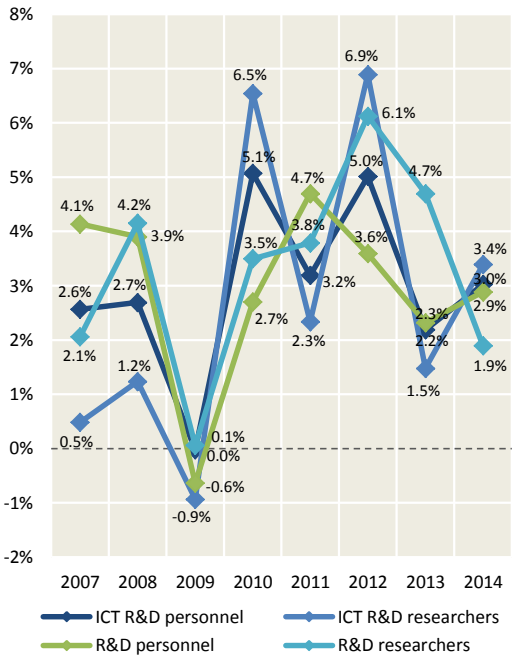


Figure 101: Annual growth rates of R&D personnel and researchers, ICT R&D personnel and ICT R&D researchers. European Union (2007-2014)

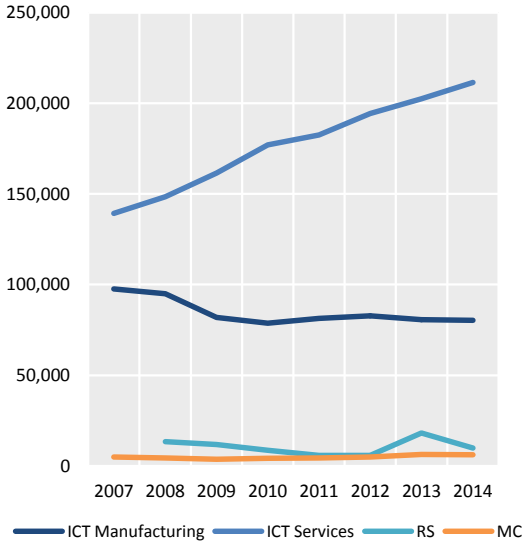


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, ICT sector R&D personnel accounted for 19.5% of total R&D personnel, while ICT R&D researchers for 22.1% of total R&D researchers. Note the high growth rates of ICT R&D researchers (over 6%) and ICT R&D personnel (around 5%) in 2010 and 2012. Also worth mentioning is that during 2013 the four variables experienced a slowdown, which was especially intense for R&D researchers in the ICT sector. In 2014, all variables, except total R&D researchers, had positive growth rates of around 3% (Figures 100 and 101).

Figure 102: R&D personnel and researchers in ICT manufacturing, ICT services, MC and RS sectors. European Union (full-time equivalent; 2006-2014)

a) R&D personnel



b) R&D researchers

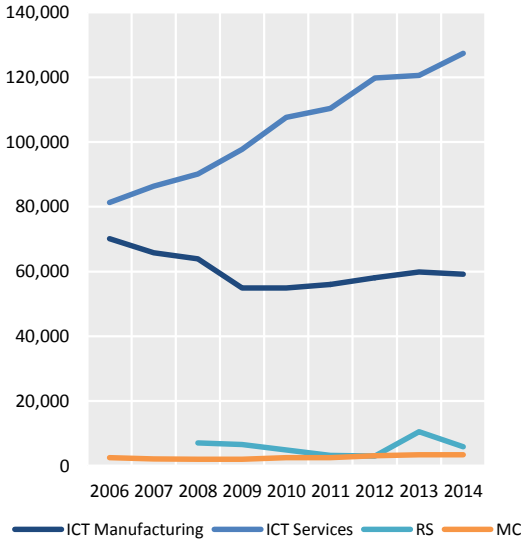
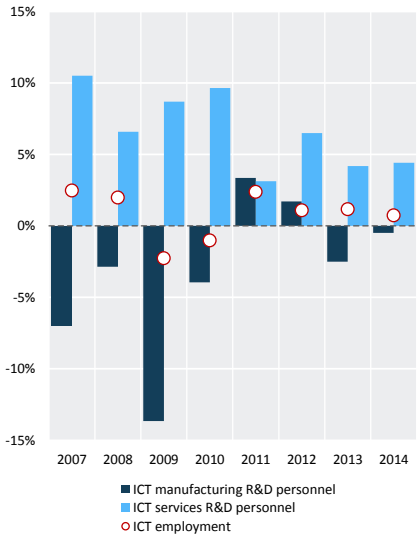
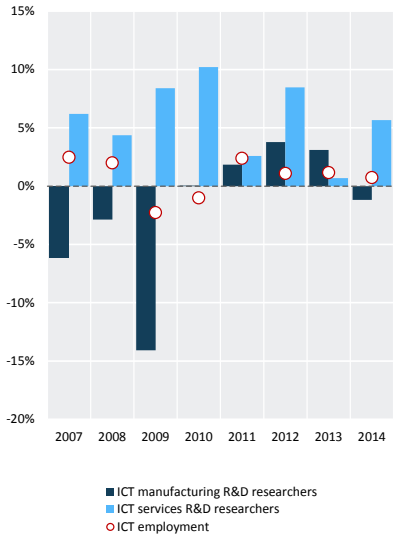


Figure 103: Annual growth rate of ICT manufacturing, ICT services and total ICT employment. European Union (2007-2014)

a) R&D personnel



b) R&D researchers



Note: MC: Media and content; RS: Retail sale via mail order houses or via Internet. The statistics available for all the countries provide data for personnel in full-time equivalent [FTE] terms, while employment is measured in terms of headcounts.

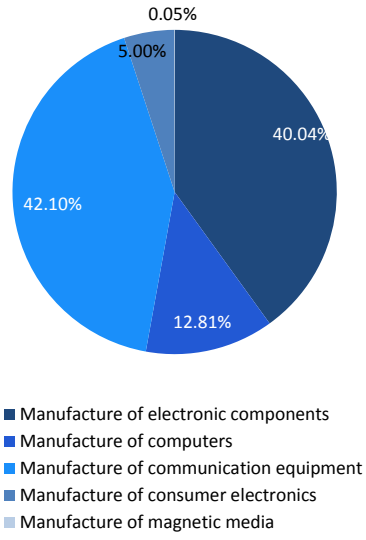
Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

While R&D personnel and researchers in the ICT services sectors retained their positive annual growth rates (even during the recession years), the opposite happened in the ICT manufacturing sectors. In the latter sector, the annual growth rate was negative from 2007 to 2010 (to 2009 for researchers). After some years of positive growth, since 2013 (2014 in R&D researchers), ICT manufacturing growth rate became negative again (Figure 102).

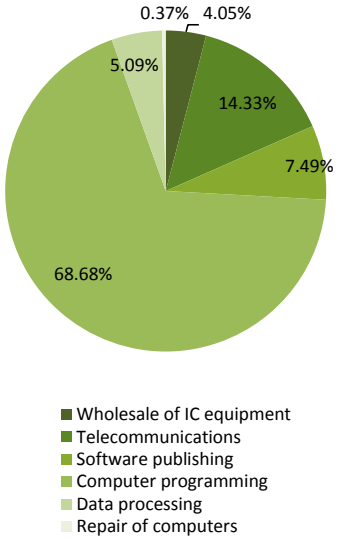
Figure 104: R&D personnel and researchers in ICT manufacturing and ICT services by sub-sectors (%). European Union (2014)

a) R&D personnel

a.1) ICT manufacturing

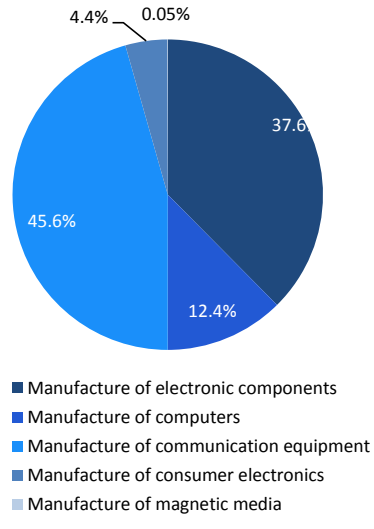


a.2) ICT services

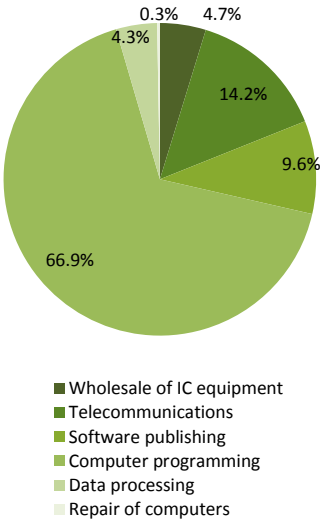


b) R&D researchers

b.1) ICT manufacturing



b.2) ICT services

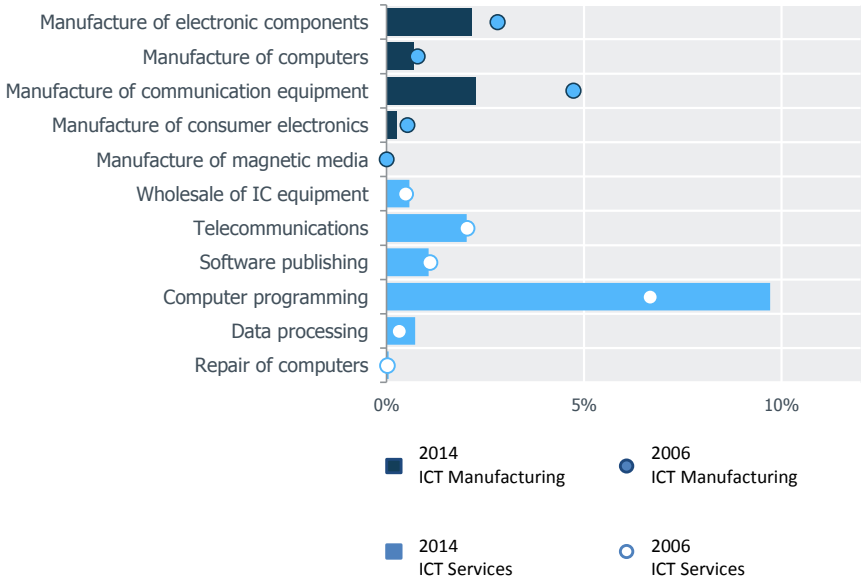


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

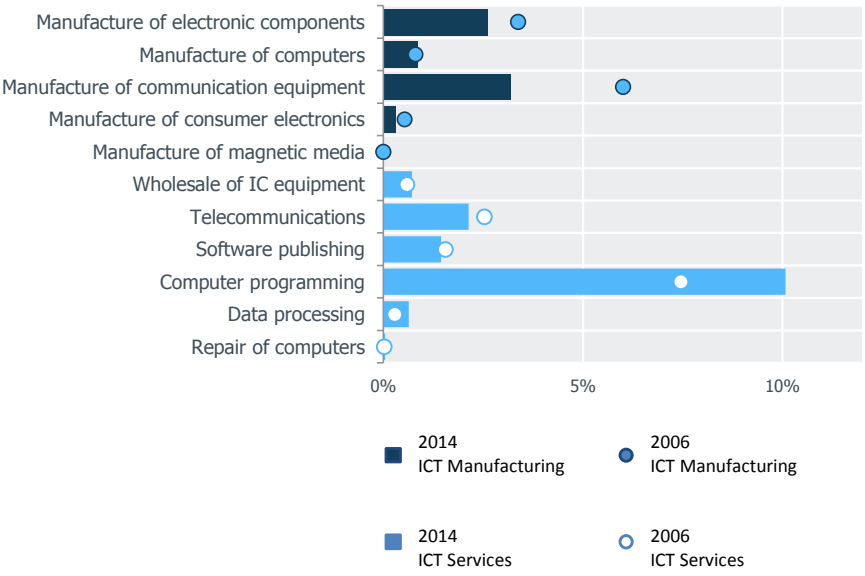
The two largest ICT manufacturing sub-sectors in the EU, *Manufacture of electronic components* and *Manufacture of communication equipment*, represented around 83% of the total ICT manufacturing R&D personnel and researchers in 2014. Also in the case of ICT services, two sub-sectors, *Telecommunications* and *Computer programing, consultancy and related activities*, jointly exceeded 80% of total ICT services R&D personnel and researchers (Figure 104).

Figure 105: ICT sector share of total by sub-sector. European Union (2006 and 2014)

a) R&D personnel



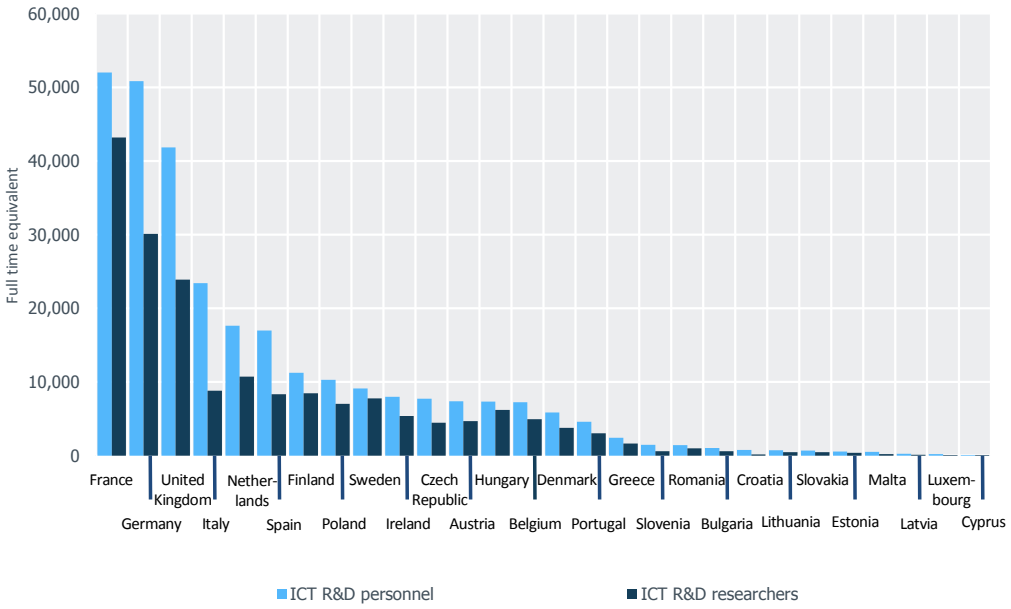
b) R&D researchers



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, the ICT sub-sectors with the highest shares of R&D personnel (and researchers) were *Computer programing, consultancy* and related activities, *Manufacture of communications equipment*, *Manufacture of electronic components* and *Telecommunications*. Between 2006 and 2014, the majority of ICT manufacturing sub-sector shares decreased, while significant increases were observed in the *Computer programing, consultancy and related activities* sub-sector (Figure 105).

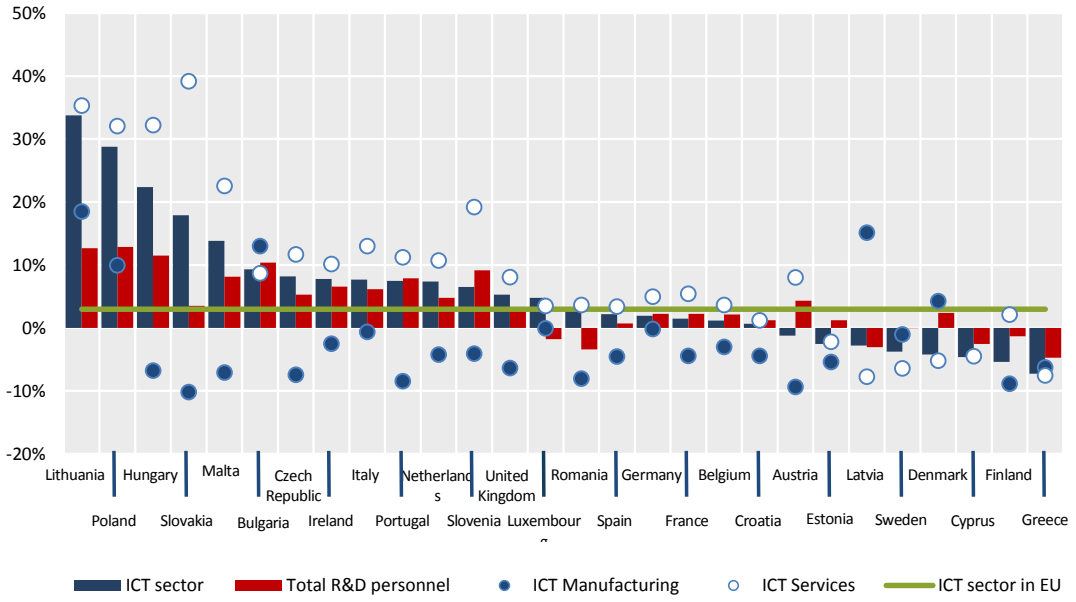
Figure 106: ICT R&D personnel and researchers. EU Member States (2014)



Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, as with other indicators, the largest EU economies also took the lead in terms of personnel and researchers. France (17.8%) and Germany (17.4%) were the leaders, followed by the UK (14.3%) and Italy (8.0%). These four countries together employed 57.6% of ICT R&D personnel in the EU in 2014. Regarding researchers, the first positions in the ranking also were held by France, Germany and UK, but here followed by Netherlands, instead of Italy (as in the case of personnel). These four countries accounted for 57.8% of ICT R&D researchers. (Figure 106).

Figure 107: Mean annual growth rate of R&D personnel in ICT sector, ICT manufacturing, ICT services and total economy. EU Member States (2006-2014)

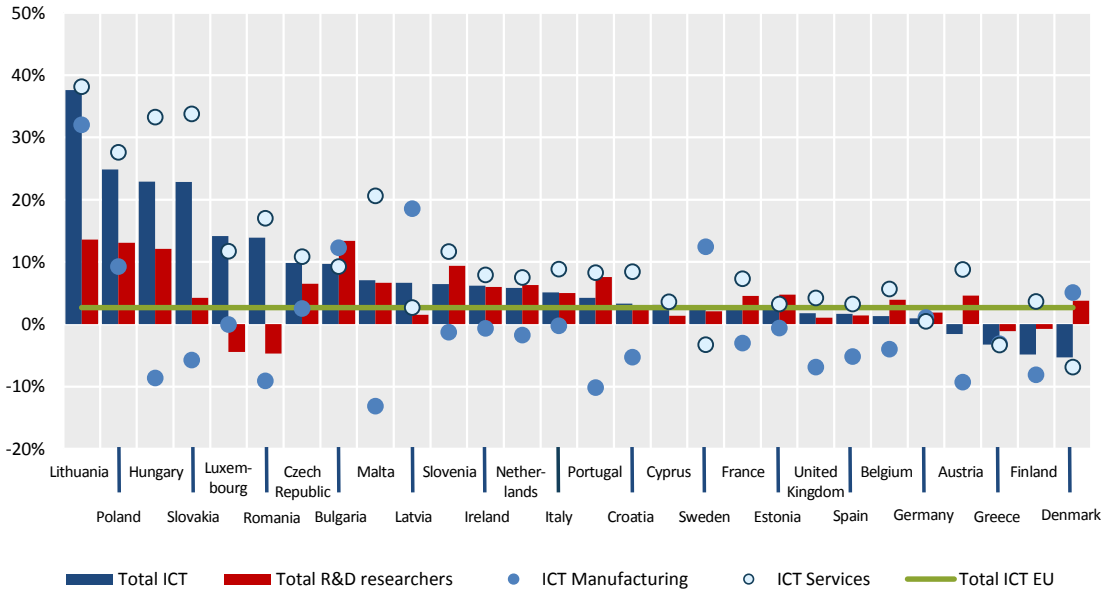


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Between 2006 and 2014, the highest growth rates in all indicators mostly corresponded to EU13 States. Lithuania, Poland and Hungary experienced rates over 20% in total ICT sector and ICT services R&D personnel. The largest decreases (all over -4.5%) in total ICT occurred in Greece, Finland and Cyprus.

ICT manufacturing reduced researchers in the majority of MS. Only Denmark and four EU13 States (Lithuania, Latvia, Bulgaria and Poland) registered positive growth rates in the period (Figure 107).

Figure 108: Mean annual growth rate of R&D researchers in ICT sector, ICT manufacturing, ICT services and total economy. EU Member States (2006-2014)

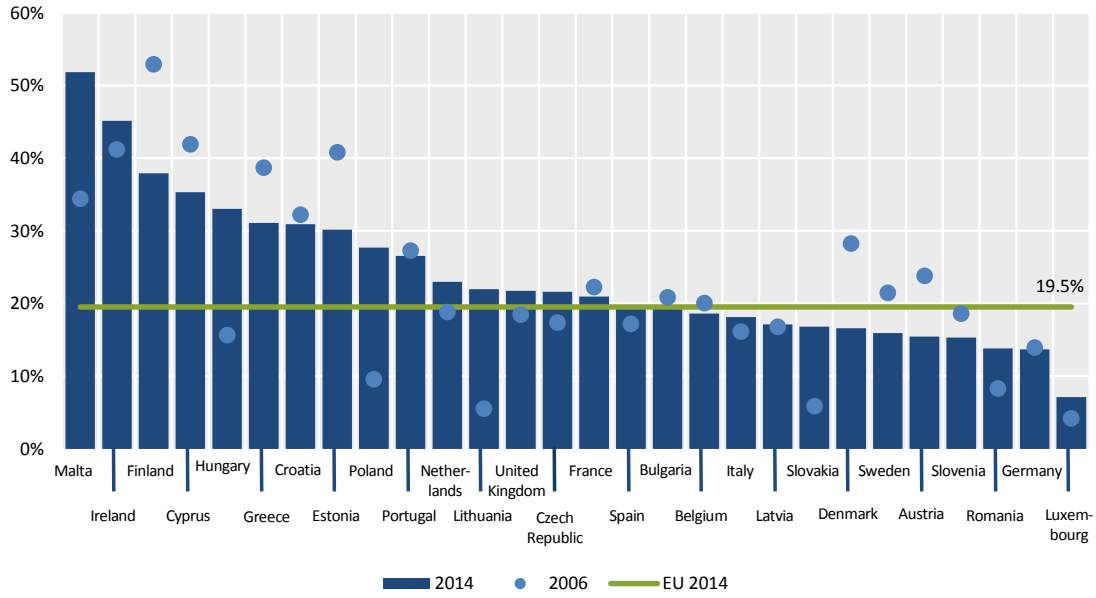


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

As in the case of R&D personnel (Figure 107), the EU13 States had the highest growth rates in all the indicators. Lithuania, Poland, Hungary and Slovakia had the highest rates in total ICT R&D researchers. By contrast, Finland and Denmark had the largest decreases in total ICT sector, over 4.5% annually.

The number of ICT manufacturing researchers fell in the majority of Member States, and especially in Malta, Portugal, Romania, and Austria, where this number fell by over 9% annually. For ICT services, the number of researchers fell only in a few EU15 States (Denmark, Greece and Sweden) (Figure 108).

Figure 109: ICT R&D personnel share of total R&D personnel. EU Member States (based on FTE, 2006 and 2014)

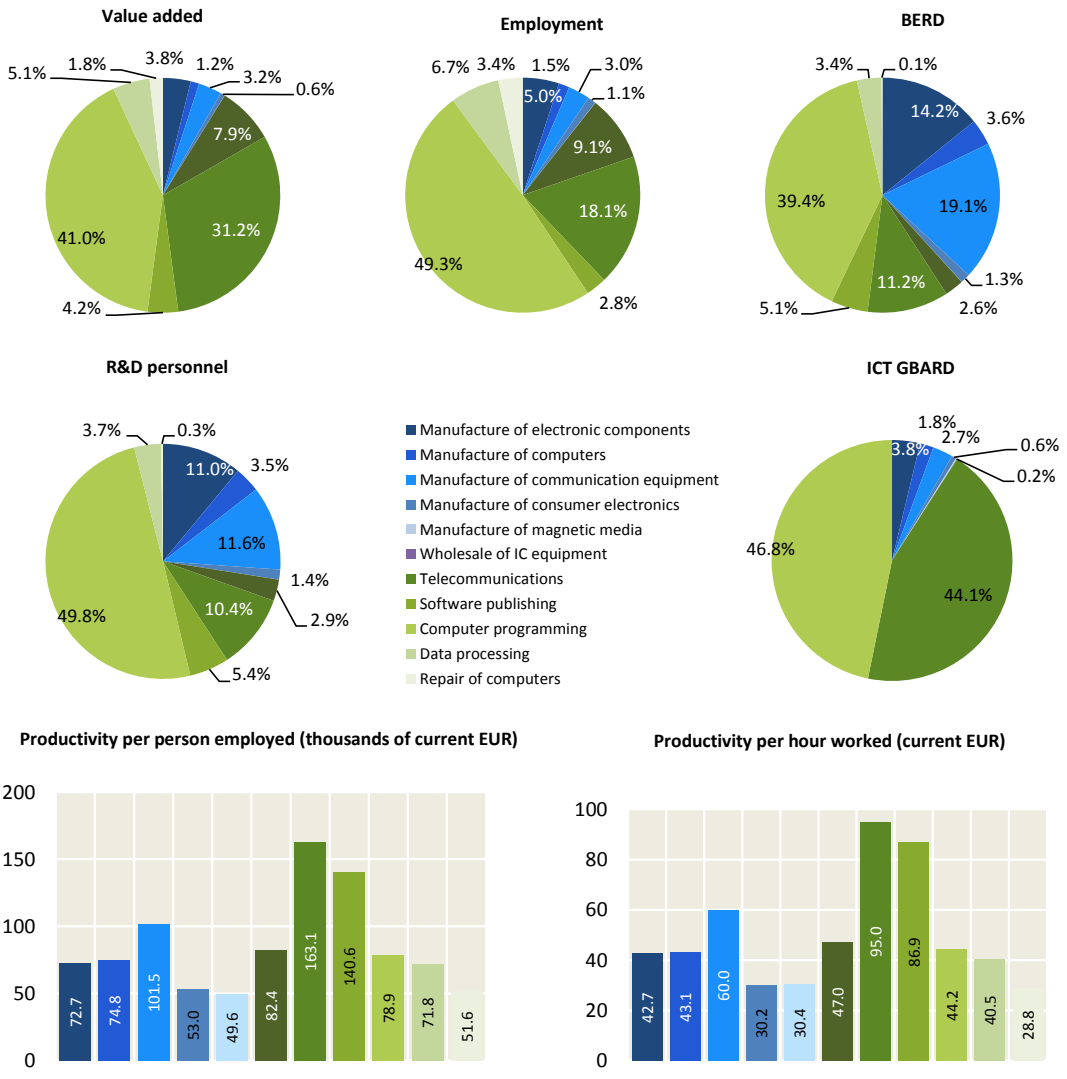


Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

In 2014, in terms of ICT sector R&D personnel over total R&D personnel, Malta, Ireland, Finland and Cyprus were the leading countries, with a share over 35%. Eleven other countries scored above the EU level (19.5%), many of which are one of the EU13 States (Figure 109).

4 Summary

Figure 110: Overview of value added, employment, BERD, R&D personnel, ICT GBARD and productivity by ICT sub-sector. European Union (2014)



Note: ICT GBARD in Computer programming includes software publishing, data processing and repair of computers.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

- The *Computer programming, consultancy and related activities* sub-sector consistently scored the highest in the first five indicators, with shares between 39.4% (BERD) and 49.8% (R&D personnel) in 2014.
- *Manufacturing of communication equipment* and *Manufacture of electronic components* are highly R&D-intensive sub-sectors.
- Of the ICT services sub-sectors, *Telecommunications* is the most R&D-intensive.
- *The Telecommunications* sub-sector led labour productivity, both productivity per person employed and productivity per hour worked.

Table 1: Summary table of ICT indicators by sub-sector. European Union (2014)

NACE Rev. 2	Description	Value added	Employment	BERD	ICT GBARD	R&D personnel
		(million of current EUR)	(thousand persons employed)	(million of current EUR)	(million of current EUR)	(thousand full-time equivalent)
261-264, 268	**ICT total manufacturing industries**	**52,417.2**	**664.0**	**11,407.0**	**75.7**	**80.2**
261	Manufacture of electronic components and boards	22,683.6	311.8	4,238.2	14.5	32.1
262	Manufacture of computers and peripheral equipment	6,958.4	93.1	1,071.8	28.3	10.3
263	Manufacture of communication equipment	18,928.7	186.5	5,700.6	27.8	33.8
264	Manufacture of consumer electronics	3,764.0	71.0	390.7	3.5	4.0
268	Manufacture of magnetic and optical media	82.6	1.7	5.8	1.6	0.0
465, 582, 61, 62, 631, 951	**ICT total services**	**540,605.6**	**5,589.4**	**18,432.0**	**1,600.6**	**211.4**
465	**ICT trade industries**	**46,719.5**	**566.9**	**780.4**	**0.0**	**8.6**
582, 61, 62, 631, 951	**ICT services industries**	**493,886.1**	**5,022.5**	**17,651.5**	**1,600.6**	**202.9**
61	Telecommunications	184,955.9	1,134.1	3,336.5	486.6	30.3
582, 62, 631, 951	Computer and related activities	308,930.2	3,888.4	14,315.1	1,114.0	172.6
582	Software publishing	24,836.5	176.7	1,513.9	-	15.8
62	Computer programming, consultancy and related activities	243,047.3	3,080.8	11,753.6	-	145.2
631	Data processing, hosting and related activities; web portals	30,240.8	421.4	1,009.7	-	10.8
951	Repair of computers and communication equipment	10,805.5	209.6	37.8	-	0.8
261-264, 268, 465, 582, 61, 62, 631, 951	**ICT total**	**593,022.8**	**6,253.3**	**29,839.0**	**1,676.3**	**291.6**

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Table 2: Summary table of ICT indicators. EU Member States (2014)

	ICT sector Value added	ICT sector Employment	ICT sector BERD	ICT sector ICT GBARD	ICT sector R&D personnel
	(million of current EUR PPS)	(1000 persons employed)	(million of current EUR PPS)	(million of current EUR PPS)	(1000 Full Time Equivalent)
Austria	10,065.7	106.5	862.1	41.6	7,380.4
Belgium	12,928.0	105.4	806.8	122.7	7,227.7
Bulgaria	4,322.0	75.4	54.0	2.2	1,047.0
Croatia	2,518.1	33.3	51.6	0.3	769.0
Cyprus	769.8	7.9	3.0	0.0	89.0
Czech Republic	12,182.4	153.1	488.1	30.6	7,726.0
Denmark	7,263.0	88.9	440.9	30.9	5,861.0
Estonia	1,358.2	22.9	58.6	3.7	542.0
Finland	8,694.9	97.3	1,666.0	72.6	11,233.9
France	80,080.7	787.0	5,608.1	172.0	52,000.8
Germany	116,158.6	1,130.5	6,319.0	309.5	50,843.8
Greece	6,052.9	69.8	151.4	5.2	2,407.3
Hungary	9,503.2	167.0	404.1	3.3	7,323.1
Ireland	21,052.0	80.7	685.5	21.6	7,984.5
Italy	53,837.3	613.9	1,947.3	221.6	23,427.6
Latvia	1,418.5	24.9	9.1	1.3	236.6
Lithuania	1,823.7	23.1	34.2	1.2	727.0
Luxembourg	2,412.5	17.0	13.2	6.4	218.4
Malta	552.1	8.0	20.7	0.0	493.0
Netherlands	29,104.1	269.8	1,131.1	80.7	17,622.1
Poland	24,576.4	369.4	643.3	32.3	10,312.1
Portugal	6,892.9	79.4	298.1	22.1	4,606.8
Romania	17,029.5	176.7	54.9	6.9	1,440.8
Slovakia	4,907.5	64.7	51.7	5.7	695.0
Slovenia	1,667.6	24.9	92.2	2.1	1,486.0
Spain	42,866.3	415.7	1,130.7	142.5	16,982.0
Sweden	20,644.6	184.6	1,540.7	27.7	9,130.2
United Kingdom	90,402.9	1,097.8	3,451.0	155.9	41,826.2
European Union	**593,022.8**	**6,253.3**	**29,839.0**	**1,676.3**	**291,639.3**

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

Table 3: Summary table of ICT indicators for the European Union and other economies

	ICT sector Value added	ICT sector Employment	ICT sector BERD	ICT sector ICT GBARD	ICT sector R&D personnel
	(million of current EUR PPS)	(thousand persons employed)	(million of current EUR PPS)	(million of current EUR PPS)	(thousand full-time equivalent)
European Union	546,220.7	5,684.8	29,052.8	1,676.3	283.0
Norway	7,081.6	70.3	567.8	-	5.9
Switzerland	14,718.5	150.5	5.7	-	0.3
Australia	25,302.7	299.9	1,353.7	-	16.5
Brazil	71,243.3	1,259.2	1,391.1	-	21.7
Canada	40,882.5	472.2	2,637.5	-	42.5
China	639,963.1	14,693.5	33,383.0	-	478.5
India	252,534.5	6,471.0	1,846.2	-	24.7
Japan	188,227.2	2,275.2	20,634.3	-	153.2
South Korea	111,103.1	1,087.7	23,493.7	-	135.7
Russia	51,697.7	1,002.0	1,371.2	-	11.3
Taiwan	127,836.8	989.4	13,713.0	-	122.1
United States	682,883.5	4,138.6	83,944.3	741.3	-

Note: ICT totals correspond to the operational definition of ICT sector, except ICT GBARD.

ICT value added: 2013 for Canada. ICT R&D personnel and BERD: 2011 for Brazil, 2012 for Switzerland and India and 2013 for Australia. ICT R&D personnel: United States not included because of lack of homogeneous data.

Source: 2017 PREDICT Dataset, elaborated by JRC-Dir. B and Ivie. See methodological notes.

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List of abbreviations used

BERD:	Business Expenditure on Research and Development
BRDIS:	Business R&D and Innovation Survey
DG CONNECT:	Directorate General for Communications Networks, Content and Technology
EU:	European Union
EUR:	Euros
Eurostat:	*Statistical Office of the European Communities*
FTE:	Full-time equivalent
GBARD:	Government budget allocations for Research and Development
GDP:	Gross domestic product
GERD:	Gross domestic Expenditure on Research and Development
ICT:	Information and Communication Technologies
ISIC:	International Standard Industry Classification
Ivie:	Valencian Institute of Economic Research
MC:	Media and Content sector
MS:	Member State
NACE:	Statistical classification of economic activities in the European Community
OECD:	Organisation for Economic Co-operation and Development
PPS:	Purchase Power Standard
PREDICT:	Prospective Insights on R&D in ICT
R&D:	Research and Development
RS:	Retail sale via mail order houses or via Internet
SIRD:	Survey of Industrial Research and Development
SNA:	System of National Accounts
US:	United States
VA:	Value added

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BERD: Intramural expenditures on R&D performed within business enterprise sector during a specific period, whatever the source of funds (Frascati Manual).

BERD intensity: BERD/GDP.

Business R&D personnel: All persons employed directly in R&D by business enterprise sector, as well as those providing direct services such as R&D managers, administrators and clerical staff. Those providing indirect services, such as canteen and security staff, should be excluded (Frascati Manual).

Business R&D researchers: Business enterprise sector's professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned (Frascati Manual).

Full-time equivalent (FTE): A full-time equivalent corresponds to one year's work by one person. Consequently, someone who normally spends 40% of his or her time on R&D and the rest on other activities (e.g. teaching, university administration or counselling) should be counted as only 0.4 FTE.

Employment: Number of persons employed. In the SNA this is defined as all persons, both employees and self-employed, engaged in some productive activity that falls within the production boundary of the SNA and that is undertaken by a resident institutional unit.

EU13: Member States of the European Union acceding since 2004, they include the 2004 and 2007 European Union enlargements consisting of Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia; and Croatia, which acceded in July 2013.

EU15: Member States of the European Union acceding before 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

GBARD: Government budget allocations for R&D are a way of measuring government support for research and development activities. GBARD include all allocations (government spending) given to R&D in central (or federal) government budgets. Provincial (or State) government posts are only included if the contribution is significant. Local government funds are excluded.

GDP: Measures the total final market value of all goods and services produced within a country during a given period. GDP is the most frequently used indicator of economic activity and is most often measured on an annual or quarterly basis to gauge the growth of a country's economy between one period and another.

GERD: Gross domestic expenditure on research and development (GERD) is total intramural expenditure on research and development performed on the national territory during a given period.

GDP deflator: Implicit price deflator for GDP is calculated as GDP at current prices divided by GDP at "constant prices" (chained volume estimates or fixed-base volume estimates, depending on countries).

ICT BERD intensity: ICT BERD/ICT VA.

ICT GBARD: Government budget allocations for ICT R&D public funding of ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector.

ICT manufacturing industries: Manufacture of electronic components and boards (NACE 261), Manufacture of computers and peripheral equipment (NACE 262), Manufacture of communication equipment (NACE 263), Manufacture of consumer electronics (NACE 264), Manufacture of magnetic and optical media (NACE 268).

ICT sector comprehensive definition: This definition is available mainly for EU Member States since 2008. It corresponds to the definition given by the OECD in 2007. This definition includes ICT manufacturing industries, ICT trade industries and ICT services industries. Data in accordance with this classification are not available for some non-EU countries. See OECD definition: http://www.oecd.org/science/sci-tech/38217340.pdf.

ICT sector employment: All employed people in the ICT sector definition given by the OECD in 2007.

ICT sector operational definition: This definition allows international comparison with non-EU countries over a longer period of time, as some of these countries do not have the necessary disaggregated information to estimate all the ICT sub-sectors included in the comprehensive definition. This definition takes into account the standard distinction between manufacturing and services, but does not include the following sectors: Manufacture of magnetic and optical media (268) and ICT trade industries (465). In addition, ICT services industries are only available for two sub-sectors: Telecommunications (61) and the aggregate Computer and related activities (582, 62, 631, 951).

ICT services industries: Software publishing (NACE 5820), Telecommunications (NACE 61), Computer programming, consultancy and related activities (NACE 62), Data processing, hosting and related activities; web portals (NACE 631), Repair of computers and communications equipment (951).

ICT trade industries: Wholesale of computers, computer peripheral equipment and software (NACE 4651), Wholesale of electronic and telecommunications equipment and parts (NACE 4652).

ICT total services: ICT trade industries and ICT services industries.

MC sector: Includes Publishing of books, periodicals and other publishing activities (581), Audiovisual and broadcasting activities (59-60) and Other information service activities (639). It corresponds to the definition given by OECD in 2007. See OECD definition: http://www.oecd.org/science/sci-tech/38217340.pdf

RS sector: Includes data for Retail sale via mail order houses or via Internet (NACE Rev. 2 Code 4791).

Member States: Member States of the European Union: Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

Other economies: Countries included for the non-European comparison using the ICT sector operational definition (see definition above), consisting of: Australia, Canada, China, Brazil, India, Japan, South Korea, Norway, Russia, Switzerland, Taiwan and the United States.

Productivity per person employed: Is defined as value added per person employed.

Productivity per hour worked: Is defined as value added per hour worked.

Purchasing Power Standard (PPS): National currencies are converted into Purchasing Power Standards (PPS), an accounting unit based on current euros, to net for the effect of differences in price levels across countries and of movements in exchange rates. Using PPS it is possible to produce meaningful indicators (based on either price or volume) required for cross-country comparisons.

Value added: In the SNA it is defined as the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector.

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