



# The EU ICT Sector and its R&D Performance

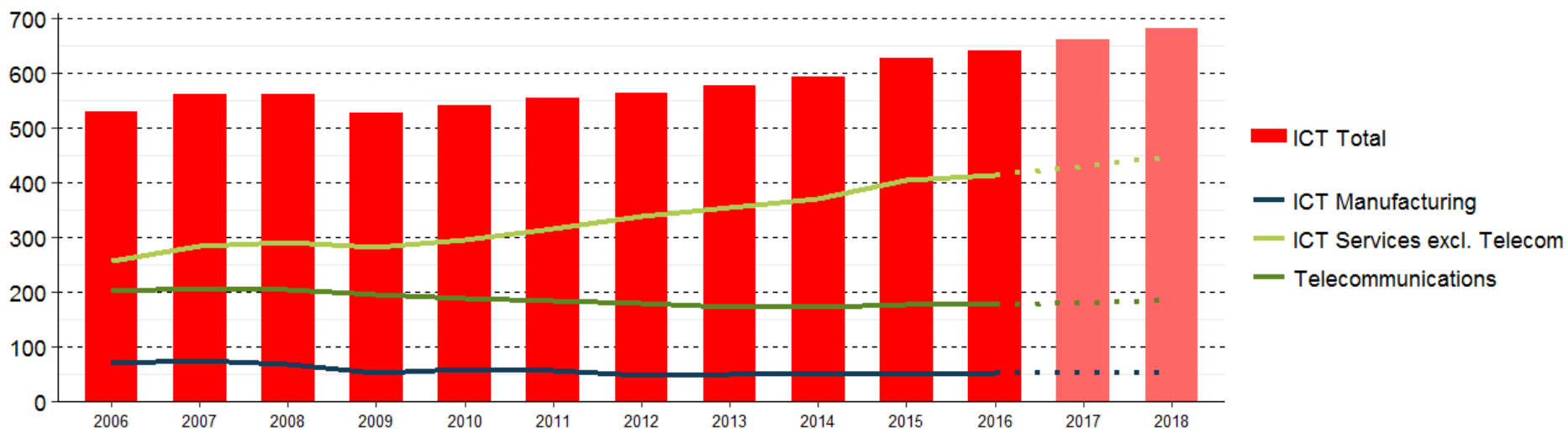
Digital Economy and Society Index Report 2019  
The EU ICT sector and its R&D performance

The **value added** of the ICT sector was EUR 642 billion in 2016. ICT services made up 92 % of total ICT sector **value added**. ICT services (excluding telecommunications) were the dominant sub-sector and the only one expanding in the medium to long term.

The value added of the EU ICT sector was EUR 642 billion in 2016, and it is expected it will have continued to grow in the two years following that. A breakdown by sub-sector shows the predominance of ICT services (EUR 590 billion and 92 % of total ICT sector value added in 2016) over ICT manufacturing.

The ICT services sub-sector (excluding telecommunications) is the only one that saw an increase in value added over the medium term (2006-2016), up to EUR 414 billion. Both the telecommunications and ICT manufacturing sub-sectors experienced a decline in the same period, only slightly recovering in the last two years.

ICT sector Value Added, EUR billion, 2006-2018



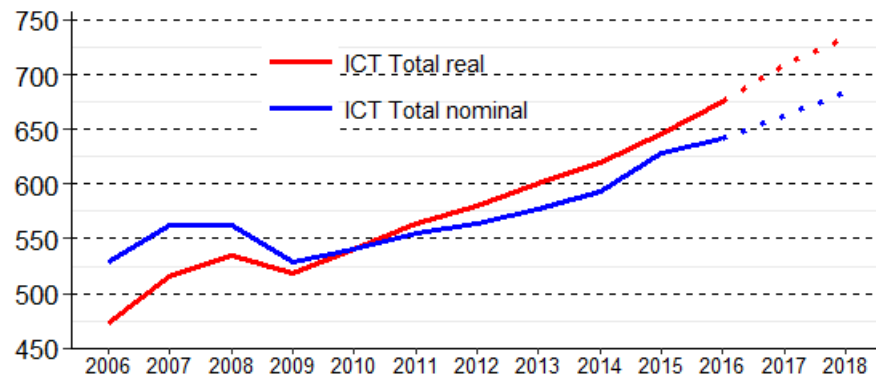
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

The **value added** of the ICT sector grew much faster in real terms than the rest of the economy. At global level, the ICT sector's share of **value added** in EU GDP lags behind that of main competitors (Japan, the United States and China).

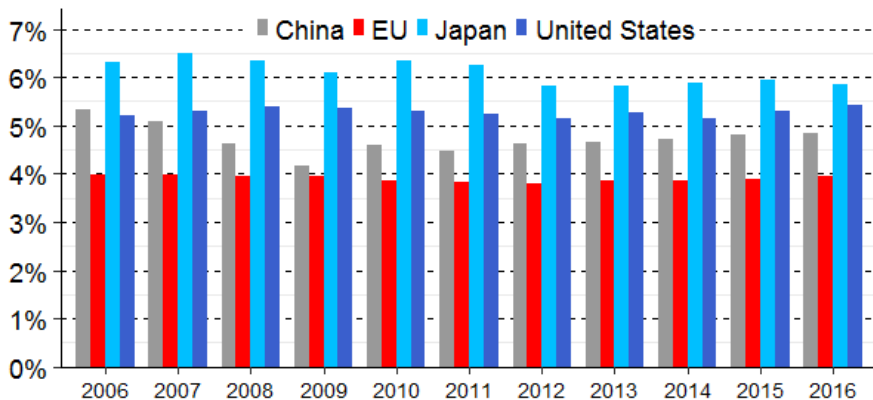
Although the value added of the ICT sector increased by 21 % in nominal terms (in line with GDP: + 22 %), it increased by 44 % in real terms over 2006-2016 (well above GDP: + 9 %). These trends are explained by the decline in prices in the ICT sector over 2006-2016 (see slide 5).

ICT sector Value Added, nominal and deflated, EUR billion, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

ICT sector share of GDP, percentage, 2006-2016



Source: Commission services' calculations and estimates based on PREDICT project

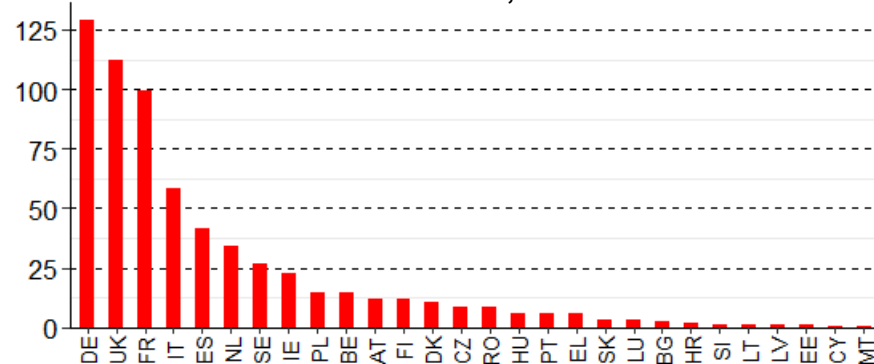
The value added of the ICT sector accounted for 4.3 % of EU GDP in 2016 (comprehensive definition\*). According to the operational definition\*, which enables world comparisons, the value added of the ICT sector in the EU (4 %) was lower than that of Japan (5.8 %), the US (5.4 %), and China (4.9 %) in 2016. The EU's ICT sector grew marginally as a percentage of GDP from the previous year, but so did that of most of its competitors, except Japan which, however, had the highest percentage.

\* See methodological note.

The EU's five largest economies (Germany, the United Kingdom, France, Italy, and Spain) were the five biggest contributors to ICT sector **value added** in 2016. However, Ireland, a medium-sized country, has by far the highest ICT sector share of GDP (11.6 % in 2014, latest data available).

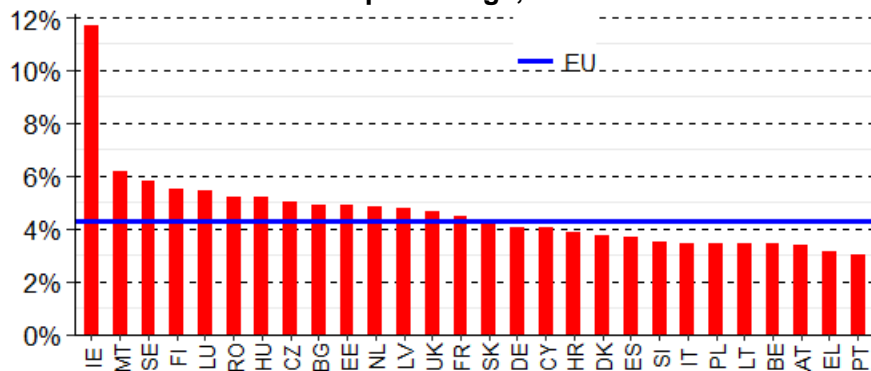
Unsurprisingly, the EU's five biggest economies were also the five biggest contributors to ICT sector value added in 2016; Germany (EUR 129 billion or 20 % in terms of shares), the United Kingdom (EUR 112 billion or 18 %), France (EUR 99 billion or 15 %), Italy (EUR 58 billion or 9 %), and Spain (EUR 41 billion or 6 %). Together, these five countries accounted for 69 % of total EU ICT sector value added in 2016.

**ICT sector Value Added,  
EUR billion, 2016**



Note: Data for Ireland refers to 2014.

**ICT sector share of GDP,  
percentage, 2016**



Note: Data for Ireland refers to 2014.

Source: Commission services' calculations and estimates based on PREDICT project

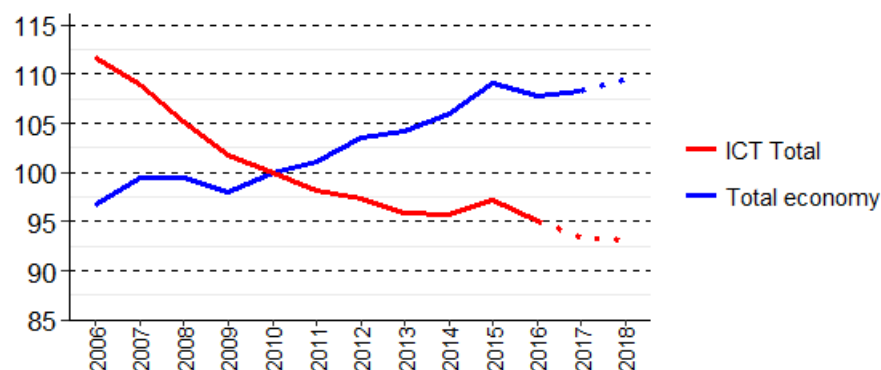
Ireland had by far the highest ICT sector share of GDP, 11.6 % in 2014 (latest data available), while Portugal lagged behind at 3 %. After Ireland, the countries with the highest share of ICT sector included Malta (6.2 %), Sweden (5.8 %), Finland (5.5 %) and Luxembourg (5.4 %).

Romania, Hungary and Czechia also had a high ICT sector share of GDP (5 % or higher). The biggest changes in ICT as a proportion of GDP over the medium term (2006-2016) were in Ireland, where it grew by 3.5 percentage points (due to the process of relocation of European operations of many non-EU ICT multinationals) and in Finland, where it fell by 3.1 percentage points (due mainly to the crisis at Nokia, the Finnish ICT manufacturer).

ICT prices continued to go down in 2016-2017 after a spike in 2015, but the decline in prices is forecast to slow in 2018. The telecommunications sub-sector experienced the largest decline.

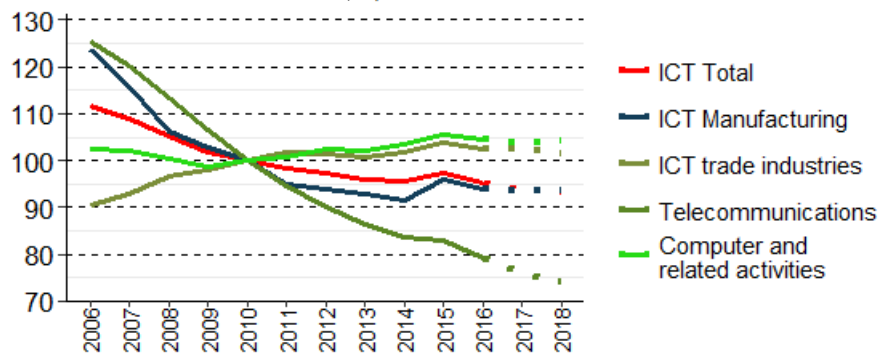
Prices in the ICT sector fell by 16 % over the medium term (2006-2017), while prices in general grew by 12 % over the same period. This highlights the particular nature of product prices in the ICT sector, which also incorporates improvements in the quality of products (e.g. CPUs' speed). This different price evolution of the ICT sector with respect to the overall economy explains the fact that, in the EU, the share of the ICT sector in total GDP remained stable (around 4%) between 2006 and 2016 (see slide 3).

Price Index, ICT sector and overall economy, Index base 2010=100, 2006-2018



Note: Values for the year 2018 and ICT sector in 2017 are nowcasted data.

Price Index, ICT by sub-sector, Index base 2010=100, 2006-2018



Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

An analysis by sub-sector shows a contrasting situation: while some sub-sectors experienced a dramatic drop in prices (telecommunications: - 39 %, ICT manufacturing: - 24 %), other saw moderate growth (the ICT trade industry: + 13 %) or stagnation (computers and related activities: + 1 %) over the medium term (2006-2017). In addition, prices in the ICT sector stabilised somewhat towards the end of 2013-2017.

The ICT sector **employed** 6.6 million people in 2016. The **main employer** was the ICT services sub-sector (excluding telecommunications), with 4.9 million people in 2016. The share of **employment** in the ICT sector relative to total employment was 2.8 % in the EU in 2016.

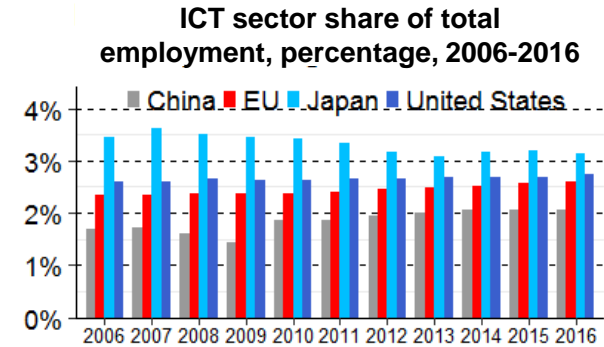
The ICT sector employed 6.6 million people in 2016, continuing on an upward trend since 2010.

The ICT services sub-sector (excluding telecommunications) employed 4.9 million people, accounting for 74 % of total ICT employment in 2016. This is the only sub-sector that recorded growth (of 31 %) over the medium term (2006-2016). The telecommunications sub-sector employed 1.1 million people in 2016, a number which fell over the medium term by 9 %. The ICT manufacturing sub-sector employed 625,000 people in 2016, a drop of 32 % since 2006.

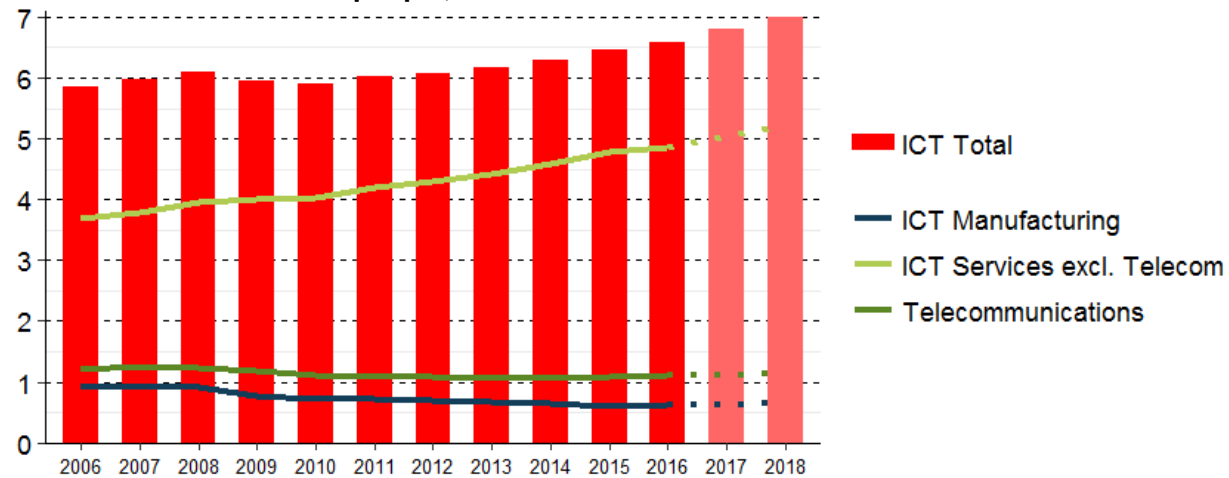
Employment in the ICT sector accounted for 2.8 % of total EU employment in 2016 (comprehensive definition\*), an increase of 8 % over the medium term.

In the operational definition\* which enables world comparisons, the US (2.7 %) was slightly ahead of the EU (2.6 %), which in turn was ahead of China (2.1 %). All three lagged well behind Japan (3.1 %) in 2016, however.

\* See methodological note.



**Employment in the ICT sector, million people, 2006-2018**



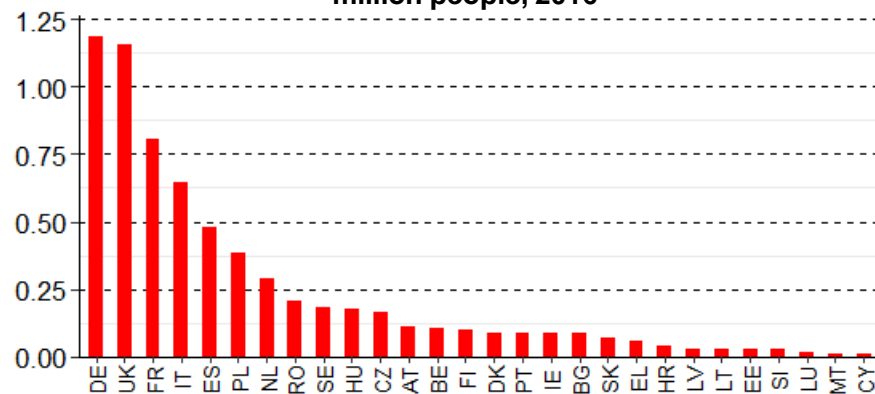
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

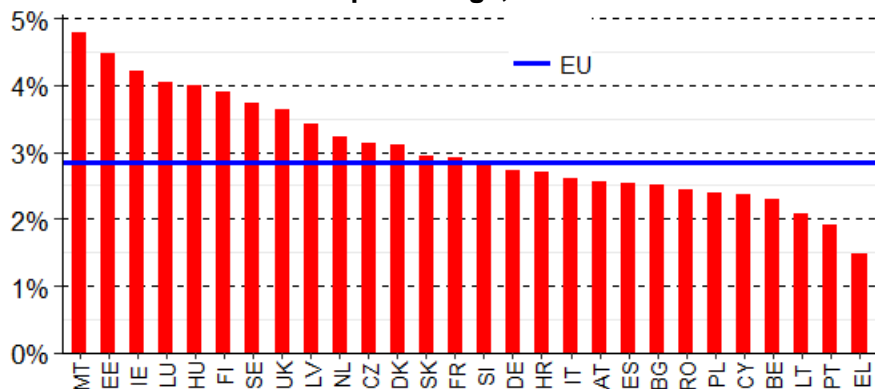
The five biggest EU economies (Germany, the United Kingdom, France, Italy, and Spain) were the five biggest **employers** in the EU ICT sector in 2016. However, small countries like Malta and Estonia had the highest rate of ICT sector **employment** as a share of **total employment** in 2016.

As was the case for value added, the EU's five largest economies were also the five largest employers in the EU ICT sector in 2016: Germany (over 1.2 million people or 18 % of total EU ICT sector employment), the United Kingdom (1.1 million people or 18 %), France (803,000 people or 12 %), Italy (646,000 people or 10 %), and Spain (480,000 people or 7 %). Together, the five largest employers accounted for 65 % of total ICT sector employment in 2016.

Employment in the ICT sector, million people, 2016



ICT sector share of total employment, percentage, 2016



In 2016, Malta had the highest share of ICT sector employment in total employment (4.8 %) and Greece the lowest (1.5 %). Other countries that performed well in 2016 included Estonia (4.5 %) and Ireland (4.2 %). Luxembourg and Hungary were close behind with rates around 4 %. Over the medium term (2006-2016), ICT sector employment as a share of total employment remained stable in most countries; small countries like Estonia and Latvia made significant progress, showing growth of almost 2 percentage points.

Source: Commission services' calculations and estimates based on PREDICT project



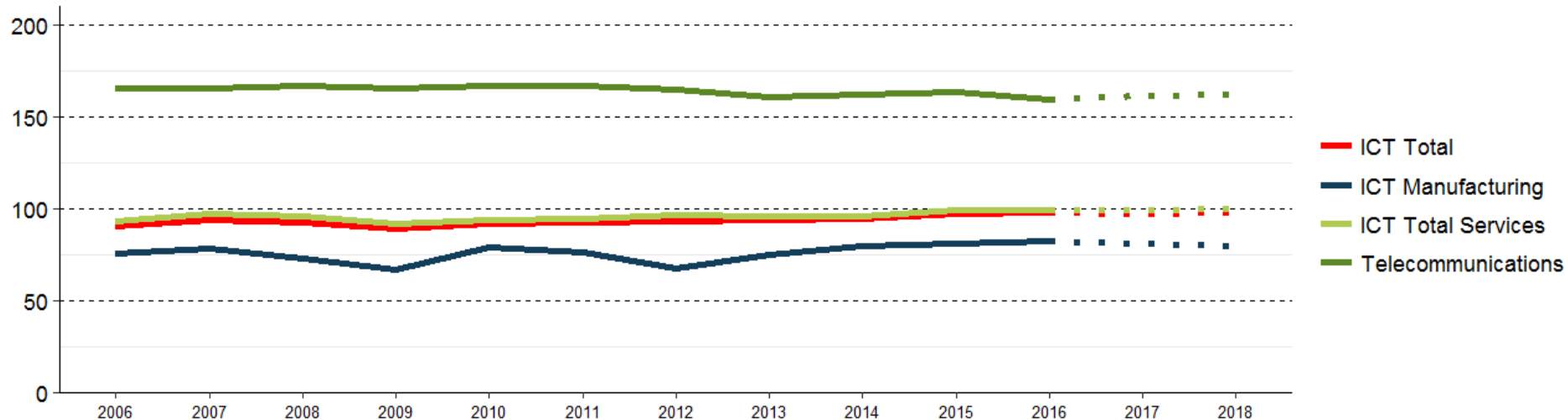
Labour **productivity** in the ICT sector was EUR 97,000 per person employed in 2016. Labour **productivity** in the telecommunications sub-sector was by far the highest.

Labour productivity in the ICT sector (comprehensive definition\*) was EUR 97,000 per person employed in 2016, a slight increase over the medium term (2006-2016). Labour productivity in the ICT manufacturing sub-sector (EUR 82,000 per person employed in 2016) was below the average of the total ICT sector, and volatile.

Labour productivity in the ICT services (i.e. services and trade), which was EUR 99,000 per person employed in 2016, is less sensitive to business cycles and was closer to the total ICT sector average than that of the ICT manufacturing. Labour productivity in the telecommunications sub-sector was by far the highest (at EUR 160,000 per person employed in 2016).

\* See methodological note.

Productivity in the ICT sub-sector, thousand EUR per person employed, 2006-2018



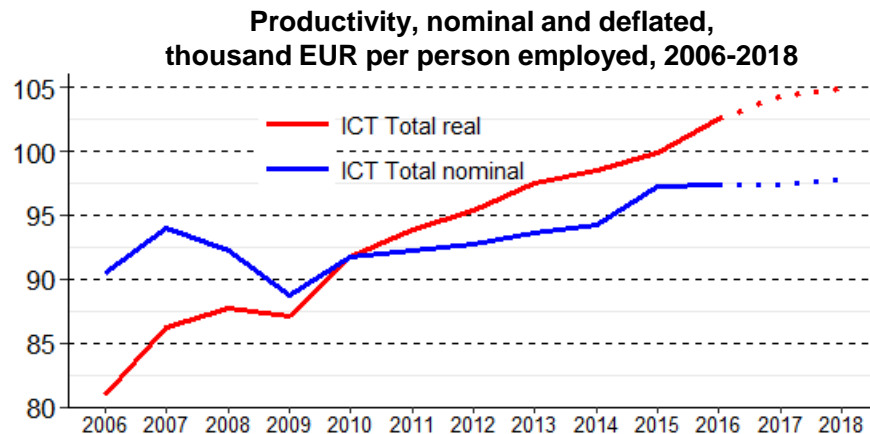
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

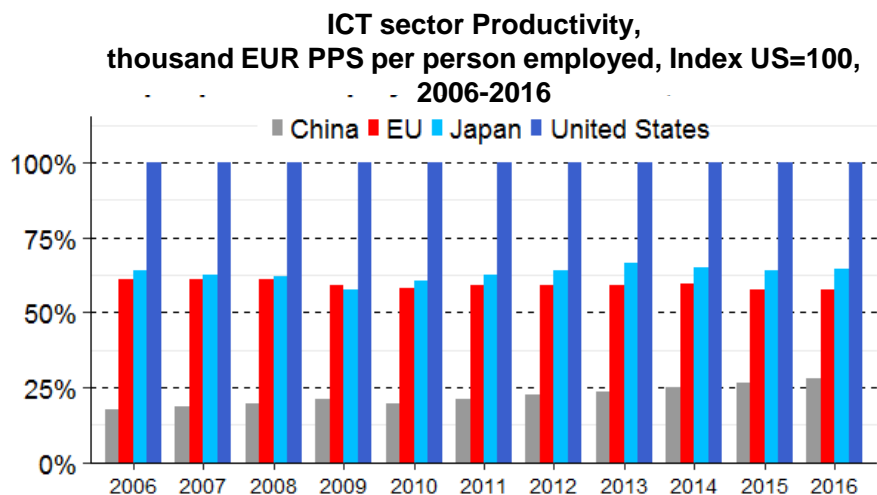


The ICT sector had higher labour **productivity** (in nominal terms) and grew faster (in real terms) over the period 2006-2016 than the overall economy. At global level, the EU ICT sector labour **productivity** was comparable with that of Japan but lagged markedly behind the US.

Labour productivity in the ICT sector was higher than in the rest of the economy (EUR 97,000 per person employed versus EUR 64,000 per person employed in 2016). Although it grew less quickly in nominal terms (+ 7 % versus + 16 % over 2006-2016), labour productivity in the ICT sector grew faster than that of the general economy in real terms (+ 23 % versus + 6 % over 2006-2016).



Note: Values for the years 2017 and 2018 are nowcasted data.



Source: Commission services' calculations and estimates based on PREDICT project

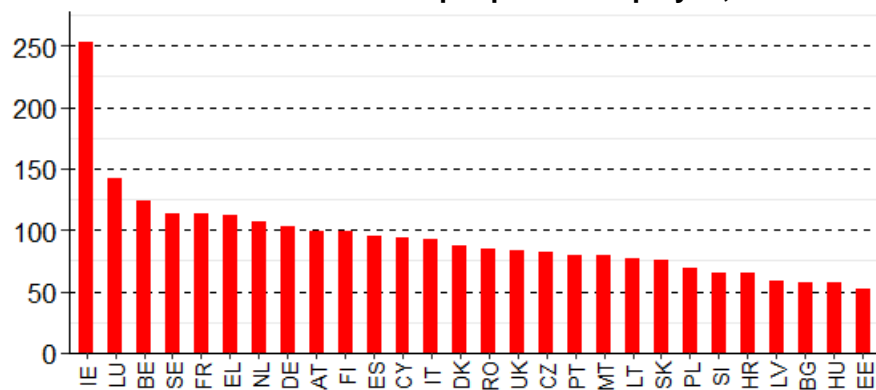
According to the operational definition\* which enables world comparisons, labour productivity in the EU ICT sector is considerably below that of the US (index: 57.8; index US=100) and also lower than Japan's (index: 64.6), but is far ahead of China (index: 28.0), which is however rapidly catching up.

\* See methodological note.

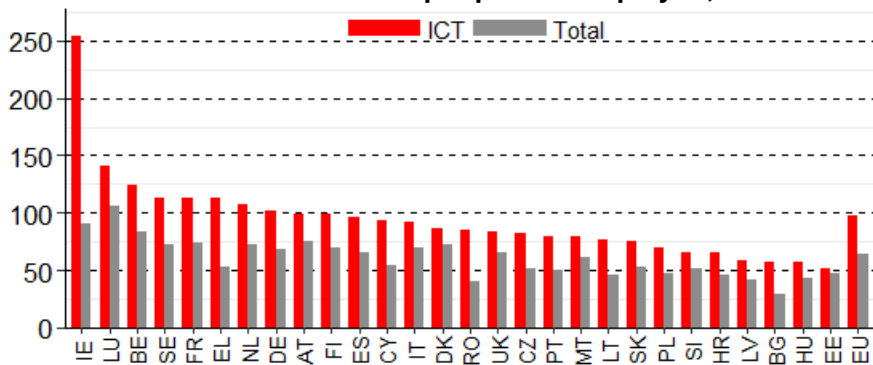
Labour **productivity** was highest in Ireland followed by Luxembourg and Belgium. Estonia, Hungary, and Bulgaria had the weakest performance.

In terms of labour productivity in the ICT sector, Ireland (EUR PPS 252,000 per person employed) by far led the way in 2014 (latest data available), but Luxembourg (EUR PPS 141,000 per person employed) and Belgium (EUR PPS 124,000 per person employed) also fared well in 2016. At the opposite end of the scale were Estonia (EUR PPS 52,000 per person employed), Hungary (EUR PPS 57,000 per person employed), and Bulgaria (EUR PPS 57,000 per person employed).

**Productivity in the ICT sector,  
thousand EUR PPS per person employed, 2016**



**Productivity, ICT sector and total,  
thousand EUR PPS per person employed, 2016**



Note: Data for Ireland refers to 2014.

Source: Commission services' calculations and estimates based on PREDICT project

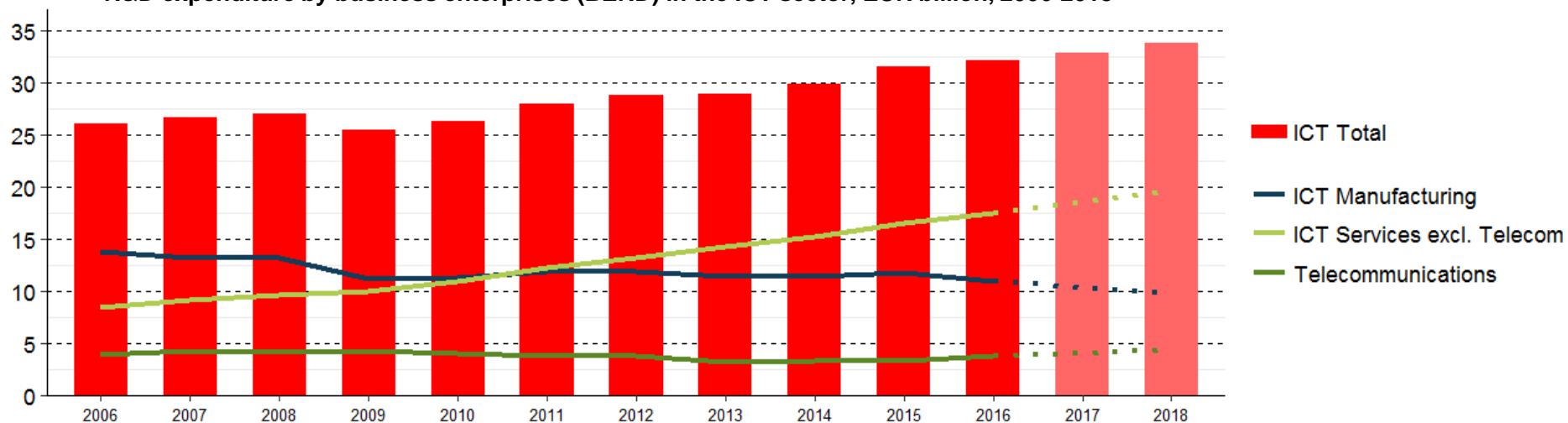
The picture for labour productivity in the economy as a whole was broadly similar. Luxembourg (EUR PPS 105,000 per person employed) and Ireland (EUR PPS 93,000 per person employed) were the best-performing countries, while Bulgaria (EUR PPS 29,000 per person employed) and Romania (EUR PPS 40,000 per person employed) were at the bottom of the scale.

**R&D expenditure by business enterprises (BERD) in the ICT sector was EUR 32 billion in 2016.** The ICT services sector was responsible for 66 % (EUR 21 billion) of **ICT BERD** in 2016.

R&D expenditure by business enterprises (BERD) in the ICT sector amounted to EUR 32 billion in 2016, its highest value over the medium term (2006-2016) and far from its low point of EUR 25 billion in 2009. A breakdown by sub-sector reveals a more balanced situation for BERD than for value added – despite accounting for only 8 % of ICT sector value added, the ICT manufacturing sub-sector was responsible for 34 % of total ICT BERD (EUR 11 billion) while the ICT services sub-sector was responsible for 63 % (EUR 21 billion) of ICT BERD in 2016.

Over the medium term (2006-2016), the situation was quite different. The ICT manufacturing sub-sector experienced structural decline (falling by 21 % in 2006-2016), whereas the ICT services saw a structural increase (rising by 72 % in 2006-2016), particularly the ICT services sub-sector excluding telecommunications, which saw an increase of 106 % in 2006-2016.

**R&D expenditure by business enterprises (BERD) in the ICT sector, EUR billion, 2006-2018**



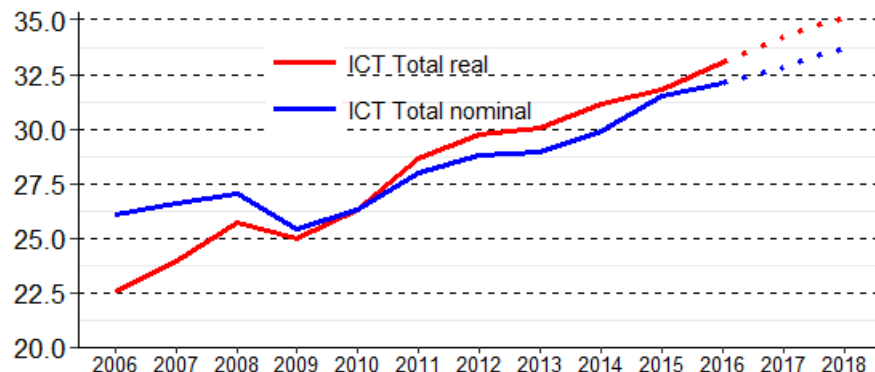
Note: Values for the years 2017 and 2018 are nowcasted data.

Source: Commission services' calculations and estimates based on PREDICT project

# R&D expenditure by business enterprises grew faster in the ICT sector than in the general economy in real terms. ICT R&D intensity was 5 % in 2016 in the EU, far behind the US and Japan.

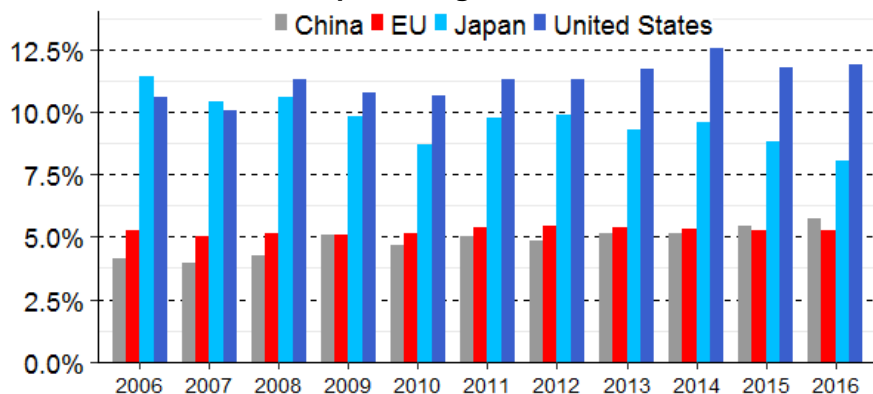
In real terms, R&D expenditure by business enterprises in the ICT sector grew faster than in the general economy (+ 38 % versus + 26 % in 2006-2015).

**R&D expenditure by business enterprises (BERD) in the ICT sector, nominal and deflated, EUR billion, 2006-2018**



Note: Values for the years 2017 and 2018 are nowcasted data.

**ICT sector R&D Intensity (BERD/VA), percentage, 2006-2016**



R&D intensity (BERD/VA) in the ICT sector (comprehensive definition\*) amounted to 5.0 % in 2016. According to the operational definition\* which enables world comparisons, China (5.5 %) surpassed the EU (5.2 %) for the second time, and both the EU and China lagged behind the US (12.0 %) and Japan (8.0 %) in 2016.

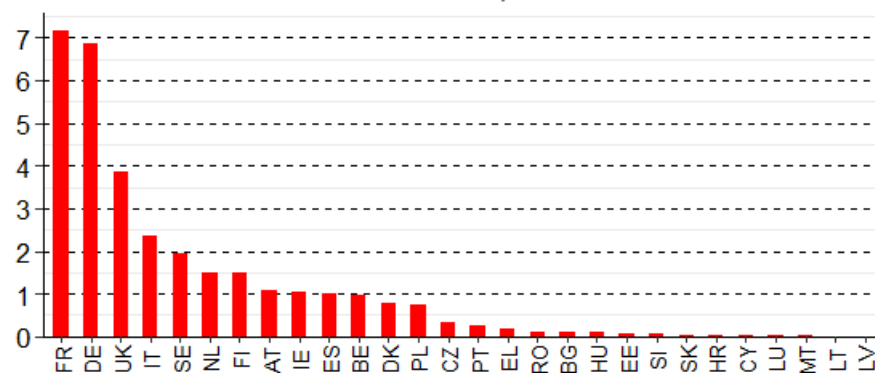
\* See methodological note.

Source: Commission services' calculations and estimates based on PREDICT project

The EU's six **main contributors** in terms of **R&D expenditure by business enterprises in the ICT sector** in 2016 were the EU's four biggest economies (France, Germany, the United Kingdom, and Italy) together with Sweden and the Netherlands..

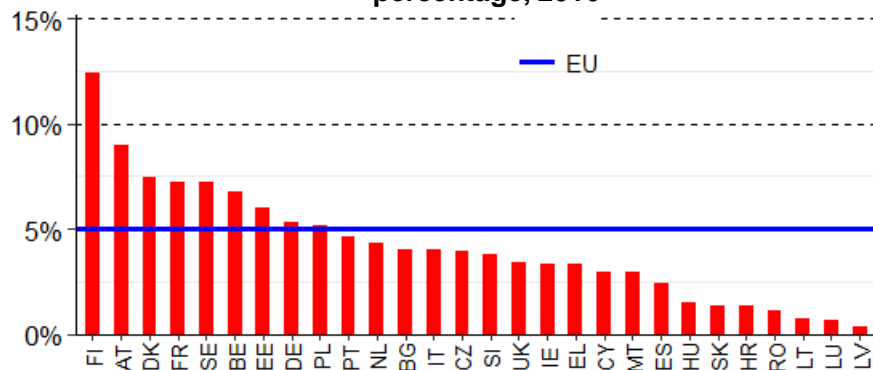
The EU's six main contributors in terms of R&D expenditure by business enterprises in the ICT sector in 2016 were the four largest economies in the EU (France, Germany, the United Kingdom and Italy), followed by Sweden and the Netherlands: France (EUR 7.2 billion or 22 %), Germany (EUR 6.9 billion or 21 %), the United Kingdom (EUR 3.8 billion or 12 %), Italy (EUR 2.3 billion or 7 %), Sweden (EUR 1.9 billion or 6 %) and the Netherlands (EUR 1.5 billion or 5 %). Together, these six accounted for 74 % of total R&D expenditure by business enterprises in the ICT sector.

**R&D expenditure by business enterprises (BERD) in the ICT sector, EUR billion, 2016**



Note: Data for Ireland refers to 2014.

**ICT sector R&D Intensity (BERD/VA), percentage, 2016**



Note: Data for Ireland refers to 2014.

Source: Commission services' calculations and estimates based on PREDICT project

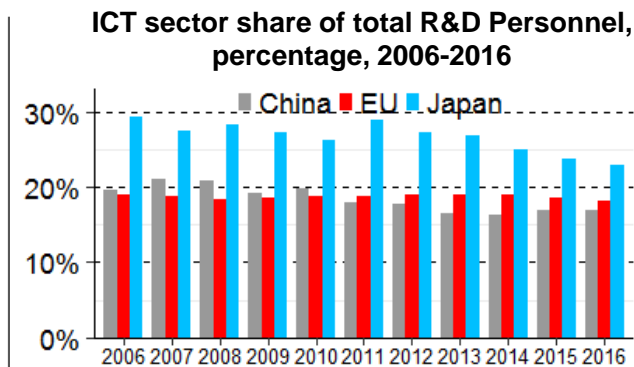
Finland led the EU with 12.4 % ICT R&D intensity rate (BERD/VA) in 2016; Denmark had a rate of 7.5 % and Sweden 7.2 %. Other strong performers include Austria (8.9 %), France (7.2 %), and Belgium (6.7 %). Over the medium term (2006-2016), ICT R&D intensity remained broadly stable, but some countries, such as Poland and Bulgaria, made significant progress.

**R&D personnel in the ICT sector** included 313,000 full-time equivalents (FTEs) in 2016. The top employer was the ICT services sub-sector (excluding telecommunications), employing 205,000 FTEs in 2016 (65 % of ICT R&D personnel). **R&D personnel in the ICT sector** made up 19 % of total R&D personnel in 2016.

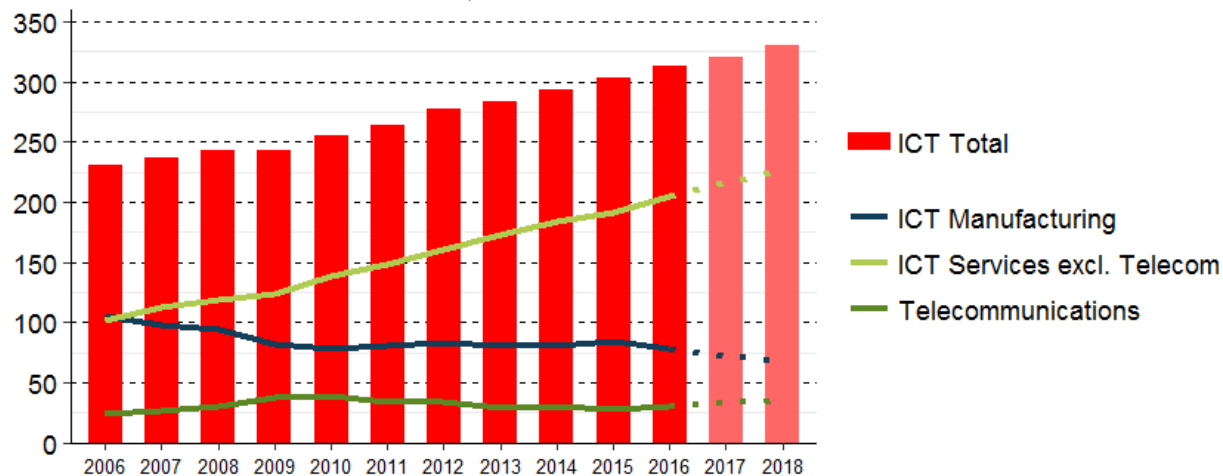
R&D personnel in the ICT sector included 313,000 full-time equivalents (FTEs) in 2016, a figure which rose over the medium term (2006-2016), growing faster after 2009. The ICT services sub-sector (excluding telecommunications) employed 205,000 FTEs in 2016 (65 % of R&D personnel in the ICT sector, making it the top employer), with a rising trend. The ICT manufacturing sub-sector employed 78,000 FTEs in 2016, with a downward trend in the medium term (2006-2016) despite an uptick in 2015. The telecommunications sub-sector employed 31,000 FTEs in 2016 (10 % of R&D personnel in the ICT sector), down by about 29 % from a peak of 39,000 FTEs in 2010.

\* See methodological note

R&D personnel in the ICT sector (comprehensive definition\*) made up 19 % of total R&D personnel in 2016, a figure which remained stable over the medium term. However, according to the operational definition\* which enables world comparisons, the EU (18 %) and China (17 %) were behind Japan (23 %) in 2016 and in the medium term (no data available for the US).



**R&D Personnel (PERD) in the ICT sector, thousand FTEs, 2006-2018**



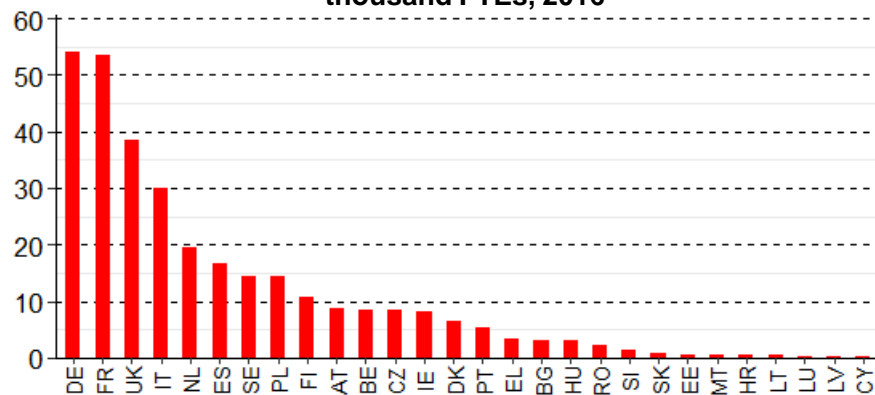
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Source: Commission services' calculations and estimates based on PREDICT project

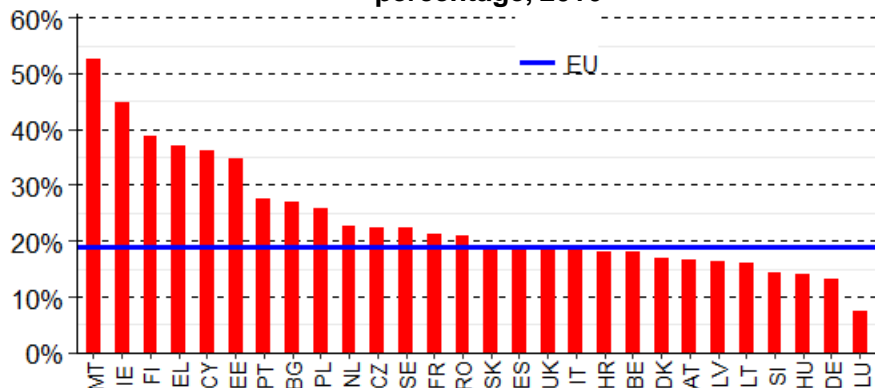
The EU's four biggest economies were also the four biggest **employers of R&D personnel** in the ICT sector in 2016: France, Germany, the United Kingdom, and Italy. Malta and Ireland were the two countries with the highest concentration of **R&D personnel in the ICT sector** in 2016.

The EU's four biggest economies were also the four biggest employers of R&D personnel in the ICT sector in 2016. These were Germany (54,000 FTEs or 17 %), France (53,000 FTEs or 17 %), the United Kingdom (38,000 FTEs or 12 %), and Italy (30,000 FTEs or 10 %). Together, the four biggest employers represented 56 % of total R&D personnel in the ICT sector in 2016.

**R&D Personnel (PERD) in the ICT sector, thousand FTEs, 2016**



**ICT sector share of total R&D Personnel (PERD), percentage, 2016**



Malta (53 %) and Ireland (45 %) were the two countries with the highest concentration of R&D personnel in the ICT sector in 2016. Luxembourg had the lowest concentration (7 %).

Other strong performers were Finland (39 %), Greece (37 %) and Cyprus (36 %).

Source: Commission services' calculations and estimates based on PREDICT project



Estimated **publicly funded expenditure on ICT R&D** in the EU grew to EUR 6.7 billion in 2017. This was more than 26 % below the necessary trend line for doubling **publicly funded ICT R&D** between 2007 and 2020.

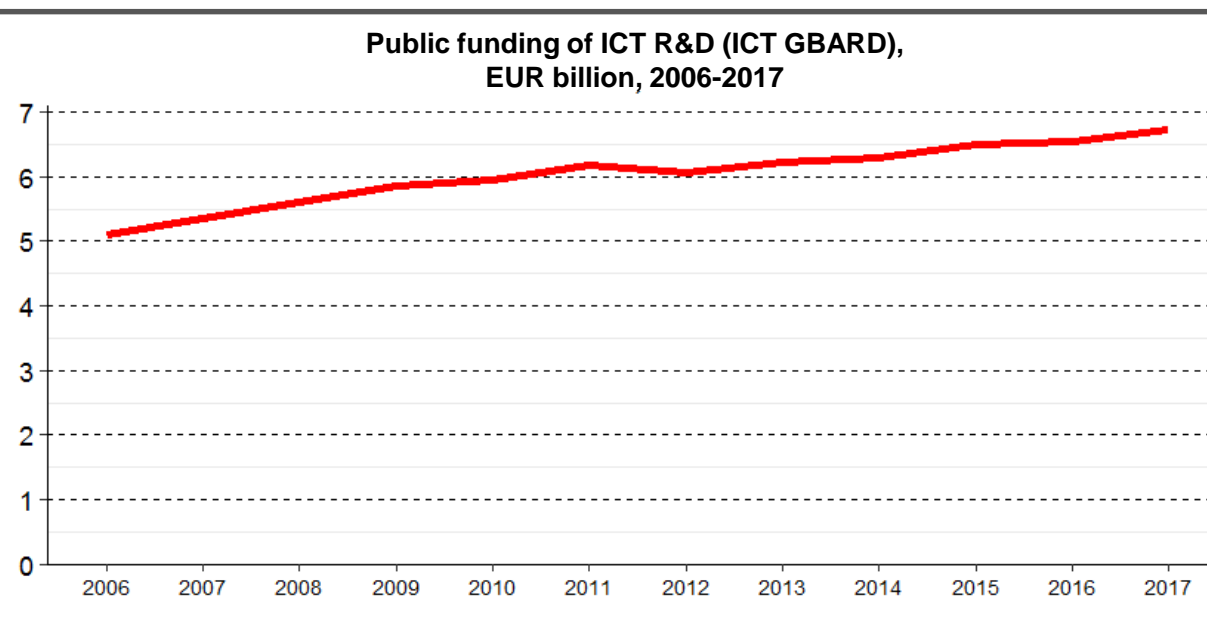
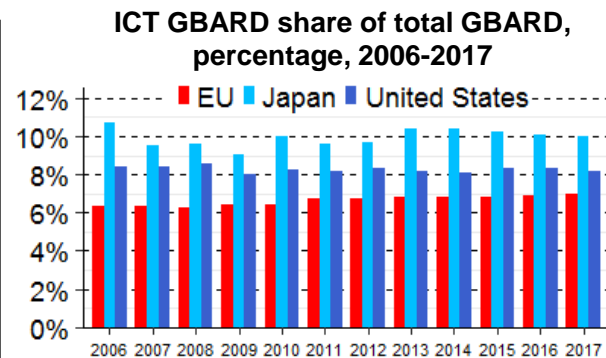
The estimated level of publicly funded expenditure on ICT R&D (in any sector of the economy) in the EU was on an increasing trend in the medium term (2006-2017), interrupted only by a fall in 2012, and reached EUR 6.7 billion in 2017.

The Digital Agenda target of doubling publicly funded ICT R&D between 2007 and 2020 requires an annual growth rate of 5.5 % (assuming a constant annual growth rate). Estimated public ICT R&D expenditure was below the necessary trend line in 2017, with a gap of more than 26 %.

In 2017, public funding of ICT R&D represented 7.0 % of EU total 'government budget allocations for R&D' (GBARD), a figure which remained broadly stable over the medium term.

The EU lagged behind the US (8.2 %) and Japan (10.0 %), a position that remained stable over the medium term (no data available for China).

\* Official statistics on public expenditure are available one year before business statistics.



Source: Commission services' calculations and estimates based on PREDICT project

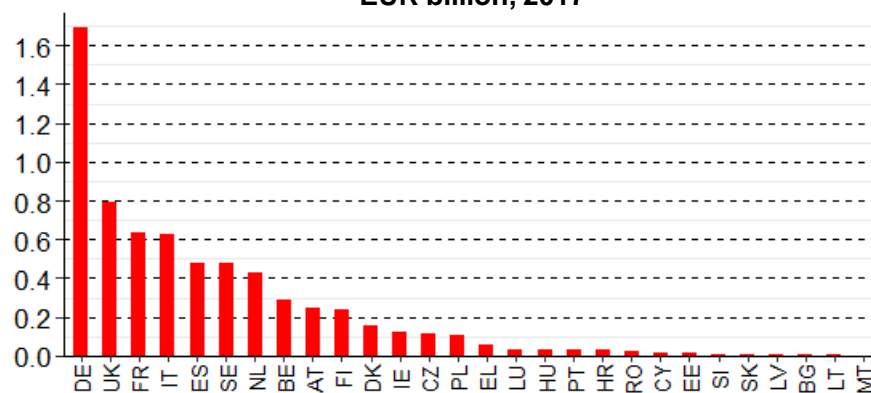


The EU's five biggest **public funders of ICT R&D** in 2017 were Germany, the United Kingdom, France, Italy and Spain. As in previous years, Cyprus had the highest rate of **ICT GBARD** as a share of **total GBARD** in 2017.

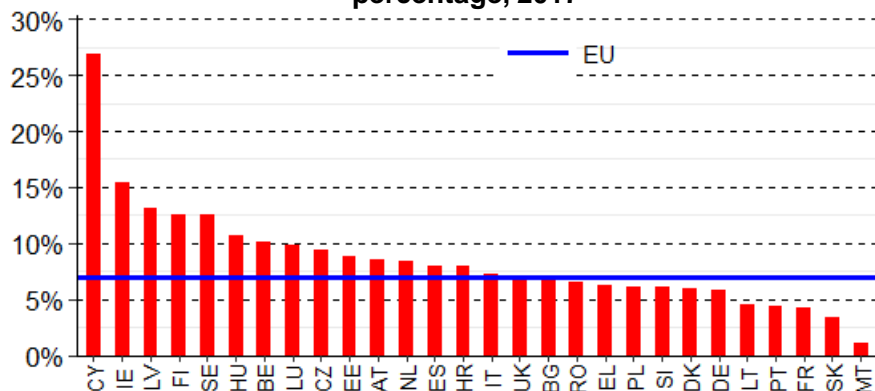
The EU's five biggest public funders of ICT R&D in 2016 were Germany (EUR 1.7 billion or 25 %), followed by the United Kingdom (EUR 793 million or 12 %), France (EUR 636 million or 9 %), Italy (EUR 623 million or 9 %) and Spain (EUR 477 million or 7 %).

Together, those five countries accounted for 63 % of total public funding for ICT R&D.

Public funding of ICT R&D (ICT GBARD), EUR billion, 2017



ICT GBARD as share of total GBARD, percentage, 2017



As in previous years, Cyprus was leading the way in the EU with the highest rate (27 %) of ICT GBARD as a proportion of total GBARD in 2016. The ranking in 2016 again reveals strong performances by Ireland (15.5 %), Sweden and Finland (both 12.5 %).

However, some other countries also pay special attention to ICT in their public spending on R&D, such as Latvia (at 13.1 %) and Hungary (at 10.7 %).

Source: Commission services' calculations and estimates based on PREDICT project



# METHODOLOGICAL NOTE

## Definition of the ICT sector

In this section, the ICT sector is defined according to the definition provided by the OECD and based on the NACE (Statistical Classification of Economic Activities in the European Community) Rev.2 (2008) nomenclature. The ICT sector has 12 industries:

### *ICT manufacturing*

- C261 Manufacture of electronic components and boards
- C262 Manufacture of computers and peripheral equipment
- C263 Manufacture of communication equipment
- C264 Manufacture of consumer electronics
- C268 Manufacture of magnetic and optical media

### *ICT services*

- G4651 Wholesale of computers, computer peripheral equipment and software
- G4652 Wholesale of electronic and telecommunications equipment and parts
- J5820 Software publishing
- J61 Telecommunications
- J62 Computer programming, consultancy and related activities
- J631 Data processing, hosting and related activities; web portals
- S951 Repair of computers and communication equipment

# METHODOLOGICAL NOTE

## Comprehensive versus operational definition

The comprehensive definition of the ICT sector applies to EU Member States for the period 2008-2016. It corresponds to the definition provided by the OECD in 2007.

The operational definition of the ICT sector enables the EU to be compared with non-EU countries over a longer period (2006-2016), as some of these countries do not have the necessary disaggregated information to estimate all the ICT industries included in the comprehensive definition. The operational definition does not include the following industries: manufacture of magnetic and optical media (268) and ICT trade industries (465).

## Sector analysis

In the previous section, an analysis by ICT sub-sectors is made for each indicator. The 12 industries are aggregated into three sub-sectors: ICT manufacturing, ICT services (excluding telecommunications), and Telecommunications.

## Source

Joint Research Centre – Dir. B Growth and Innovation (JRC – Dir. B) calculations and estimates, based on Eurostat, the OECD's structural analysis database (STAN), EU-KLEMS data and other national sources, from the JRC's PREDICT project.

All data contained in these databases come from official sources (e.g. Eurostat, OECD, national statistical institutes). However, there may be some discrepancies with the original sources, e.g. due to updates of the original data or the use of multiple auxiliary sources and variables.