

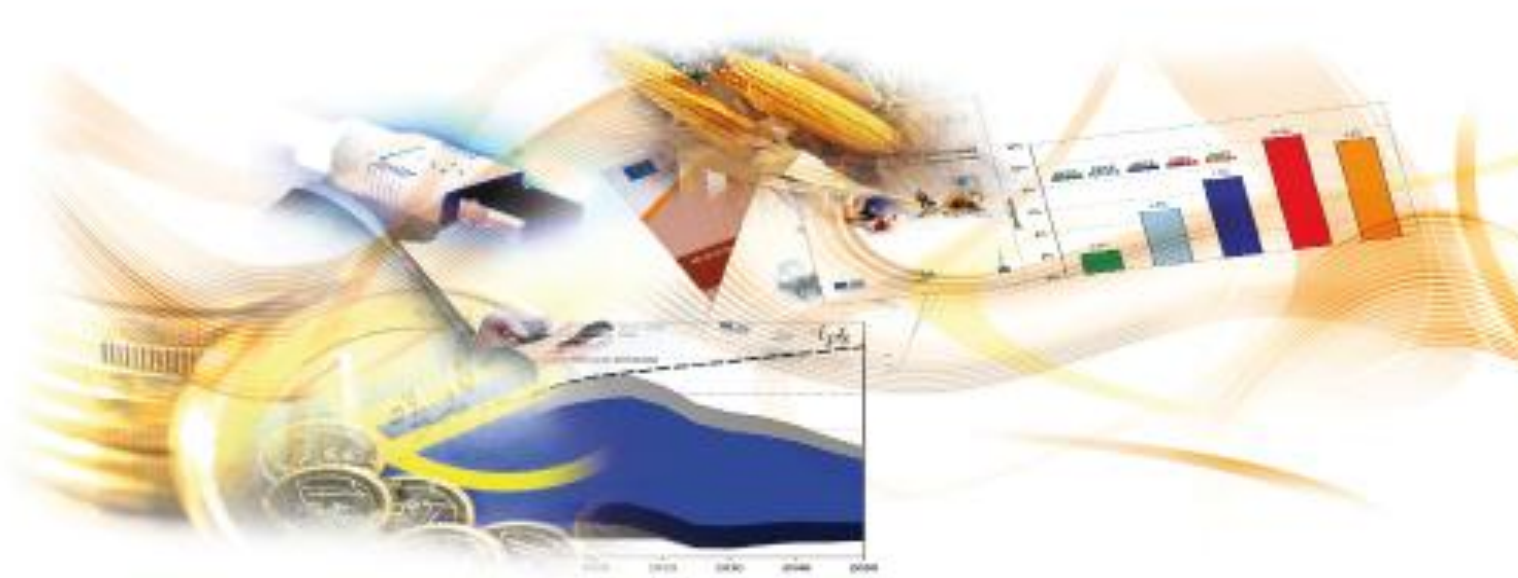
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THE 2012 PREDICT REPORT

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

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Executive Summary

Introduction

The 2012 PREDICT report provides a detailed quantitative analysis of the state of the Information and Communication Technologies (ICT) sector and its Research and Development (R&D) in the European Union and beyond.

This analysis was produced by the Information Society Unit of the Institute for Prospective Technological Studies (JRC-IPTS) under the PREDICT project (*Prospective Insights on R&D in ICT*). PREDICT is being run by JRC-IPTS for the Directorate General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission.

This is the fifth in a series of reports which are published annually, and it is the first web-based edition. Like the previous reports, this one is based on the latest data available from official sources such as EUROSTAT and OECD.² This year our analysis therefore covers the years 2008 and 2009, a period marked by a deep financial and economic crisis.

The analysis provides first an overview of the importance of the EU ICT sector and its R&D. It then gives detailed information by ICT manufacturing and services sub-sector and by EU Member State, and in comparison with the USA.

This report confirms the trends observed in previous PREDICT analyses. The main observations made in this year's report are the following:

- The importance for the EU economy of the ICT sector as a whole, and of ICT services in particular (notably *Telecommunications* and *Computer programming, consultancy and related activities*).
- The importance of R&D investments made by the ICT sector, particularly in ICT manufacturing but also in ICT services, making the ICT sector one of the most R&D-intensive sector in the EU economy.
- The resilience of ICT services in times of crisis.

² For the first time this year, PREDICT analyses follow the NACE Rev 2 definition of the ICT sector (See: OECD Information Economy – Sector definitions based on the International Standard Industry Classification (ISIC 4), Annex 1, p.15, available at: <http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf>). After the adoption in 2006 of this new definition of the ICT sector, all Member States must now apply it when reporting ICT sector data, starting with year 2008. More details are provided in Mas Matilde, Juan Carlos Robledo and Juan Pérez, 'ICT sector definition transition from NACE Rev. 1.1 to NACE Rev.2: A methodological note', Instituto Valenciano de Investigaciones Económicas, 2012..

Following the NACE Rev 2 definition, the ICT sector is composed of the following sub-sectors:

ICT manufacturing

- 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

ICT services

- 4651 Wholesale of computers, computer peripheral equipment and software
- 4652 Wholesale of electronic and telecommunications equipment and parts
- 5820 Software publishing
- 61 Telecommunications
- 62 Computer programming, consultancy and related activities
- 631 Data processing, hosting and related activities; web portals
- 951 Repair of computers and communication equipment

- The important contribution of the largest EU economies to the performance of the EU ICT sector and the leadership of Nordic countries in terms of ICT R&D intensity,
- The clear US leadership when comparing the performance of EU and US ICT sectors in terms of sector size and R&D.

The importance of the EU ICT sector and of ICT services

In 2009, the EU ICT sector represented 4.0% of EU GDP, a share that has remained stable over the last few years. It employed 6.1 million people, or 2.7% of total EU employment. It is characterised by the predominance of services over manufacturing. In 2009, more than 90% of the Value Added produced by the ICT sector was produced in ICT services, which employed 5.1 million people, or 85% of the ICT sector workforce.

Furthermore, in 2009, labour productivity in ICT Services was more than twice that of ICT Manufacturing, partly because labour productivity is far more sensitive to business cycles in manufacturing than it is in services.

When looking closer at ICT service sub-sectors in 2009, *Telecommunications* and *Computer programming, consultancy and related activities* together represented almost 75% of the total Value Added produced by the EU ICT sector (respectively 38% and 35%). These two ICT sub-sectors had the highest levels of employment. In 2009, *Telecommunications* was the ICT sub-sector with the highest level of labour productivity, producing more Value Added than the *Computer programming, consultancy and related activities* sub-sector, with less than half its employment level.

The importance of R&D investments in the ICT sector

The ICT sector is one of the most research-intensive sectors in the EU economy. With a ratio of 5.3% in 2009, the R&D intensity of the ICT sector was more than four times the average ratio of 1.2% in the EU economy.³ In 2009, ICT business expenditures in R&D (ICT BERD) made up 17% of total business expenditures in R&D in the entire EU economy, demonstrating the importance of the R&D investments made by a sector that represented "only" 4% of the EU GDP. Estimated public ICT R&D funding in the EU in 2009 amounted to € 5.3 billion which represented almost 6% of total EU public funding of R&D.⁴ The ICT sector is therefore a key contributor to the EU's aim to reach the target of 3% of GDP invested in R&D by 2020.

When comparing R&D investments in ICT manufacturing with those in ICT services, although ICT manufacturing sub-sectors produced only 8% of the ICT sector Value Added in 2009, ICT BERD was almost equally divided between ICT manufacturing (€ 11.3 billion) and ICT services (€ 13.7 billion). In 2009, ICT manufacturing was on average almost ten times more research-intensive than ICT services, and while 10% of employees in ICT manufacturing sub-sectors were R&D personnel, they were only 3.7% in ICT services. When looking at individual ICT sub-sectors in the same year, however, the *Computer programming, consultancy and related activities* service sub-sector was the most important ICT sub-sector in the EU in terms of the amount of ICT BERD. It overtook *Manufacturing of communication equipment* (the most important ICT sub-sector in 2008), which was

³ R&D intensity measured by the ratio of R&D expenditures in Value Added.

⁴ See Stančík, J. 2012. A Methodology to Estimate Public ICT R&D Expenditures in the EU Member States. JRC Technical Note, JRC 69978, available at <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5119>.

followed by *Telecommunications* -another service sub-sector- and *Manufacturing of electronic components and boards*.

The resilience of ICT services in times of crisis

From 2008 to 2009, ICT sector Value Added decreased by 7.0%, the result of a decrease of 30% in ICT manufacturing and of -only- 4% in ICT services. ICT sector employment decreased by 3% - in real terms, 183 000 people - therefore less than Value Added. The decrease in employment was also higher in ICT manufacturing than in ICT services.

ICT BERD decreased by a similar percentage to Value Added, 7.4%, the result of a decrease of 17% in ICT manufacturing combined with a slight increase in ICT services (2.2%). The hardest hit manufacturing sub-sector was *Manufacturing of communication equipment*, while the increase of ICT BERD in services was mostly in the *Computer programming, consultancy and related activities* sub-sector. Similarly, while employment of R&D personnel decreased by 13% in ICT manufacturing (from 107 000 in 2008 to 93 000 in 2009), this decrease was partly offset by an 8% increase in ICT Services (from 177 000 in 2008 to 192 000 in 2009), resulting in a stable R&D employment figure for the ICT sector as a whole.

The important contribution of the largest EU economies to the performance of the EU ICT sector; and the leadership of Nordic countries in terms of ICT R&D intensity

Mainly because of the size of their economies, Germany, France, the United Kingdom, and Italy (the four largest economies in the EU) lead on all main figures: ICT Value Added, ICT employment, ICT R&D expenditures (both private investment and public funding) and ICT R&D personnel. In 2009, the fifth largest EU economy, Spain, had a high level of public financing of ICT R&D, although its private investment in ICT R&D was lower than in other large economies.

Nordic countries kept their lead in ICT BERD intensity: in 2009, Finland, Sweden and Denmark had the highest levels of ICT BERD intensity (ICT BERD/ICT Value Added) as well as the highest shares in GDP of public funding of ICT R&D. Finland and Sweden also had the highest shares of ICT R&D personnel in ICT employment. But in spite of the ICT specialisation of their economy, the contributions made by these countries to total EU ICT sector value added and employment are rather low, because of the relatively small size of their economies.

It is interesting to note that in 2009 the six EU countries that are most specialised in ICT (Ireland, Luxembourg, Hungary, Finland, Malta and Sweden), produced together only 8.8% of EU ICT Value Added, i.e., about the share of ICT Value Added produced by Spain. This is explained by the relatively small size of these countries.

In 2009, most of the newer Member States still had low levels of ICT sector labour productivity. The twelve newer EU Member States employed together a rather high percentage of the EU ICT sector workforce (16%), but produced only 8% of total EU ICT Value Added. Their combined investment in ICT R&D remained low (4% of total public funding of ICT R&D in the EU and 2% of total private ICT investment in the EU), and they employed only 6% of the total EU ICT R&D personnel. Of the newer Member States, Poland,

the Czech Republic, Hungary and Romania are leaders for most of the analysed ICT indicators.⁵

The clear leadership of the US versus the EU

When comparing performance of the EU and US ICT sectors, the US clearly leads on all figures.

In 2009, the US ICT sector's Value Added was higher than the EU ICT sector's Value Added by 22%.⁶ The difference increased from 2008 to 2009 because, while the total ICT Value Added decreased in the EU, it increased in the US in both ICT manufacturing and ICT services, in spite of the crisis. The weight of ICT Manufacturing in the ICT sector is more important in the US than in the EU: while in the EU 9% of the Value Added produced by the ICT sector in 2009 was produced in ICT manufacturing, in the US this ratio was 18%. In 2009, US ICT manufacturing Value Added was therefore more than twice that of EU ICT manufacturing. The US ICT sub-sectors *Manufacture of electronic components and boards* and *Manufacture of computers and peripheral equipment* produced respectively four times and five times the Value Added produced by those sectors in the EU. Even Value Added of *Manufacture of communication equipment*, the most important ICT manufacturing sub-sector in the EU, was 20% larger in the US than in the EU.

The US ICT sector labour productivity lead is clear in all ICT sub-sectors. Although it produces more Value Added, the US ICT sector employs considerably fewer people than the EU ICT sector. In 2009, over 3.4 million people worked in the ICT sector in the US, compared with 5.3 million in the EU.⁷ On average, in 2009, US ICT labour productivity was twice that of the EU and was higher than in any individual EU Member State.

In 2009, US ICT BERD amounted to 2.5 times the EU figure, having increased slightly from 2008 to 2009. This increase originated in the manufacturing sub-sectors, while BERD in ICT services remained stable. In contrast, in the EU, ICT BERD in manufacturing dropped between 2008 and 2009, and slightly increased in ICT services. As in the EU, US ICT BERD is almost equally divided between manufacturing and services, although there are large differences at the level of individual sub-sectors. US ICT BERD was higher than EU ICT BERD in almost all ICT sub-sectors; the exceptions were *Telecommunications*, *Manufacture of consumer electronics*, and *Manufacture of magnetic and optical media*. The largest US lead in ICT BERD was in *Software publishing*, and in *Manufacture of electronic components and boards*.

Finally, US ICT BERD intensity (measured by the ratio of ICT BERD in ICT Value Added) is more than twice the EU figure (12.3% vs. 5.89% in 2009). This is partly due to the higher weight of manufacturing in the US ICT Sector (18% vs. 9%), but also to higher R&D intensity in both ICT manufacturing and services.

These differences between the EU and US ICT sectors show both different specialisation patterns and progressively different trajectories in terms of industrial development in the two regions.

⁵ The reader should note that this analysis of ICT indicators by Member State limits itself to providing an aggregated view at the level of each country. It does not attempt to capture performance of more localised ICT activities, such as those of specific companies or poles of excellence, or those taking place in specific regions.

⁶ Excluding –for both regions– the Trade and Repair sub-sectors for which US data is not available

⁷ Excluding –for both regions– the Trade and Repair sub-sectors for which US data is not available

The above observations are analysed in detail in the 2012 PREDICT report, which is available in easy-to-read sections formatted for the web, or as a fully downloadable report.⁸

⁸ See: <http://is.jrc.ec.europa.eu/pages/ISG/PREDICT/2da/index.html>

Introduction

"The 2012 PREDICT Report: An Analysis of ICT R&D – in the EU and Beyond" provides a detailed analysis of the state of Information and Communication Technologies (ICT) Research and Development (R&D) activities in the European Union.

This is the fifth edition of a series which is published annually. The 2012 edition has been, for the first time, designed to be primarily published as a web-based source of data and analyses, with downloadable data sets. The present report is therefore a compilation of the different sections of the web-based version available at:

<http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html>.

This edition is based on latest data available from official sources, such as EUROSTAT and OECD. It therefore covers years 2008 and 2009, a period marked by a deep financial and economic crisis.

This analysis was produced by the Information Society Unit of the Institute for Prospective Technological Studies (JRC-IPTS) under the Prospective Insights on R&D in ICT (**PREDICT**) project, a research project analysing R&D in ICT in Europe. PREDICT is being run by JRC-IPTS for the Directorate General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission.

The PREDICT analysis provided here is structured as follows:

- First an overview of the importance of the EU ICT sector and of its R&D is provided.
- Detailed information is then provided by ICT manufacturing and services sub-sectors, by EU Member States, and by comparison with the USA. Data and analyses are provided according to the following categories: Size of the ICT sector in terms of its share in GDP (i.e., ICT sector value added), ICT sector employment and labour productivity, ICT sector business expenditures in R&D (ICT BERD), estimates of public funding of ICT R&D at EU and Member States levels, and ICT Sector R&D personnel. Finally, a comparison of main indicators is provided, by sub-sectors, by Member States, and with the USA.

Methodological note

Data and analyses provided here are based on data from national accounts. For the first time this year, PREDICT analyses follow the NACE Rev 2 definition of the ICT sector⁹ After the adoption in 2006 of this new definition of the ICT sector, all Member States must now apply it when reporting ICT sector data, starting with year 2008.¹⁰

For most of the data, 2009 figures were the latest available in April 2012 when the data was downloaded and analysed.

⁹ OECD Information Economy – Sector definitions based on the International Standard Industry Classification (ISIC 4), Annex 1, p.15, available at:
<http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf>

¹⁰ More details on methodology are provided in: Mas Matilde, Juan Carlos Robledo and Juan Pérez, 'ICT sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note', Instituto Valenciano de Investigaciones Económicas, 2012.

1. Overview of the Importance of the EU ICT Sector and its R&D

This chapter provides an overview of the importance of the EU ICT sector and its R&D by presenting main indicators on EU ICT sector as a whole. The following chapters of the report provide more detailed data and analyses.

Size of the EU ICT Sector (Value Added)

- ICT sector Value Added (VA) in the EU amounted to € 470 billion in 2009. This represented a share of 4.0% of EU GDP, a share that has remained stable over the last few years.
- ICT Services represented by far the largest share of ICT VA (91.9% or € 432 billion in 2009), and amounted to 3.7% of EU GDP, while ICT Manufacturing VA represented 8.1% of ICT VA (€ 38 billion), amounting to 0.3% of GDP.

ICT Sector Employment and Labour Productivity

- In 2009, over 6.1 million people worked in the EU ICT sector, representing 2.7% of employment in the EU.
- ICT employment is highly concentrated in ICT Services: 5.1 million people worked in ICT Services (85%) whereas 0.9 million worked in ICT Manufacturing (15%).
- In 2009, labour productivity per person in ICT Manufacturing in the EU was € 41 170 while in ICT Services it was € 84 170.

ICT Sector Business Expenditures in R&D (ICT BERD)

- In 2009, ICT BERD was € 25 billion, 7.4% less than it was in 2008 (€ 27 billion).
- This amount was almost equally divided between Manufacturing (€ 11.3 billion) and Services (€ 13.7 billion).
- The ICT sector is one of the most R&D-intensive sectors in the EU economy. In 2009, ICT BERD made up 17% of total BERD, while ICT VA represented only 4% of GDP. In the same year, ICT R&D intensity, measured by the ratio of ICT BERD over ICT VA, was 5.3%.

Public Funding of ICT R&D (ICT GBAORD)

- Public ICT R&D funding in the EU in 2009 was estimated at € 5.3 billion which represented almost 6% of the total EU public funding of R&D.

ICT R&D Personnel

- ICT R&D personnel (including both researchers and R&D supporting staff) made up 4.7% of total ICT Employment in the EU.
- In 2009, 10% of employees in the EU ICT Manufacturing sub-sectors were R&D personnel, whereas it was only 3.7% in ICT Services..

2. Analysis by ICT Sub-sector

2.1 Size of the EU ICT Sector (Value Added)

ICT sector Value Added (VA) amounted to € 470 billion in 2009. This represented a share of 4.0% of EU GDP, a share that has remained stable over the last few years. ICT Services contributed by far the largest share of ICT VA (90.8%, or € 432 billion in 2009), amounting to 3.7% of EU GDP, while ICT Manufacturing VA contributed 8.1% of ICT VA (€ 38 billion), amounting to 0.3% of GDP.

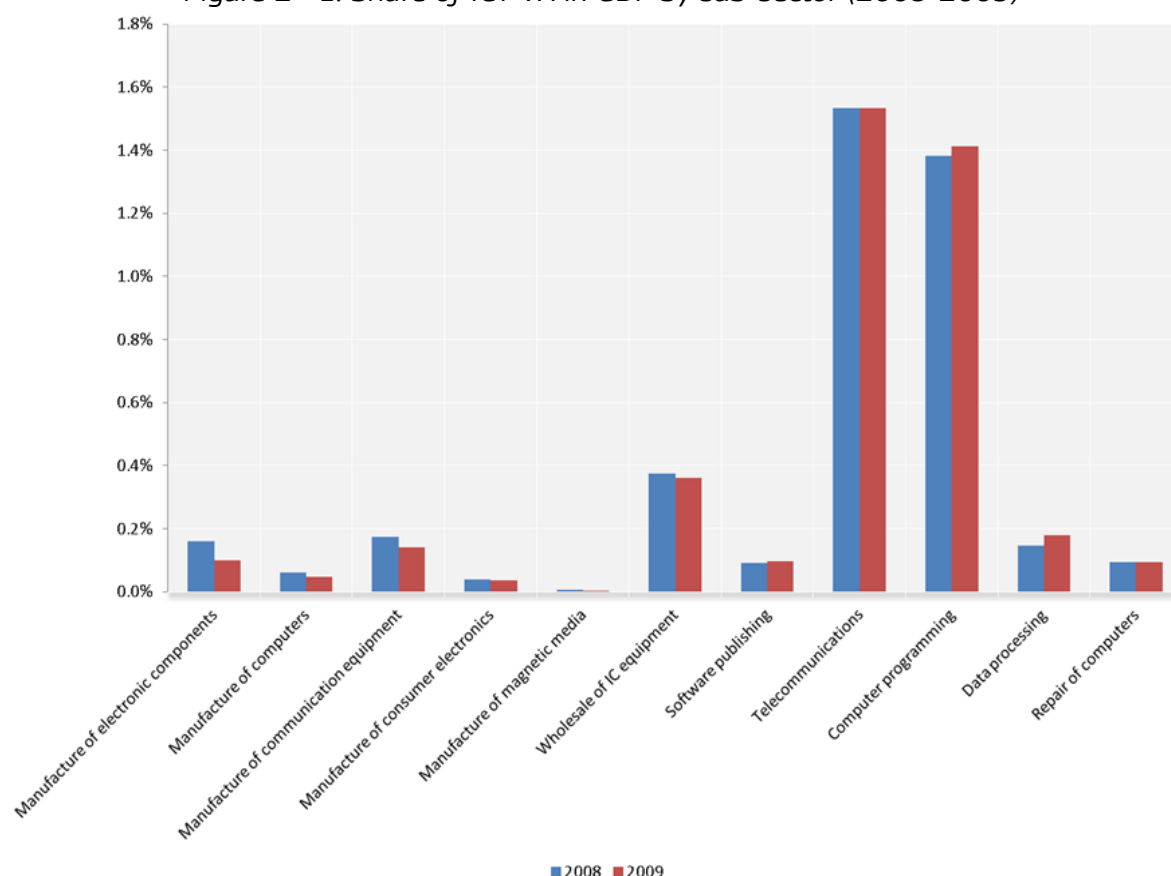
Figure 2—1 plots the share of ICT VA in GDP by ICT sub-sectors. By far the two largest ICT Services sub-sectors in the EU are *Telecommunications (NACE 61)*, which generated a VA of € 180 billion in 2009 (1.5% of EU GDP) and *Computer programming, consultancy and related activities (NACE 62)*, which generated a VA of € 166 billion in 2009 (1.4% of EU GDP). These two sub-sectors represented almost three quarters of the total VA generated by the ICT sector in 2009. ICT Trade activities generated VA of € 42 billion in 2009, or 0.4% of EU GDP. In 2009, the Value Added generated in ICT Trade services was more than the VA generated in ICT Manufacturing. From 2008 to 2009, Value Added generated by ICT Services decreased by € 19 billion (a 4% decrease).

The two largest ICT Manufacturing sub-sectors in the EU are *Manufacturing of communication equipment (NACE 263)* and *Manufacturing of electronic components and boards (NACE 261)*. Their cumulative contribution to EU GDP was, however, only 0.2% in 2009. From 2008 to 2009, Value Added generated by ICT Manufacturing decreased by € 16 billion (30%). The largest decrease was in *Manufacturing of electronic components and boards* (41%).

Box 1: List of NACE Rev. 2 ICT Sub-sectors:

NACE rev.2	Description
ICT Manufacturing sub-sectors	
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
ICT Services sub-sectors	
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
5820	Software publishing
61	Telecommunications
62	Computer programming, consultancy and related activities
631	Data processing, hosting and related activities; web portals
951	Repair of computers and communication equipment

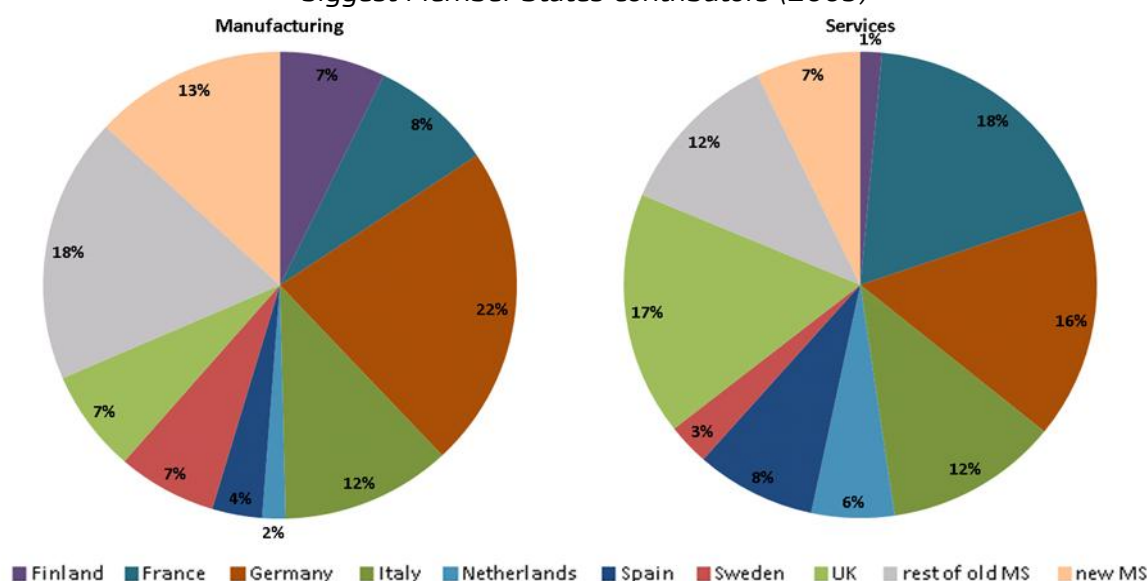
Figure 2—1: Share of ICT VA in GDP by sub-sector (2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2—2 provides a comparison of ICT Manufacturing and Services sub-sectors in terms of contributions by Member States to ICT VA in 2009. On the one hand, Germany dominated ICT Manufacturing (contributing 22% of EU ICT Manufacturing VA), followed by Italy (contributing 12%) and several other countries (Finland, France, Sweden and the UK which contributed similar shares of 7-8%). On the other hand, the ICT Services sub-sector was dominated by a group of four countries (France, Germany, Italy and the UK) that represented almost two thirds of the total EU ICT Services VA. The biggest differences in Member States' contributions can be seen in Finland (7% in Manufacturing vs. 1% in Services), France (8% vs. 18%), Netherlands (2% vs. 6%) and the UK (7% vs. 17%). The twelve new Member States contributed more to ICT VA in ICT Manufacturing (13%) than in ICT Services (7%).

Figure 2—2: Comparison of ICT Manufacturing and Services: distribution of ICT VA among biggest Member States contributors (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.2 ICT Sector Employment and Labour Productivity

2.2.1 ICT Sector Employment

In 2009, over 6.1 million people worked in the EU ICT sector, representing 2.7% of employment in the EU. ICT employment is highly concentrated in ICT services: 5.1 million people worked in ICT Services (85%) whereas 0.9 million worked in ICT Manufacturing (15%). ICT sector employment overall decreased by 3% - in real terms, 183 000 people - from 2008 to 2009. This was made up of 119 000 people in Manufacturing (11%) and 64 000 in Services (only 1.2%, in spite of the economic crisis). The decrease of employment in ICT Manufacturing was therefore higher in both relative and absolute terms than in ICT Services.

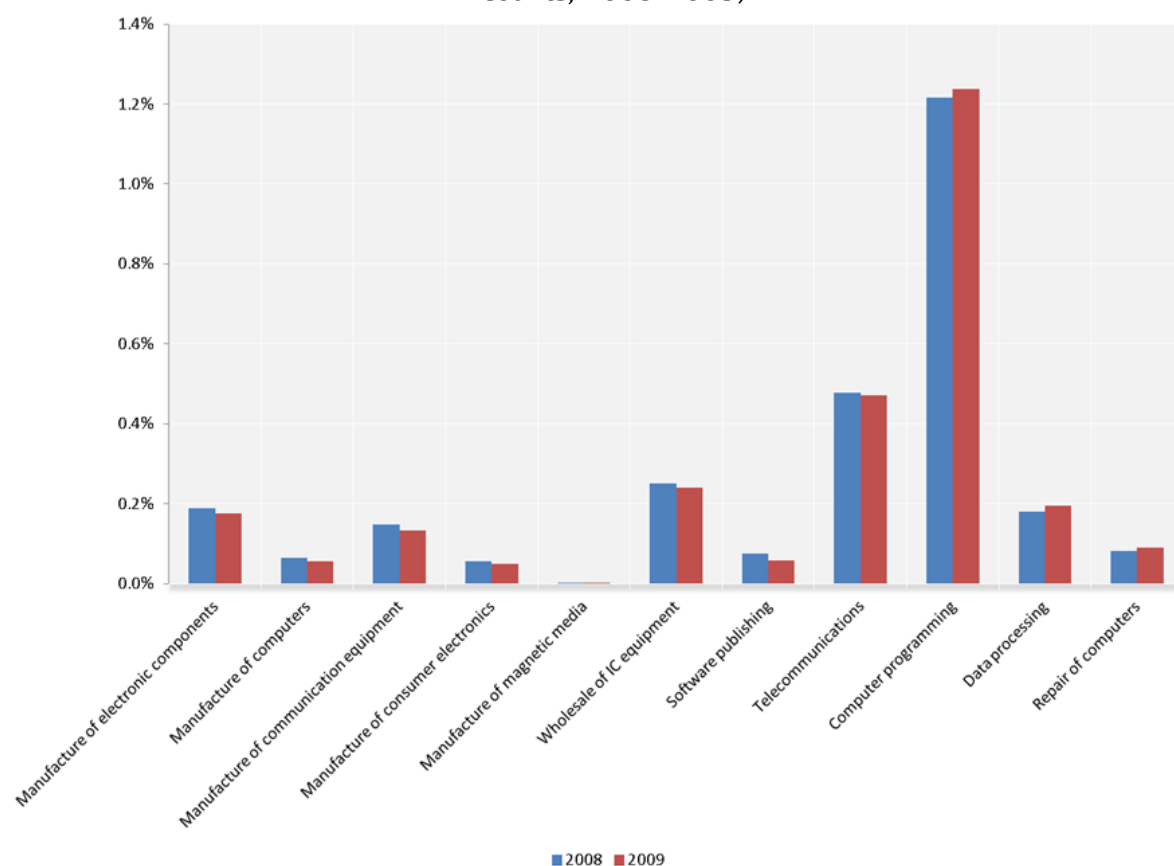
Figure 2—3 plots the share of ICT employment in total employment by ICT sub-sectors. As is the case for Value Added, ICT employment in the EU is highly concentrated in just two Service sectors, *Computer programming, consultancy and related activities* (NACE 62), with 2.8 million people (1.2% of total employment), and *Telecommunications* (NACE 61) with 1.1 million people (0.5% of total employment). In 2009, these two sub-sectors represented 63% of total ICT employment. In the same year, ICT Trade services employed 0.5 million people (0.2% of total employment).

In ICT Manufacturing, most employment is provided by two subsectors: *Manufacturing of electronic components and boards* (NACE 261) employs 0.4 million people (0.2% of total employment) and *Manufacturing of communication equipment* (NACE 263) employs 0.3 million people (0.1% of total employment).

From 2008 to 2009, ICT Services employment remained constant in *Computer programming, consultancy and related activities* (NACE 62) and decreased by 2.7% in *Telecommunications* (NACE 61). Employment increased by 7% in *Data processing, hosting and related activities; web portals* (NACE 631), to 0.44 million people in 2009. In ICT Manufacturing, employment decreased by 12% in *Manufacturing of communication*

equipment (NACE 263) and by 8% in *Manufacturing of electronic components and boards* (NACE 261).

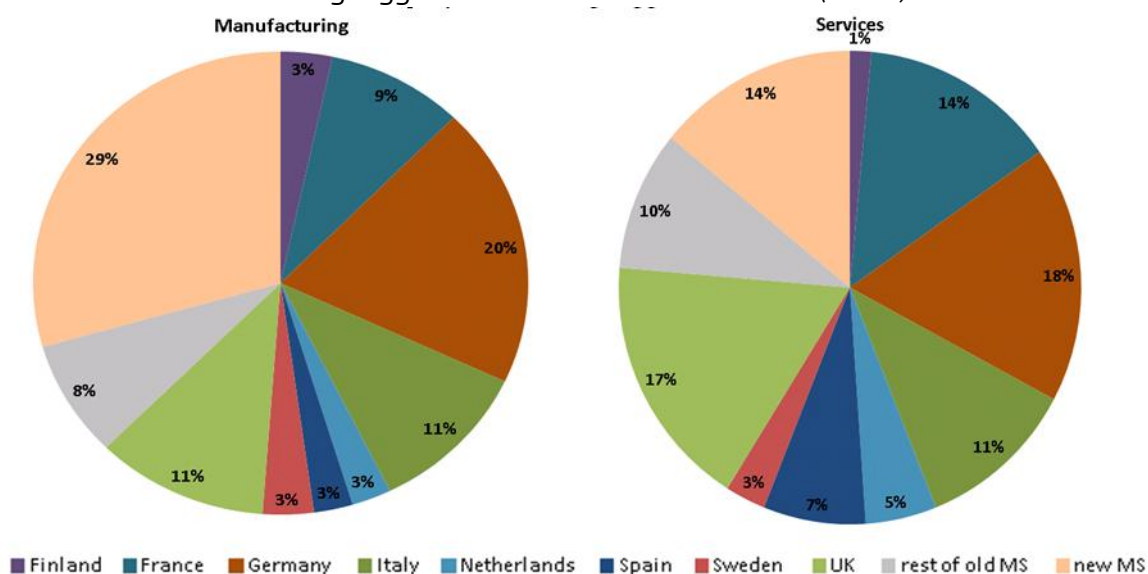
Figure 2—3: *Share of ICT employment in total employment by sub-sectors (based on head counts, 2008-2009)*



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2—4 provides a comparison of employment in the ICT Manufacturing and Services sub-sectors by Member States (MS) in 2009. The most striking observation is the contribution of the new Member States. These 12 countries employed in total almost 30% of all employees from the EU ICT Manufacturing sub-sector, significantly above the 20% employed by Germany. In Services, however, their contribution was only half that value (14%). In terms of single-country contributions, Germany dominated both ICT Manufacturing and Services (providing 18-20% of EU ICT employment). France, Italy and the UK together contributed 31% and 42% to total EU ICT Manufacturing and Services employment, respectively. Compared to other analyzed indicators, the differences between individual country shares (Manufacturing vs. Services) remained quite stable.

Figure 2—4: Comparison of ICT Manufacturing and Services: distribution of ICT employment among biggest Member State contributors (2009)

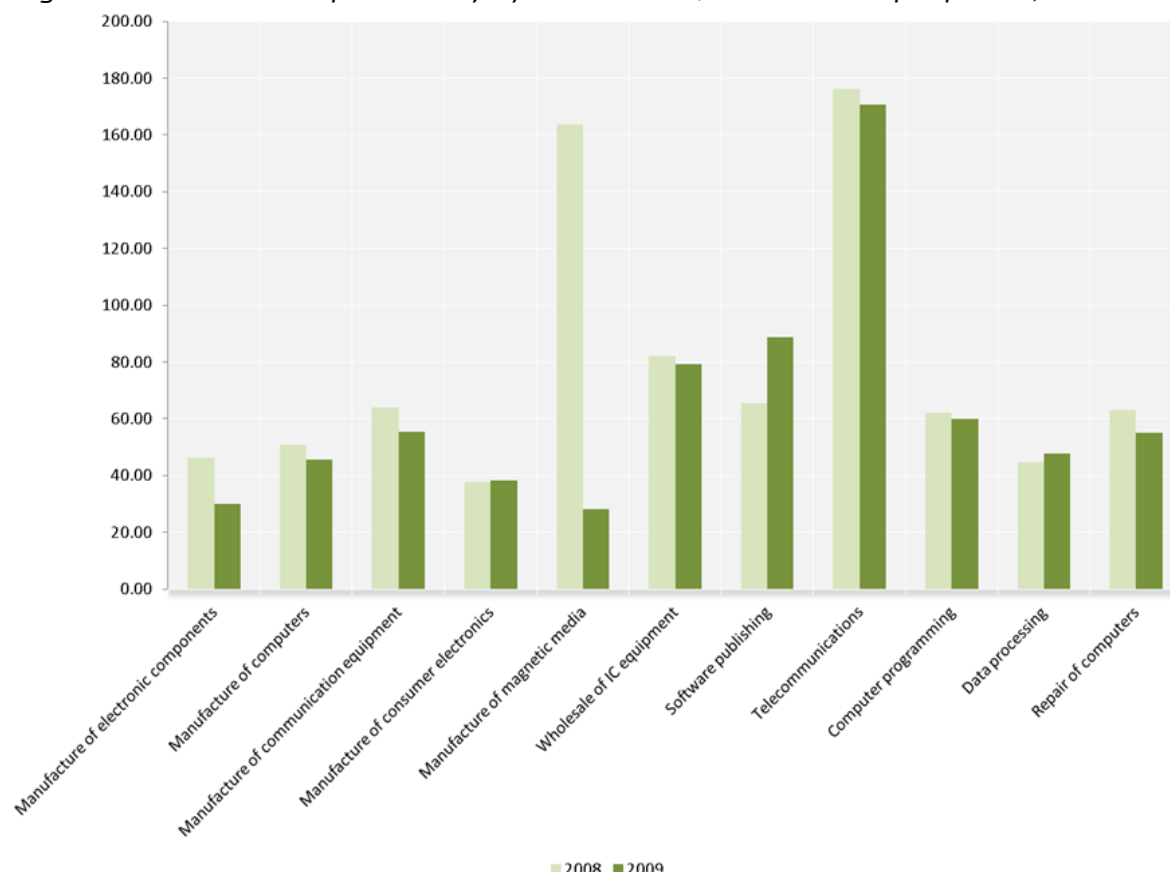


Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.2.2 ICT Sector Labour Productivity

In 2009, labour productivity per person in ICT Manufacturing in the EU was € 41 170 while in ICT services it was € 84 170. The highest labour productivity was achieved in *Telecommunications (NACE 61)*, where it was more than € 170 000 (see Figure 2—5). Between 2008 and 2009, ICT labour productivity in the EU contracted by 4%. This decrease was more intense in ICT Manufacturing (on average 21%) than in Services (3%). The biggest drop was recorded in *Manufacture of magnetic and optical media (NACE 268)*, almost 83%, while the biggest increase was in *Software publishing (NACE 5820)*, more than 35%.

Figure 2—5: ICT Labour productivity by sub-sectors (thousand EUR per person, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.3 ICT Sector Business Expenditures (ICT BERD)

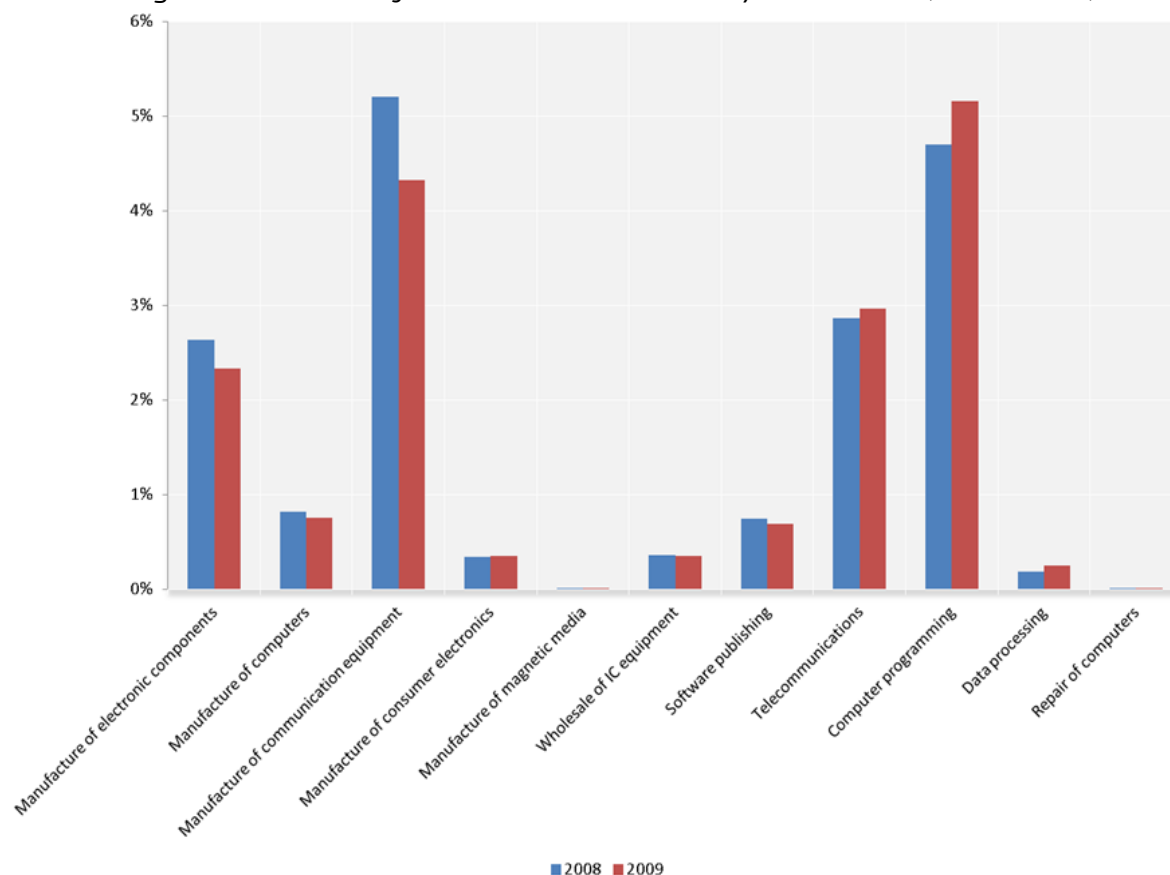
Analysing ICT Sector Business Expenditures in R&D (ICT BERD) across ICT sub-sectors provides a quite different perspective to the one resulting from a comparison of Value Added or employment across the sub-sectors, or from a look at recent evolution (see Figure 2—6).

In 2009, ICT BERD amounted to € 25 billion, 7.4% less than it was in 2008 (€ 27 billion). This amount was almost equally divided between Manufacturing (€ 11.3 billion) and Services (€ 13.7 billion).

In 2009, more than half ICT Manufacturing BERD (56%) was invested in *Manufacturing of communication equipment (NACE 263)* (€ 6.3 billion, or 4.3% of total BERD in the EU economy), and 30% in *Manufacturing of electronic components and boards (NACE 261)* (€ 3.4 billion). More than half ICT Services BERD (55%) was invested in *Computer programming, consultancy and related activities (NACE 62)* (€ 7.5 billion), and 31% in *Telecommunications (NACE 61)* (€ 4.3 billion).

From 2008 to 2009, ICT BERD invested in ICT Manufacturing decreased by 17% (€ 2.3 billion). *Manufacturing of communication equipment* experienced the biggest drop (almost 20%). In ICT Services, however, it increased by 2.2% (€ 0.3 billion), mostly in *Computer programming, consultancy and related activities* (by € 0.4 billion) and *Data processing, hosting and related activities; web portals (NACE 631)*, by 28%.

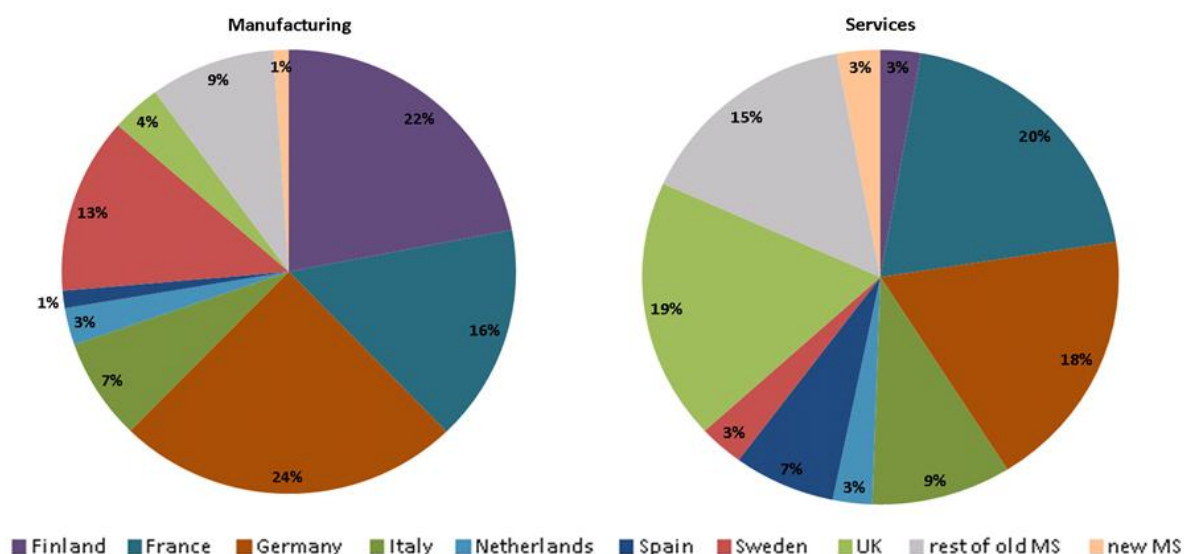
Figure 2—6: Share of ICT BERD in total BERD by sub-sectors (2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2—7 provides a comparison of the ICT Manufacturing and Services sub-sectors in terms of contributions to ICT BERD by Member States in 2009. ICT Manufacturing was dominated by Germany (24% of EU ICT Manufacturing BERD) and Finland (22%). France and Sweden then followed with 16% and 13%, respectively. These four countries represented 75% of the total EU ICT Manufacturing BERD. However, when looking at ICT Services BERD, Finland and Sweden contributed only 3% each, in sharp contrast to their contribution to ICT Manufacturing BERD, which was 35% in total. In contrast, Germany and France had leading positions in Services also (18% and 20%). The UK and Spain are among the Member States with larger ICT BERD contributions in Services than in Manufacturing – Spain (1% in Manufacturing vs. 7% in Services) and the UK (4% vs. 19%).

Figure 2—7: Comparison of ICT Manufacturing and Services: distribution of ICT BERD among biggest Member States contributors (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

The ICT sector is one of the most R&D-intensive sectors in the EU economy. In 2009, ICT BERD made up 17% of total BERD, while ICT VA represented only 4% of GDP. In the same year, ICT R&D intensity, measured by the ratio of ICT BERD over ICT VA, was 5.3%, very close to its 2008 value of 5.4%.

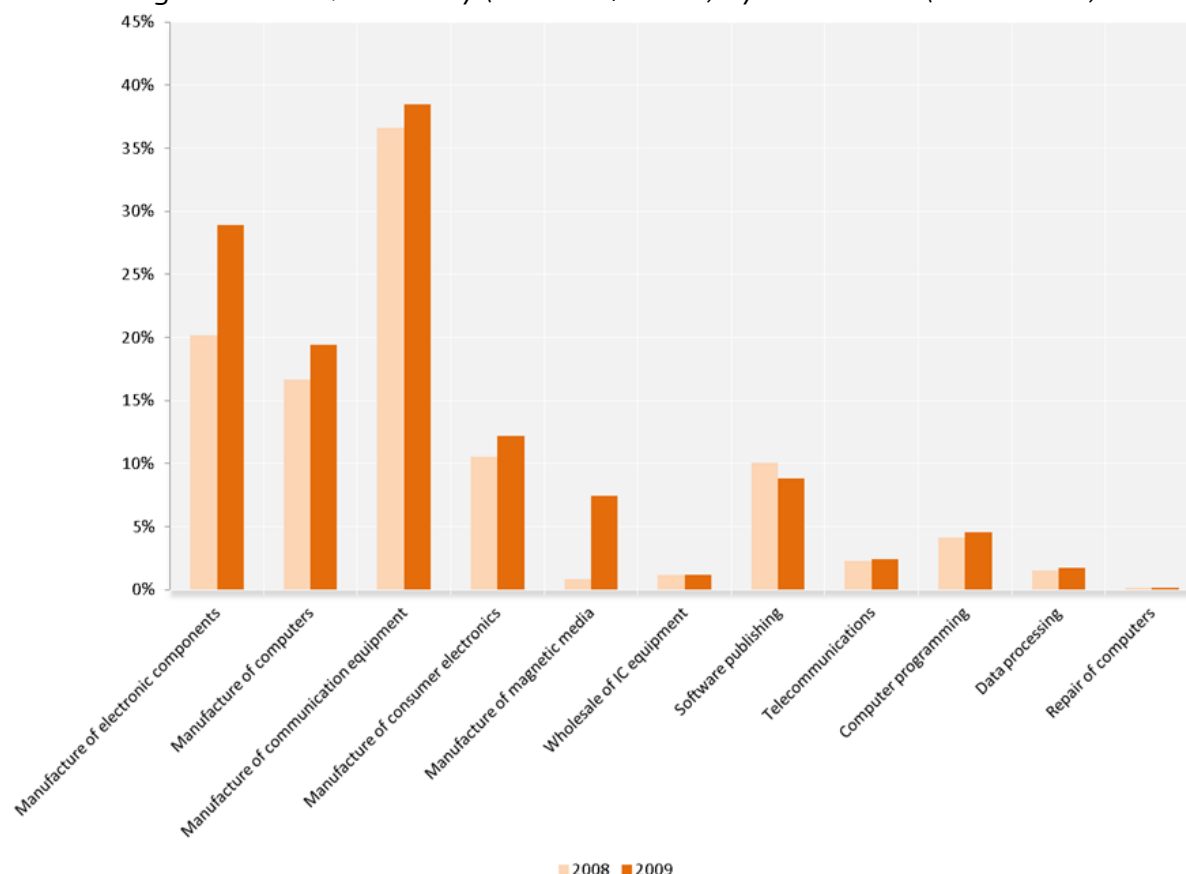
In 2009, though ICT Manufacturing sub-sectors produced only 8% of ICT Value Added, they accounted for 45% of ICT BERD. ICT Manufacturing sub-sectors are thus much more R&D intensive than ICT Services sub-sectors. In fact, ICT BERD intensity is almost ten times higher in ICT Manufacturing (29.6%) than it is in ICT Services (3.2%).

Figure 2—8 provides a comparison of R&D intensity among ICT sub-sectors. R&D intensity (measured by the ratio of ICT BERD over ICT VA) was extremely high, especially in two Manufacturing sub-sectors: 38% in *Manufacturing of communication equipment* (NACE 263) and 29% in *Manufacturing of electronic components and boards* (NACE 261). From 2008 to 2009, ICT Manufacturing BERD decreased by 17%, and ICT Manufacturing VA decreased even more, by 30%. This difference resulted in an increase in R&D intensity.

In ICT services in 2009, more than half ICT Services BERD (55%) was invested in *Computer programming, consultancy and related activities* (NACE 62) (€ 7.5 billion), and 31% in *Telecommunications* (NACE 61) (€ 4.3 billion). In these two sub-sectors, R&D intensity was significantly lower than it was in most ICT manufacturing sub-sectors: 4.5% in *Computer programming, consultancy and related activities* (NACE 62) and 2.4% in *Telecommunications* (NACE 61).

From 2008 to 2009, unlike the evolution in ICT Manufacturing BERD, ICT Services BERD increased by 2.2% (while VA decreased by 4.3%), also resulting in an increase in R&D intensity. ICT BERD increased mostly in *Computer programming, consultancy and related activities* (by 5.6%) and remained stable in *Telecommunications*.

Figure 2—8: R&D intensity (ICT BERD/ICT VA) by sub-sectors (2008-2009)



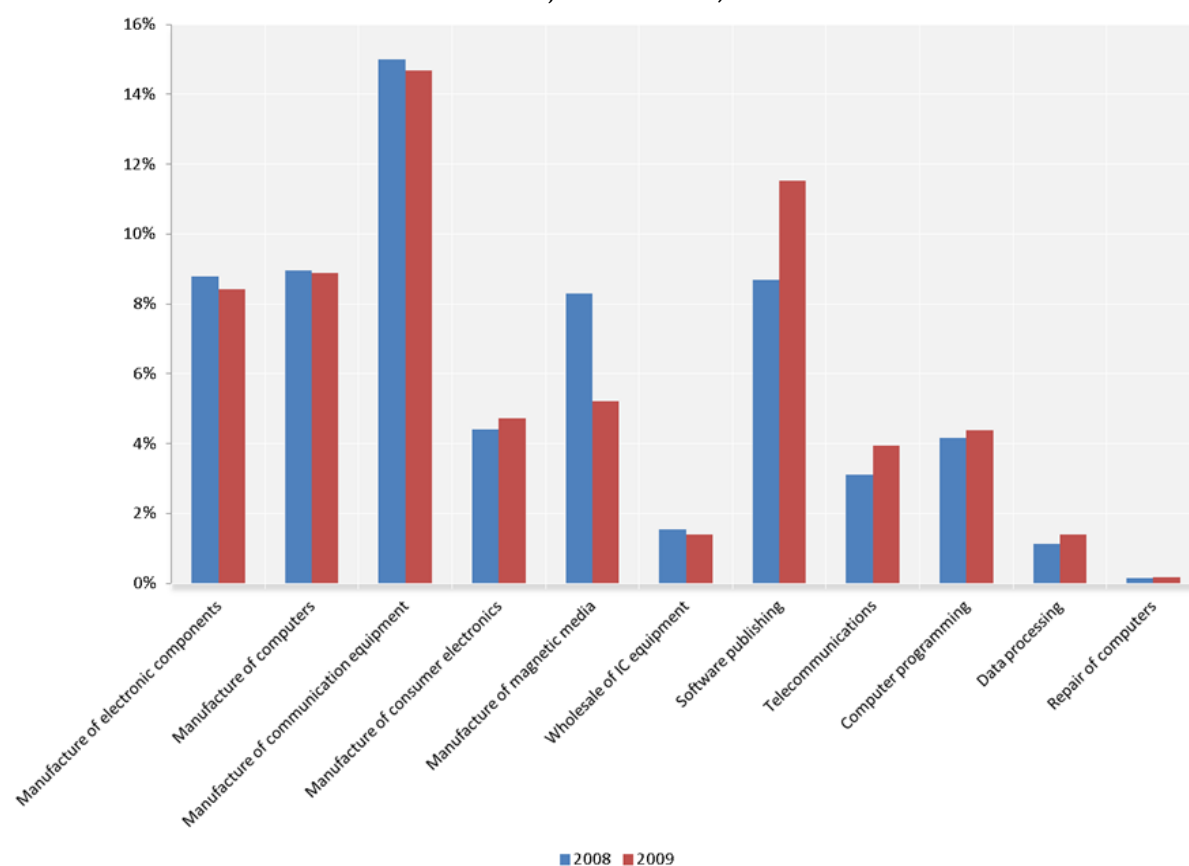
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.4 ICT Sector R&D Personnel

ICT R&D personnel (including both researchers and R&D supporting staff) made up 4.7% of total ICT Employment in the EU. In 2009, 10% of employees in the EU ICT Manufacturing sub-sectors were R&D personnel, whereas it was only 3.7% in ICT Services. According to Figure 2—9, the ICT sub-sectors with the highest share of R&D personnel were *Manufacture of communication equipment (NACE 263)* and *Software publishing* (14.7% and 11.5%, respectively). In contrast, the ICT sub-sectors with the lowest shares of R&D personnel were *ICT Trade industries*, *Data processing, hosting and related activities; web portals (NACE 631)* and *Repair of computers and communication equipment (NACE 951)* – each employing less than 2%.

There were more than 280 000 R&D employees working in the EU ICT sector in 2009, only 0.02% less than in 2008. This apparent stability is, however, the result of a 13% decrease in ICT Manufacturing R&D employment (from 107 000 in 2008 to 93 000 in 2009) being partly offset by an 8% increase in ICT Services employment (from 177 000 in 2008 to 192 000 in 2009). The drop in ICT Manufacturing personnel occurred mainly in *Manufacture of magnetic and optical media (NACE 268)* sub-sector, while the largest increase in ICT Services personnel occurred in *Software publishing (NACE 5820)*. Similar trends are observed in the numbers of ICT researchers.

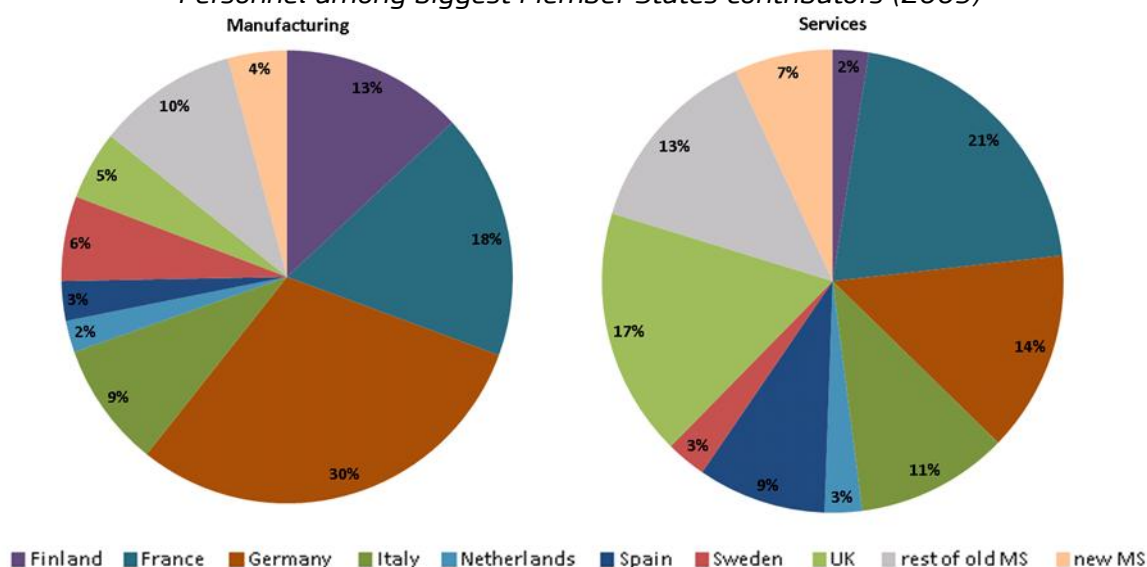
Figure 2—9: Share of ICT R&D personnel in total ICT employment by sub-sectors (based on FTE, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 2—10 provides a comparison between the share of ICT R&D personnel employed in the ICT Manufacturing sub-sector and the ICT Services sub-sector by Member States in 2009. On the one hand, similarly to previous indicators, Germany has the highest share: 30% of EU ICT Manufacturing R&D personnel work in Germany, followed by 18% in France and 13% in Finland. These three countries alone account for more than 60% of the total EU ICT Manufacturing R&D personnel. On the other hand, in ICT Services, only 14% of ICT R&D personnel are employed in Germany and 2% in Finland. France has the highest share (21%), closely followed by the UK (17%). A large difference in ICT R&D personnel employment figures can also be observed in Spain (3% in Manufacturing vs. 9% in Services).

Figure 2—10: Comparison of ICT Manufacturing and Services: distribution of ICT R&D Personnel among biggest Member States contributors (2009)



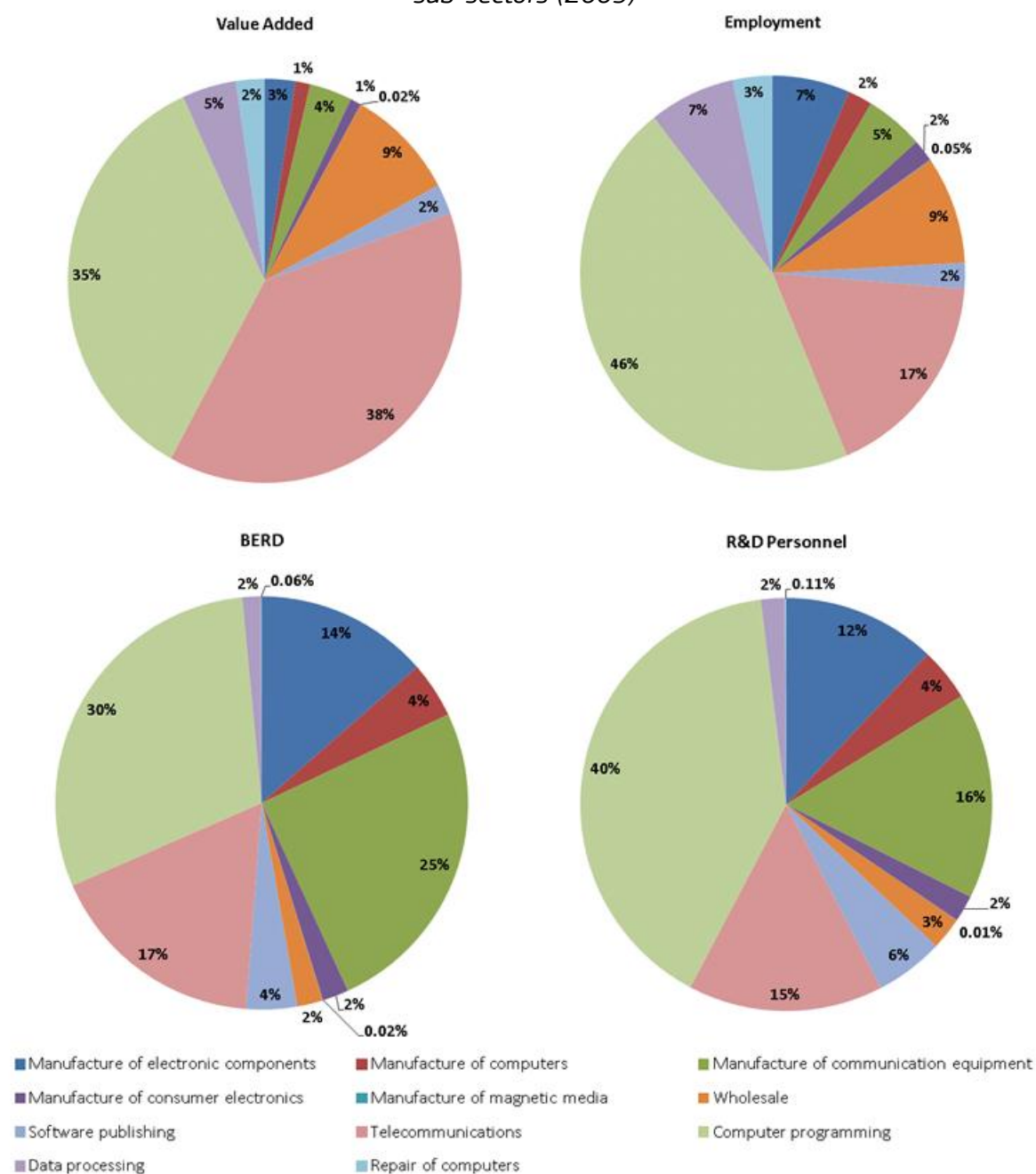
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

2.5 Comparison of Indicators

Figure 2—11 provides a comparison by ICT sub-sectors of the four main indicators – Value Added, Employment, BERD and R&D personnel, for 2009. The main results of this comparison can be summarized as follows:

- The *Computer programming, consultancy and related activities (NACE 62)* sub-sector consistently scored highest in all four indicators, with shares between 30% to 46%.
- *Manufacturing of communication equipment (NACE 263)* was a highly R&D-intensive sub-sector. While it produced only 4% of the total ICT VA in 2009 and employed only 5% of the total ICT workers, it invested 25% of the total ICT BERD and employed 16% of ICT R&D personnel. Similar characteristics can be seen also in *Manufacture of electronic components and boards (NACE 261)*.
- A different situation is observed in the *Telecommunications (NACE 61)* sub-sector. On the one hand, this sub-sector produced 38% of the total EU ICT VA. On the other hand, it represented only half this share in terms of ICT sector employment (17%), ICT BERD (17%) and ICT R&D personnel (15%). ICT trade industries behaved similarly with 9% of the total ICT Value Added, and only 2% of the total ICT BERD.

Figure 2—11: Comparison of Value Added, Employment, BERD and R&D personnel by ICT sub-sectors (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3. Analysis by Member State

3.1 Size of the EU ICT Sector (Value Added)

ICT sector Value Added (VA) in the EU amounted to € 470 billion in 2009. This represented a share of 4.0% of EU GDP, a share that has remained stable over the last few years.

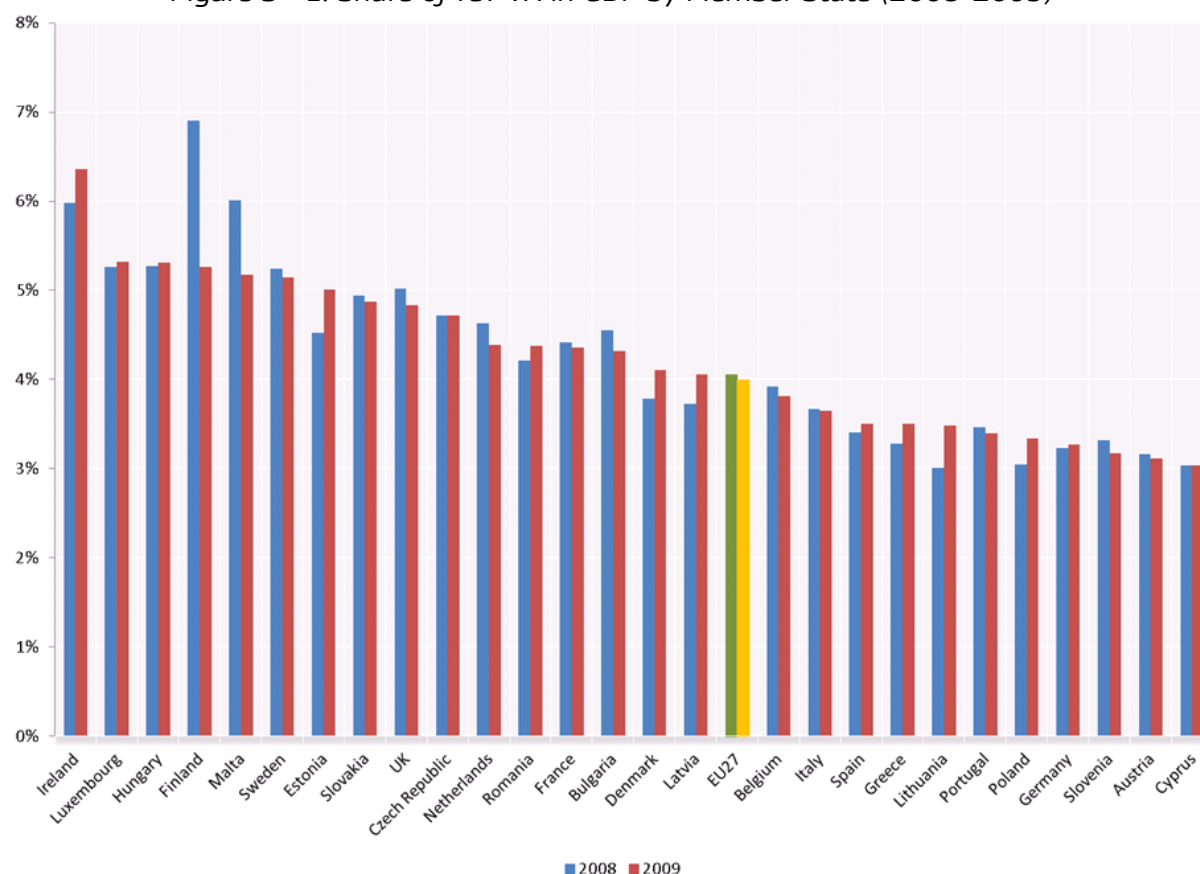
From the individual countries perspective in 2009, the share of ICT sectors ranged from 6.4% of total VA for Ireland down to a 3.0% for Cyprus (see Figure 3—1). Ireland took the leading position from Finland whose ICT sectors' share in VA dropped from 6.9% in 2008 to 5.3% in 2009. In 2009, Luxemburg came next with a share more than 1 percentage point lower (5.3%). Five other countries had shares above 5% (Hungary, Finland, Malta, Sweden and Estonia) and eleven countries had shares below the EU level (4%). It is noticeable that while eight of the twelve Member States that joined the EU most recently ("newer Member States") have ratios of ICT VA in GDP above the EU level, seven of the fifteen *older* Member States have ratios that are below the EU level.

In almost all countries the share of ICT sector VA in GDP remained fairly stable from 2008 to 2009. However, some exceptions should be highlighted. The most noticeable one was the sharp drop experienced by the ICT sectors in Finland (mentioned already above). In Malta, the ICT industries' VA also fell in this period by almost 1 percentage point.¹¹ On the other hand, Ireland, Estonia, Latvia, Denmark, Lithuania and Poland experienced moderate increases between 2008 and 2009. Here, however, it is necessary to stress that these drops and increases are relative to GDP. In some of these countries, it may be that the change in the ratio ICT VA/GDP was due to a change in GDP rather than in ICT VA. Nevertheless, almost all EU Member States (except Denmark and Greece) also experienced drops in the nominal values of ICT VA.¹²

¹¹ Due to measurement problems in this country, caution is recommended when interpreting its results.

¹² 2009 data for Greece were estimated due to lack of available official data. Figures for Greece should therefore be interpreted with caution.

Figure 3—1: Share of ICT VA in GDP by Member State (2008-2009)



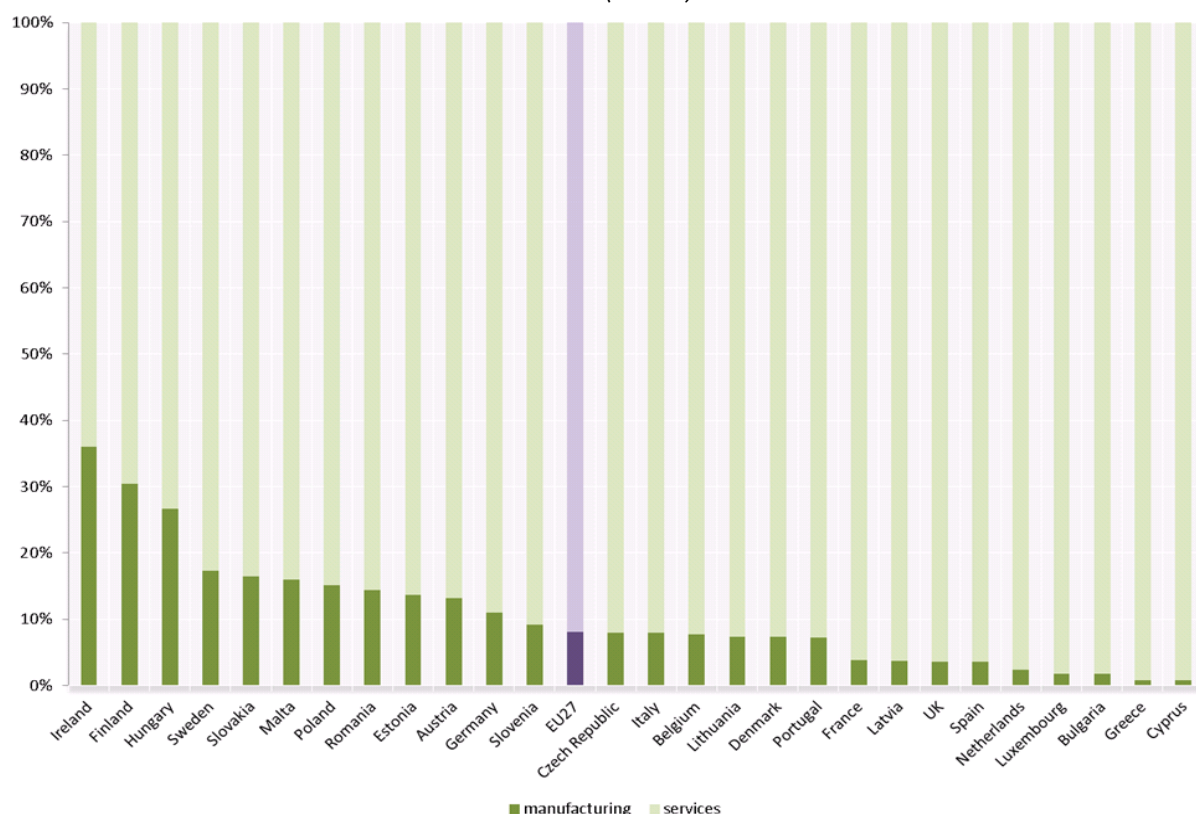
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

At the EU level, ICT Services contributed by far the largest share of ICT VA (91.9% in 2009), while ICT Manufacturing VA contributed only 8.1%.

Figure 3—2 shows the distribution VA shares for ICT Manufacturing and ICT Services by country in 2009. The three most *ICT manufacturing-oriented countries* in the EU are Ireland (its ICT Manufacturing industries produce 36.1% of total ICT VA), Finland (30.4%) and Hungary (26.6%). Other countries with ICT Manufacturing sectors that produce relatively high percentages of ICT VA were Sweden (17.3%), Slovakia (16.5%), Malta (16.0%) and Poland (15.1%).

Clearly, in terms of VA, the ICT sector of every EU Member State is dominated by ICT Services. In 2009, the ICT Services sectors of nine countries produced over 95% of total ICT sector VA: Cyprus (99.2%), Greece (99.2%), Bulgaria (98.3%), Luxembourg (98.2%), Netherlands (97.6%), Spain (96.4%), United Kingdom (96.4%), Latvia (96.2%) and France (96.1%).

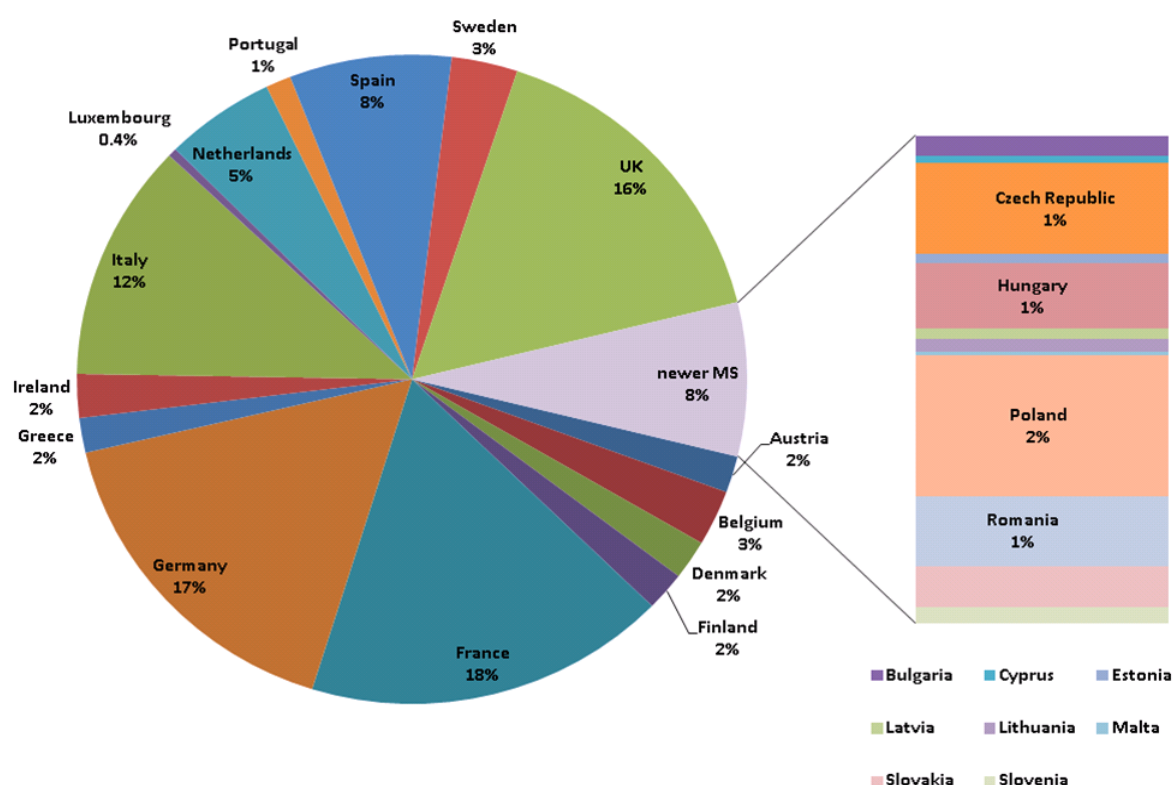
Figure 3—2: Distribution of VA shares for ICT Manufacturing and ICT Services by Member State (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3—3 provides a comparison of contributions by Member States to EU ICT VA in 2009. It comes as no surprise that the biggest EU economies contributed the most – France (17.5%), Germany (16.5%), United Kingdom (16.1%), Italy (11.8%) and Spain (7.8%). Together, these five countries produced 70% of the total EU ICT VA. The Netherlands followed with 5.3%. Although, overall, the twelve newer Member States contributed 12.5% to total EU GDP in 2009, their ICT sectors together contributed only 7.6% to EU ICT VA. In 2009, the six EU economies that are most specialised in ICT (Ireland, Luxembourg, Hungary, Finland, Malta, Sweden – see Figure 3—2) produced together only 8.8% of the EU ICT VA, i.e., about the share of Spain.

Figure 3—3: Distribution of ICT VA among Member States (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3.2 ICT Sector Employment and Labour Productivity

3.2.1 ICT Sector Employment

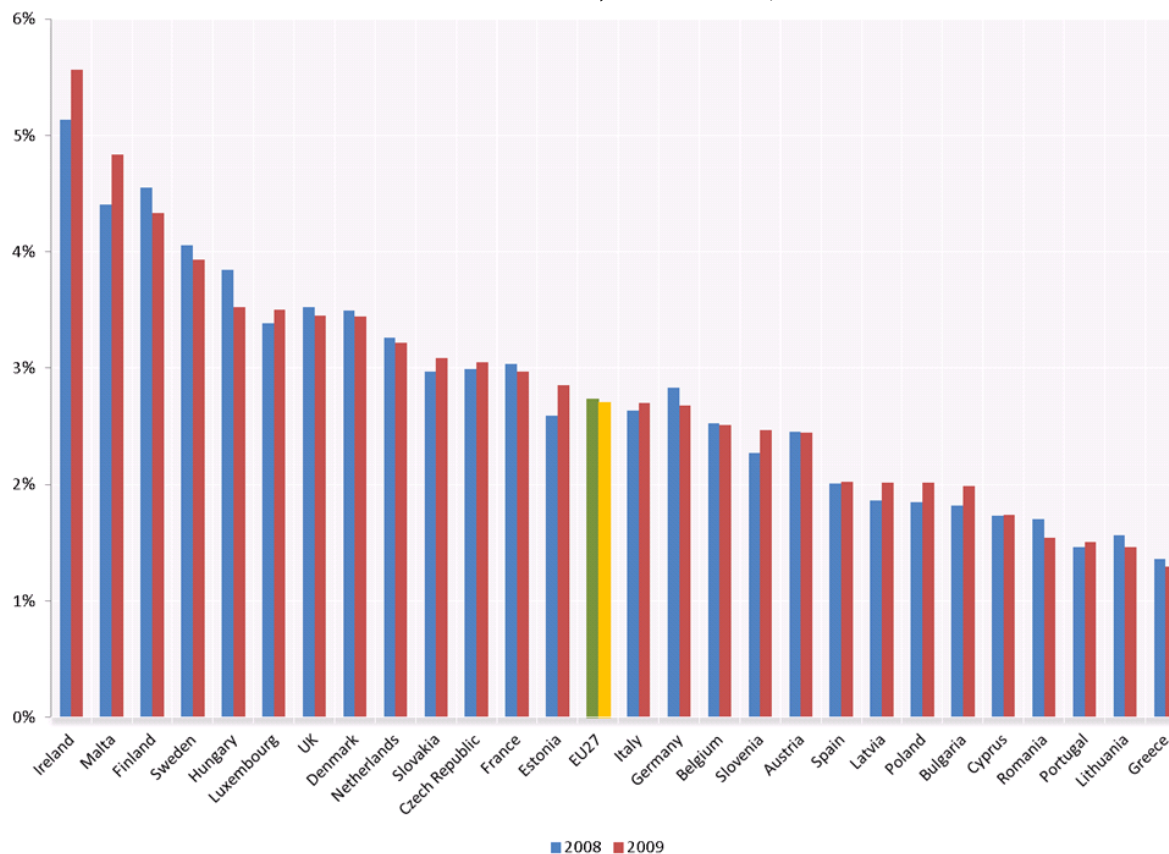
In 2009, over 6.1 million people worked in the EU ICT sector, representing 2.7% of employment in the EU. This percentage was almost identical in 2008.

Figure 3—4 compares the shares of ICT sector employment in total employment by Member State (based on head counts). As with ICT Value Added in GDP, the leading country in 2008 and 2009 was Ireland with more than 5% shares in both years (5.6% in 2009). Only two other countries, Malta and Finland, exceeded a 4% share (4.8% and 4.3%, respectively). At the other end of the scale, six countries – Bulgaria, Cyprus, Romania, Portugal, Lithuania and Greece– had shares below 2% in 2009.

Between 2008 and 2009, the EU ICT sector lost 183 000 workers (in head counts). Germany was the country that experienced the sharpest drop, almost 61 000 (33.3% of the total EU reduction), while the United Kingdom experienced a fall of 39 000 (21.3%), France 26 000 (14.2%) and Spain 24 000 (13.1%). Thus, these four countries were responsible for more than 80% of the EU ICT sector employment contraction. Interestingly, in spite of the economic crisis, ICT employment increased in some countries, most noticeably in Poland where almost 28 000 more workers were employed (according to head counts). Italy and Bulgaria also employed 4 000 additional workers. What is even more interesting is that although Ireland and Malta experienced the biggest rises in their ICT sector employment shares (both almost 0.5 percentage points), in terms of head counts

they were much less significant – only 679 new workers in Malta and even a decline in Ireland (496 workers fewer).

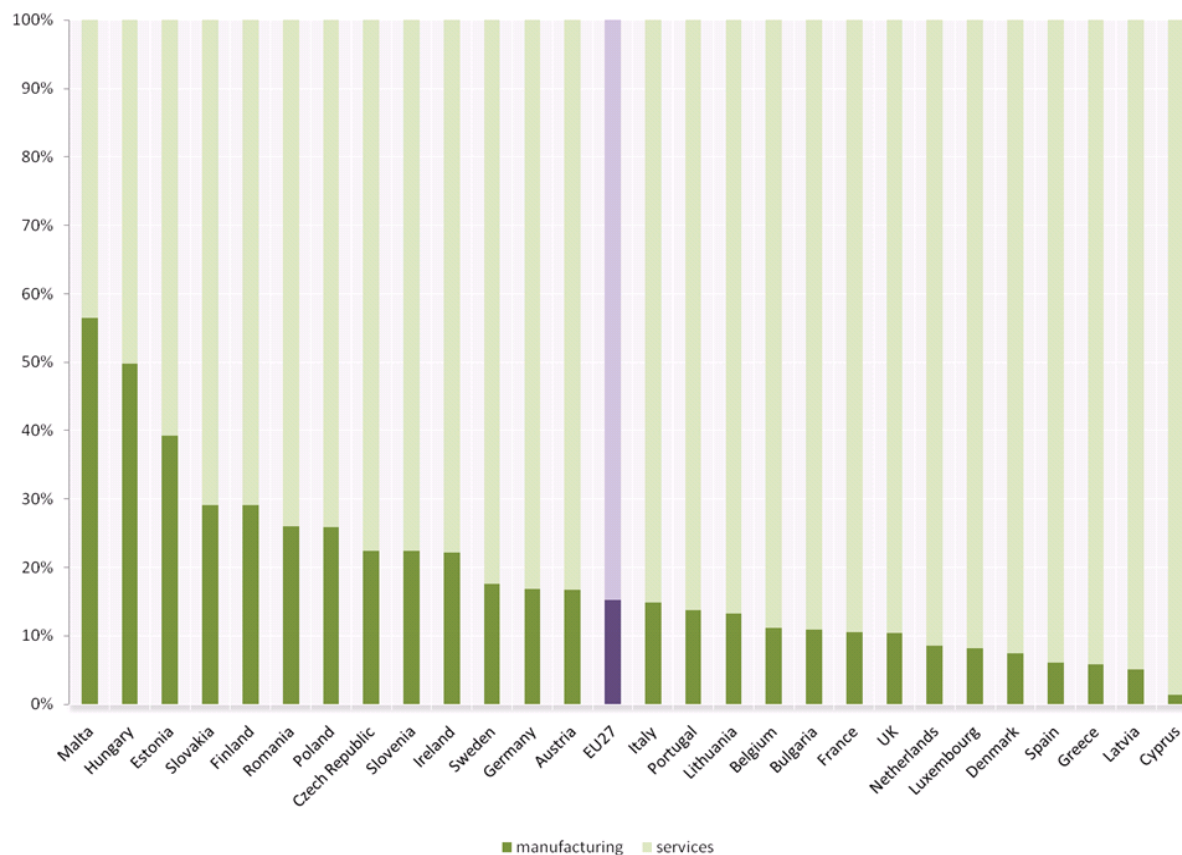
Figure 3—4: Share of ICT sector employment in total employment by Member State (% of head counts, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

At the EU level in 2009, ICT Manufacturing employed 15.3% of the ICT sector workforce. There is considerable variation between Member States in the distribution of labour between the two ICT sectors (Manufacturing and Services). A large number of newer EU Member States have become important ICT manufacturing countries, and have relatively high employment in ICT Manufacturing (see Figure 3—5). This was the case for Malta (56.5% of ICT sector employment in Manufacturing), Hungary (49.7%), Estonia (39.3%), Slovakia (29.1%), Romania (26.1%), Poland (25.9%), Czech Republic (22.5%) and Slovenia (22.5%). Other EU countries with a relatively high share of ICT manufacturing employment were Finland (29.0%), Ireland (22.2%) and Sweden (17.5%). On the other hand, countries with the biggest share of ICT Services employment in 2009 were Cyprus (98.6%), Latvia (95.0%), Greece (94.2%) and Spain (94.0%).

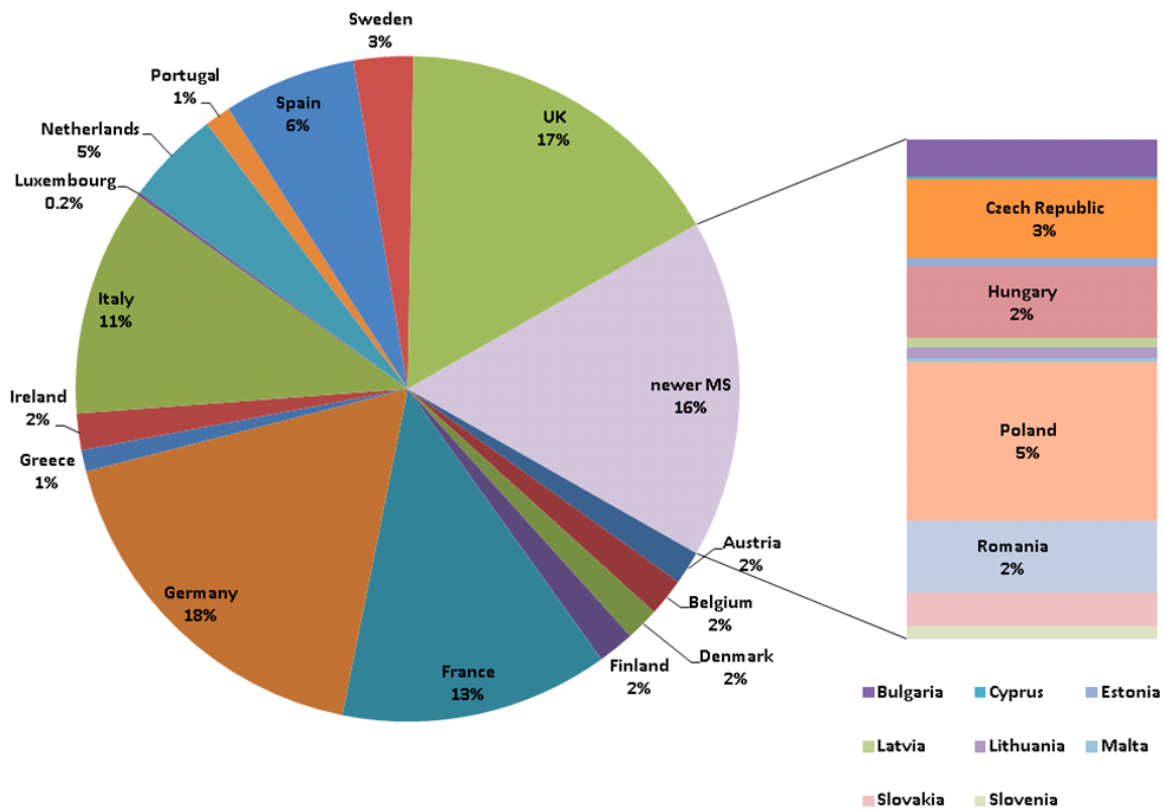
Figure 3—5: Distribution of employment shares between ICT Manufacturing and ICT Services by Member State (% of head counts, 2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3—6 compares Member State contributions to EU ICT sector employment in 2009. As can be expected, EU ICT sector employment was concentrated in the five largest EU economies. Germany came first with 17.9% of total ICT sector employment in 2009. UK was second with 16.5%, followed by France (13.1%), Italy (11.1%), and Spain (6.4).. Thus, almost two thirds of EU ICT sector employment is concentrated in these five countries. Other EU countries with relatively high shares of ICT employment compared with their economic size are Poland (5.3%) and the Netherlands (4.6%). Three newer Member States, the Czech Republic (2.6%), Hungary (2.3%) and Romania (2.3%) have rather high contributions, followed by Finland, with 1.8%.

Figure 3—6: Distribution of ICT employment among Member States (head counts, 2009)



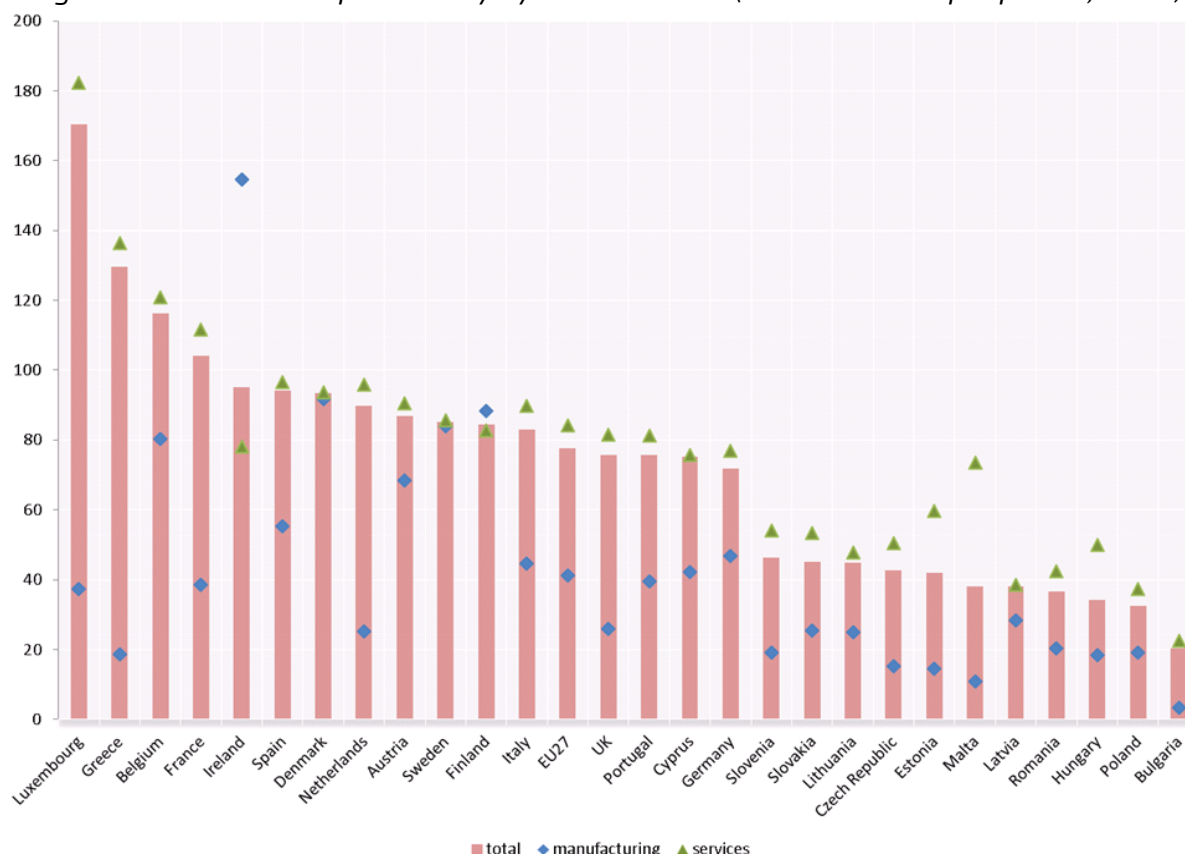
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3.2.2 ICT Sector Labour Productivity

As shown by Figure 3—7, the EU ICT labour productivity level in 2009 was almost € 78 000 per person. Luxembourg had the highest level (€ 170 000 per person). Surprisingly, Greece had the second highest EU labour productivity (€ 130 000 per person).¹³ The newer Member States – Bulgaria, Poland, Hungary, Romania and Latvia – had the lowest levels. All the newer Member States (except Cyprus) had the lowest levels of ICT labour productivity and there is a clear difference between the last older Member State (Germany) and the first newer Member State (Slovenia) – almost € 26 000 per person. But this difference is mostly caused by different price levels among newer and older Member States, and may not necessarily be due to lower labour productivity in terms of volumes. It is also interesting to note that ICT Services in almost all countries had higher labour productivity than the total, and thus than ICT Manufacturing. The only two exceptions were Finland and Ireland.

¹³ 2009 Labour Productivity data were estimated for both countries, Luxembourg and Greece, due to lack of available official data. They should therefore be interpreted with caution..

Figure 3—7: ICT labour productivity by Member State (thousands EUR per person, 2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

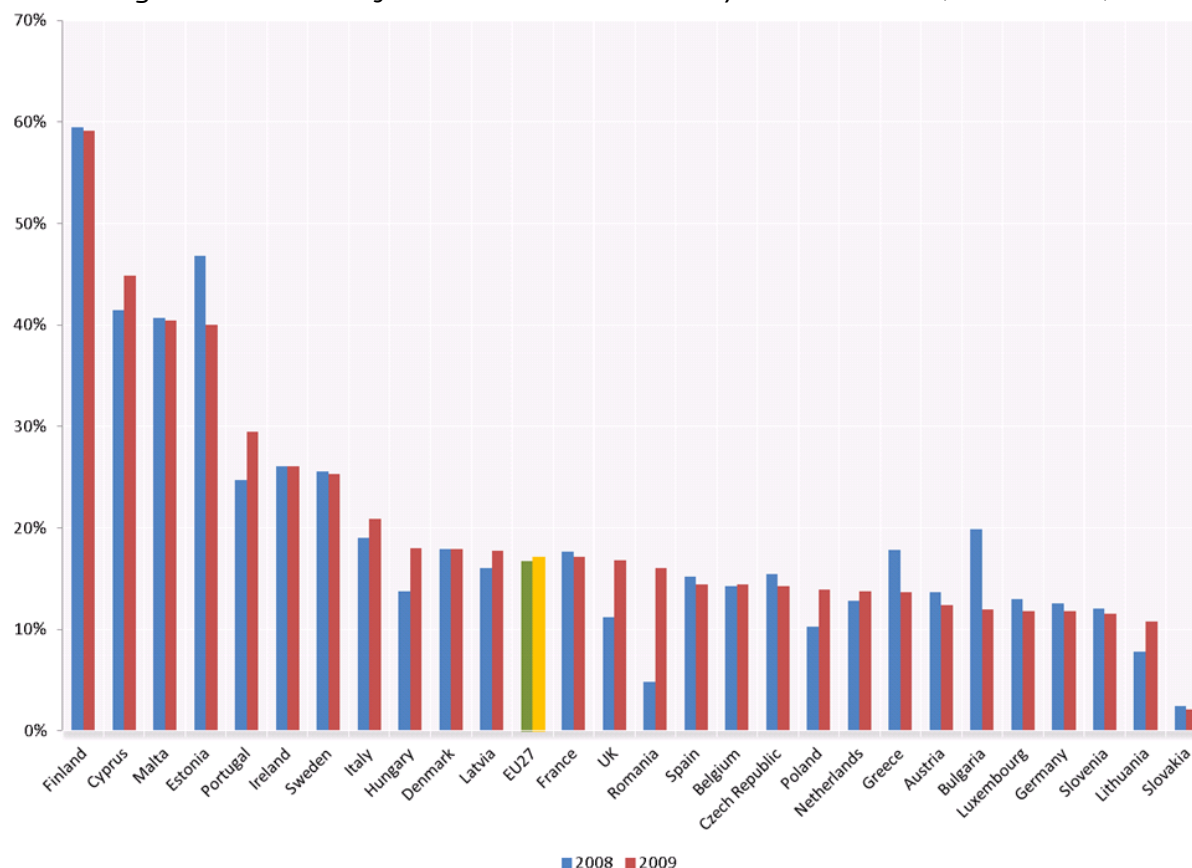
3.3 ICT Sector Business Expenditures (ICT BERD)

In 2009, EU ICT sector Business Expenditures on R&D (ICT BERD) amounted to € 25 billion, 7.4% less than it was in 2008 (€ 27 billion). This represented 17.2% of the total EU BERD in 2009.

Figure 3—8 presents shares of ICT BERD in total BERD by Member State. Finland spent almost 60% of total BERD in the ICT sector in 2009, i.e. almost 15 percentage points more than the second country, Cyprus (44.8%). Malta and Estonia followed with about 40% shares. Portugal, Ireland, Sweden and Italy, which spent between 20% and 30% of total BERD on ICT, were next. The country in 2009 with by far the lowest share of ICT BERD in total BERD was Slovakia, with 2.1%.

In 2009, twelve out of the twenty-seven countries had a higher share of ICT BERD in total BERD than in 2008. This group consisted of six countries belonging to the former EU15 (Ireland, Italy, Portugal, the United Kingdom, the Netherlands and Belgium) and six countries that entered the EU in recent years (Poland, Hungary, Cyprus, Latvia, Romania and Lithuania). The biggest jump took place in Romania, from 4.8% in 2008 to 16.0% in 2009. In the remaining countries, the weight of ICT BERD in total BERD dropped. The sharpest drop occurred in Bulgaria, from 19.8% in 2008 to 12.0% in 2009.

Figure 3—8: Share of ICT BERD in total BERD by Member State (2008-2009)



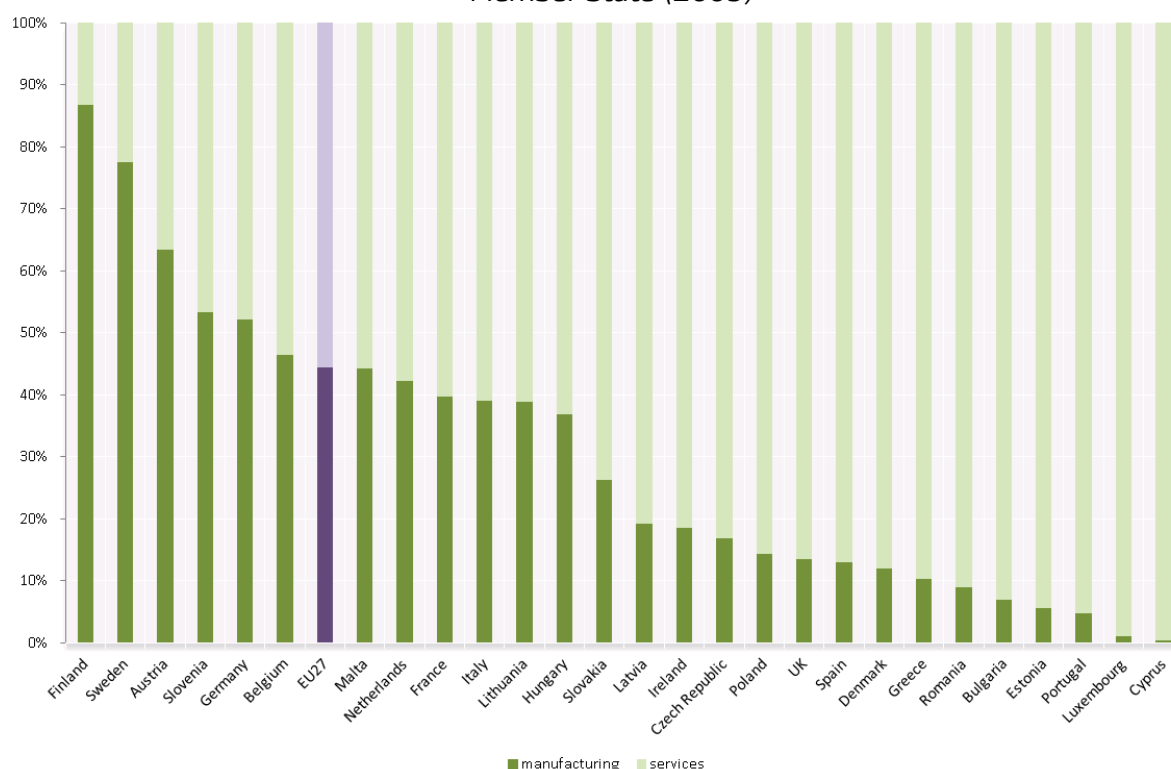
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

At EU level in 2009, ICT BERD (€ 25 billion) was almost equally divided between Manufacturing (€ 11.3 billion) and Services (€ 13.7 billion).

Figure 3—9 shows the distribution of ICT BERD between ICT Manufacturing and ICT Services by Member State in 2009. There were only six EU countries with more ICT BERD in Manufacturing than in Services. Finland led with a share of 87.0%, followed by Sweden (77.6%) and Austria (63.5%). The remaining three countries in this group were Slovenia (53.3%), Germany (52.2%) and Belgium (46.5%).

On the other hand, shares of ICT BERD in Services were especially important in Cyprus (99.6%), Luxembourg (98.9%), Portugal (95.4%), Estonia (94.3%), Bulgaria (92.1%) and Romania (91.0%).

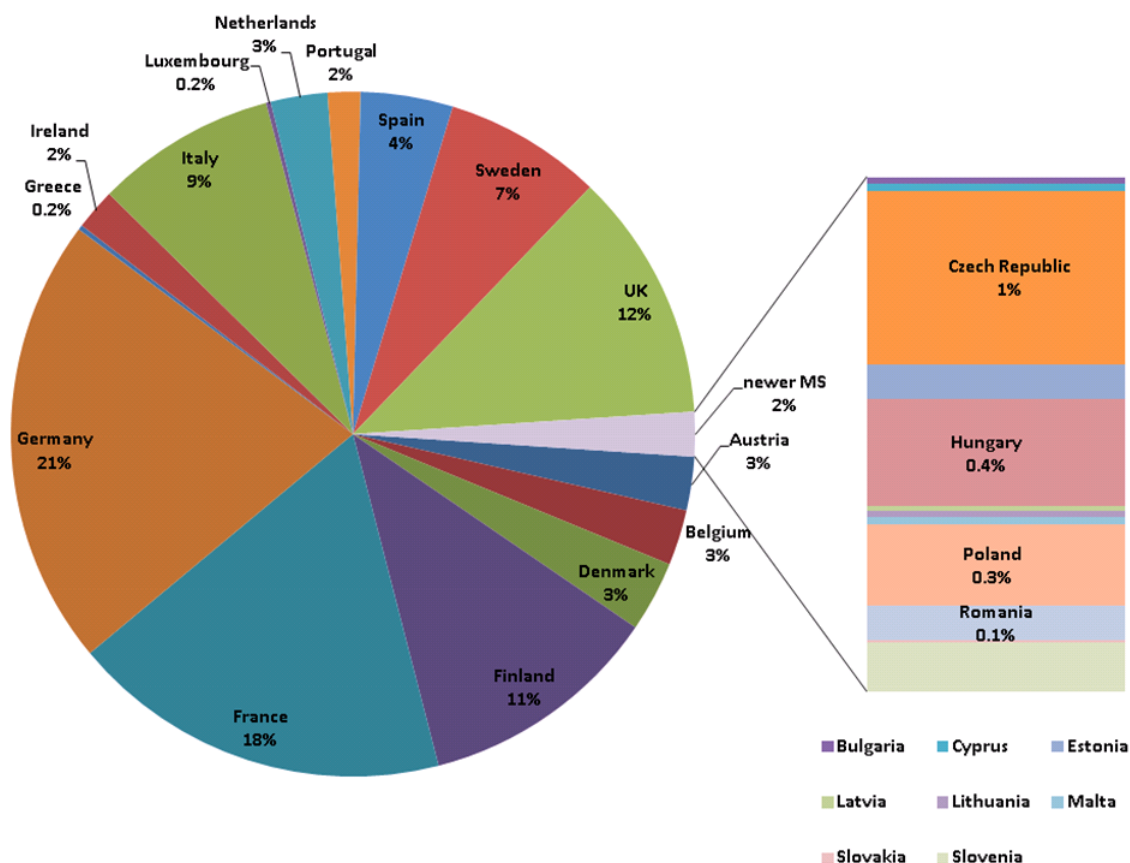
Figure 3—9: Distribution of ICT BERD between ICT Manufacturing and ICT Services by Member State (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

In 2009, the largest contributors to EU ICT BERD were Germany and France (21.2% and 18% respectively). These two countries alone were responsible for almost 40% of total EU ICT BERD. They were followed, albeit at a certain distance, by the United Kingdom (11.8%) and Finland (11.4%). Though Finland is a small economy in terms of GDP and even in terms of absolute ICT VA, it has the strongest ICT BERD intensity in the EU. These countries were followed by Italy (8.5%) and Sweden (7.5%), again a relatively small country with strong ICT BERD intensity. These six countries together spent almost 80% of total EU ICT BERD in 2009.

Figure 3—10: Distribution of ICT BERD among Member States (2009)

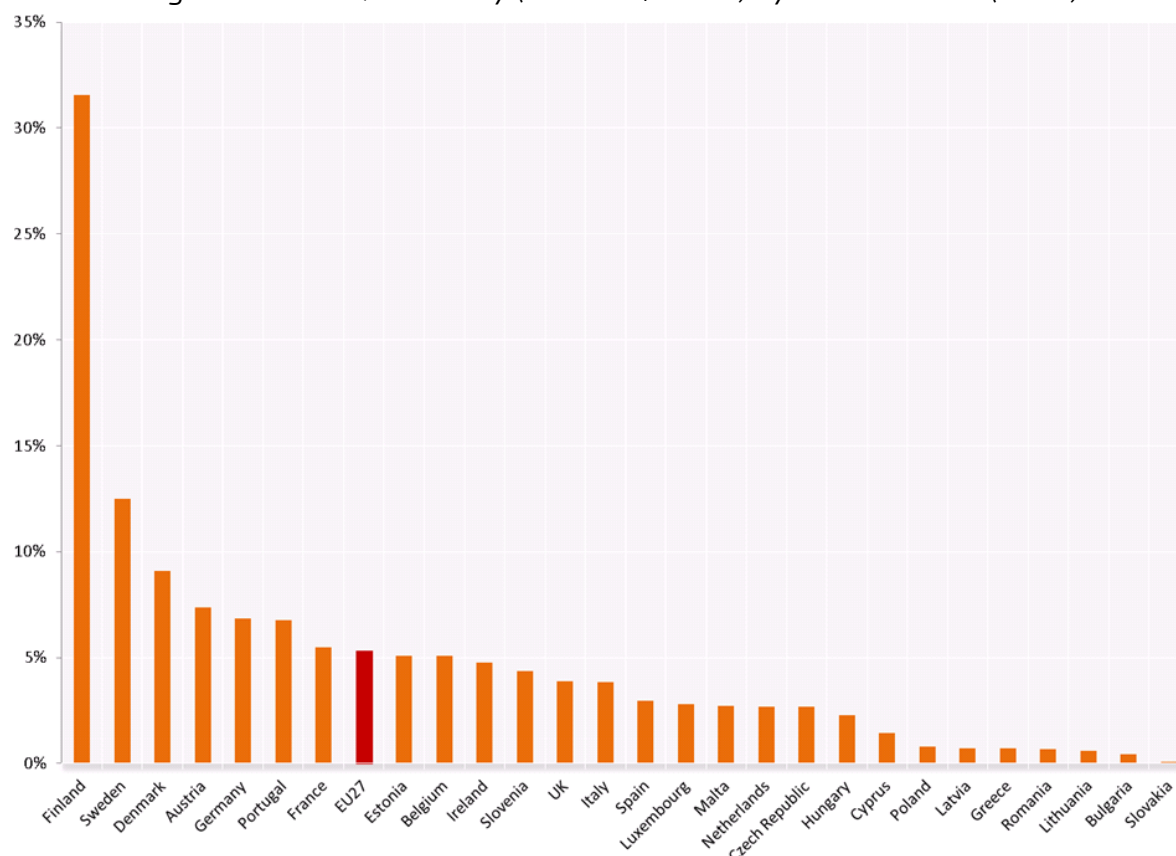


Source: Eurostat, elaborated by Ivie and JRC-IPTS.

In 2009, Finland was the country with by far the highest ICT BERD intensity (defined as the ratio of ICT BERD in ICT Value Added). ICT BERD intensity in this country amounted to 31.6%, while the EU level was 5.3% (see Figure 3—11). Sweden and Denmark also had relatively high ICT BERD intensities, but only around a third of the Finnish one. In the same year, ICT BERD intensity in Sweden amounted to 12.5% and in Denmark to 9.1%. Only four other countries had ICT BERD intensities above the EU level: Austria (7.4%), Germany (6.8%), Portugal (6.8%) and France (5.5%). Some of the newer Member States – Slovakia (0.1%), Bulgaria (0.4%), Lithuania (0.6%), Romania (0.7%), Latvia (0.7%) and Poland (0.8%), together with Greece (0.7%) – had the lowest levels.

ICT BERD intensity increased slightly in the EU as a whole between 2008 and 2009 (from 5.0% to 5.3%). As already mentioned, Finland was the country with the highest increase but other countries experienced increases as well. Among these, we should mention Portugal, France, Belgium, Ireland, Slovenia, the United Kingdom, Italy, Malta, Hungary, the Netherlands, Cyprus, Poland, Latvia, Lithuania and Romania.

Figure 3—11: R&D intensity (ICT BERD/ICT VA) by Member State (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3.4 Public Funding of ICT R&D

In 2009, estimated public ICT R&D funding in the EU amounted to € 5.3 billion – almost 6% of the total EU public funding of R&D. In this analysis, public funding of R&D is measured via GBAORD¹⁴ and public ICT R&D funding is obtained by **estimating**¹⁵ the share of total EU GBAORD that is allocated to ICT R&D.

Figure 3—12 shows public ICT R&D funding intensity (defined as Public Funding of ICT R&D /GDP) in EU Member States in 2008 and 2009. In both years, Sweden led (with 0.12% in 2009), followed by Finland (0.09%) and Denmark (0.08%). With the exception of four newer Member States (Romania, Slovakia, Latvia and Lithuania), all other EU Member

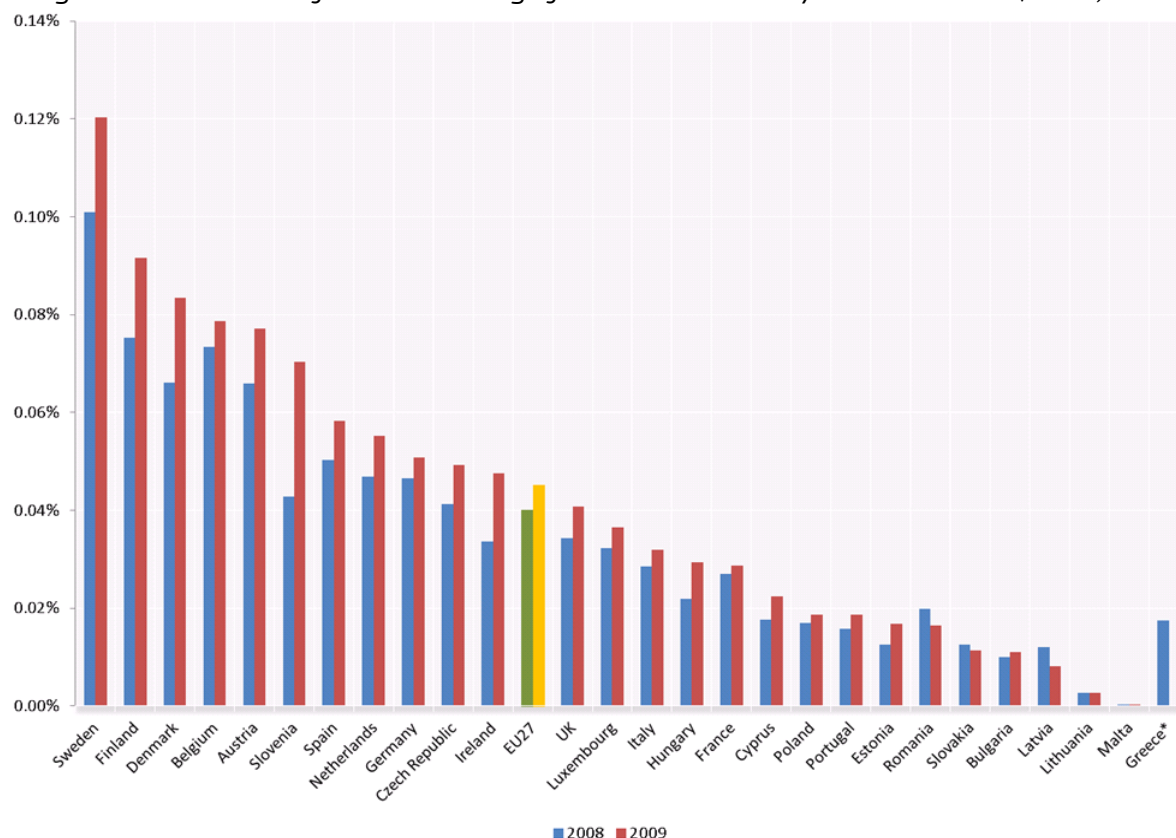
¹⁴ Government Budget Appropriations or Outlays for R&D by Socio-economic Objectives (GBAORD) is a budget-based data, which allows government support for R&D to be measured. Essentially, this involves identifying all the budget items with an R&D component and measuring or estimating their R&D content in terms of funding. These estimates are less accurate than performance-based data but as they are derived from the budget, they can be linked to policy through classification by “objectives” or “goals”. GBAORD series cover R&D in natural sciences, engineering, social sciences and humanities and in both current and capital expenditures. They include R&D performed on national territory as well as payments to foreign performers, including international organizations. GBAORD, however, covers only R&D financed by central government; local government and sometimes also provincial government are excluded.

¹⁵ Stančík, J. 2012. A Methodology to Estimate Public ICT R&D Expenditures in the EU Member States. *JRC Technical Note*, JRC 69978. Available at: <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5119>

States experienced increases in their shares of public funding of ICT R&D in GDP in the period 2008 to 2009.¹⁶

It is also interesting to note that, in 2008, Slovenia was below the EU level. In 2009, however, it surpassed the level of several older Member States (Spain, the Netherlands and Germany) and was ranked the sixth most intensive country in the EU. It is also the country with the biggest increase from 2008 to 2009 (almost 0.03 percentage points). Overall, eleven countries performed better than the EU level (0.05%) and this group also included two newer Member States (the Czech Republic and Slovenia).

Figure 3—12: Share of Public Funding of ICT R&D in GDP by Member State (2008, 2009)



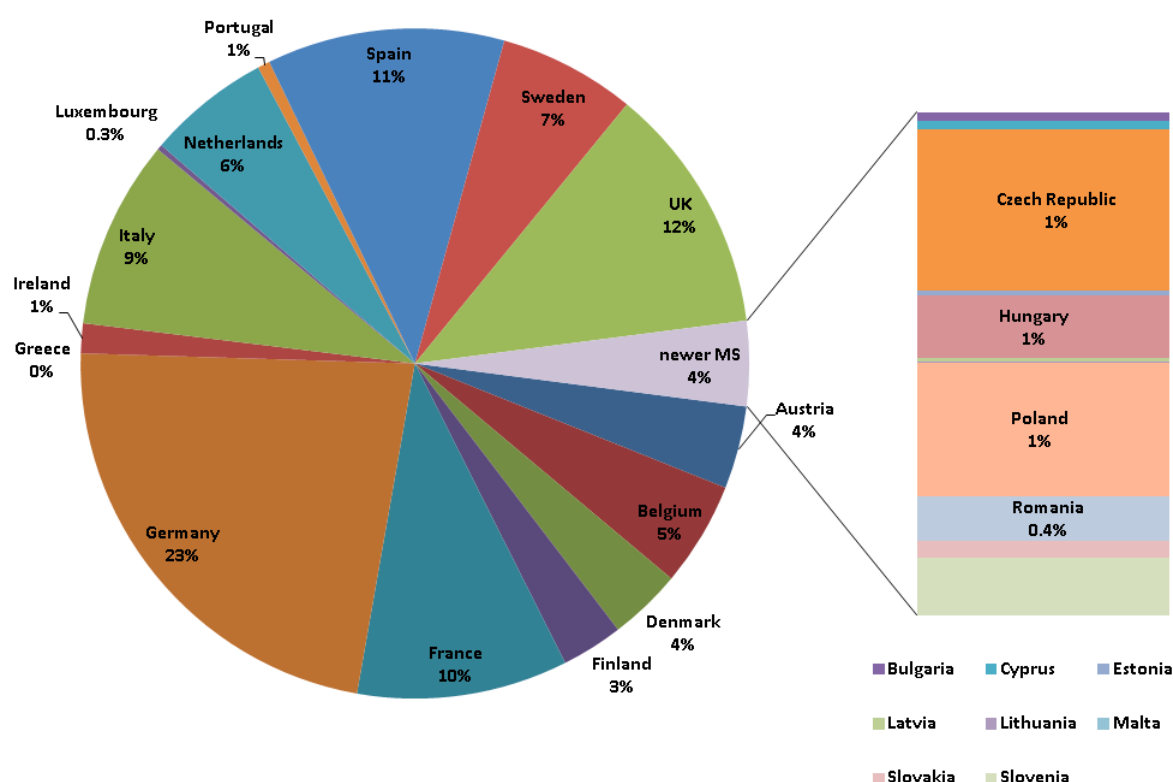
Source: JRC-IPTS estimations (based on Stančík 2012).

Note: Data for Greece in 2009 are not available.

In 2009, the EU's five largest economies – and Sweden – provided the largest contributions to total public funding of ICT R&D in the EU: Germany (22.7%), the UK (12%), Spain (11.5%), France (10.2%), Italy (9.1%) and Sweden (6.6%). These six countries together accounted for more than 70% of total public funding of ICT R&D in the EU. Next came the Netherlands (5.9%), Belgium (5%) and Austria (4%). The newer Member States together accounted for only 4.1% of the total public funding of ICT R&D, a contribution that was significantly below their economic weight (12.5% of the total EU GDP).

¹⁶ Please note that data from Greece are missing for 2009. For illustration, in the last available year, the estimate of publicly-funded ICT R&D expenditures in Greece was € 41 million (2008).

Figure 3—13: Distribution of Public Funding of ICT R&D among Member States (2009)



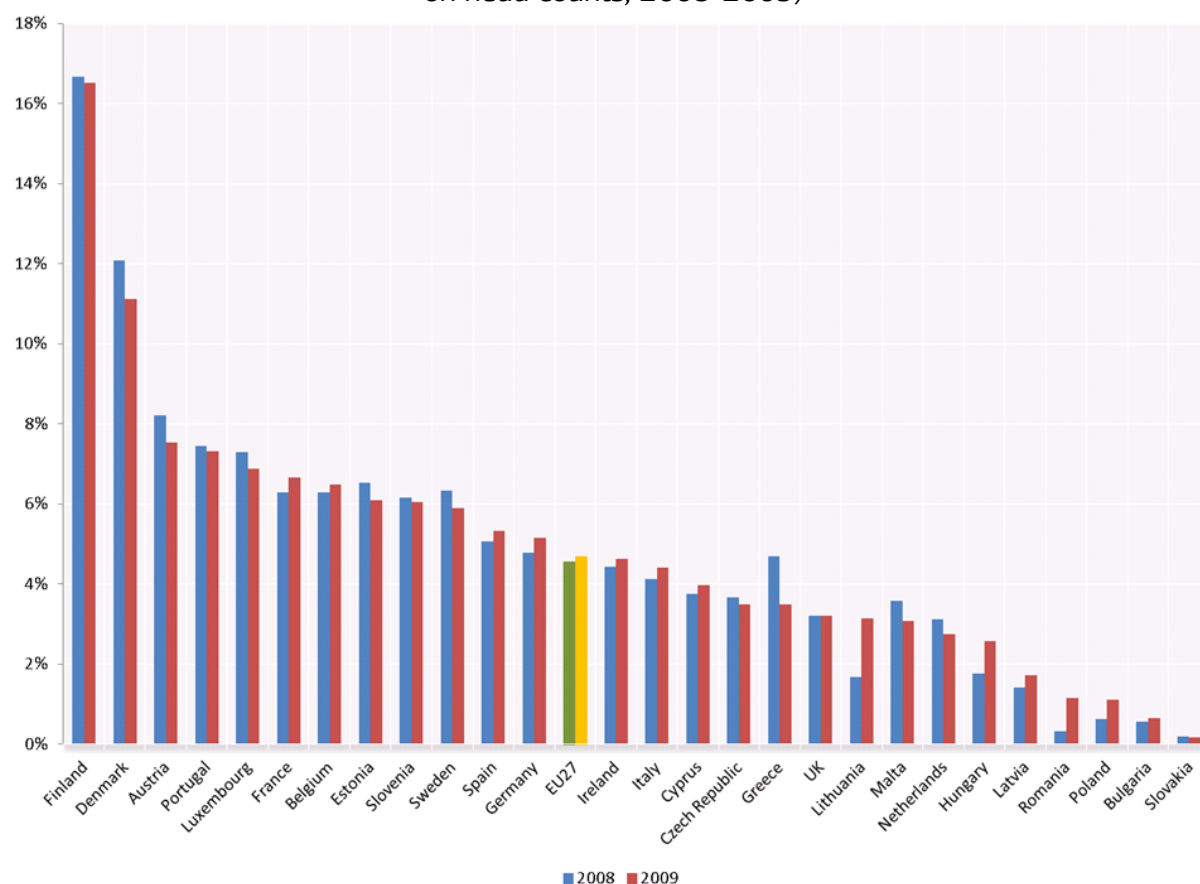
Source: JRC-IPTS estimations (based on Stančík 2012).

3.5 ICT Sector R&D Personnel

In 2009, ICT R&D personnel (including both researchers and R&D supporting staff) made up 4.7% of total ICT Employment in the EU. This represents a slight increase from 2008 (by 0.14 percentage points).

Figure 3—14 presents shares of ICT R&D personnel in total ICT employment by Member State. During the analysed period (2008-2009), Finland led the EU Member States with a share of almost 17% in both years. At a distance of more than 5 percentage points, Denmark came next with an 11.1% share in 2009, followed by Austria (7.5%) and Portugal (7.3%). Eight other countries scored above the EU level (4.7% in 2009). The lowest ranking countries were mostly newer Member States (Latvia 1.7%, Romania 1.2%, Poland 1.1%, Bulgaria 0.7% and Slovakia 0.2%) but also several important ICT R&D players like the Netherlands (2.7%) and the United Kingdom (3.2%).

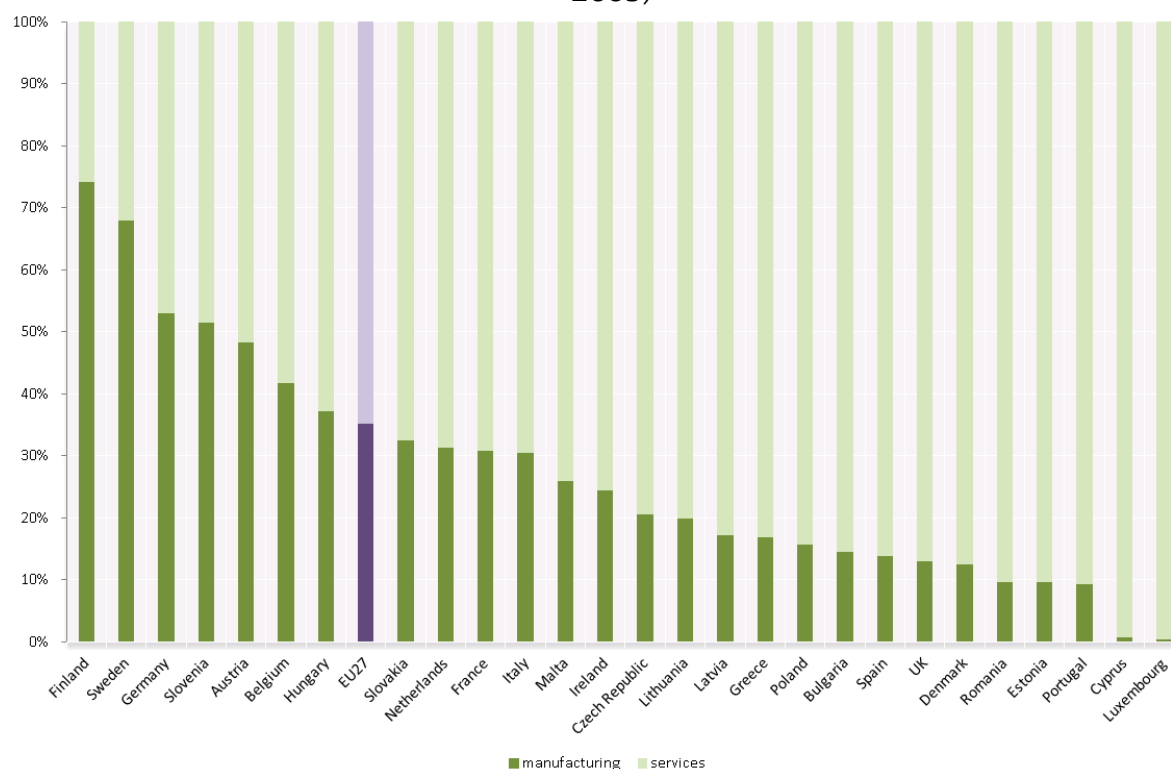
Figure 3—14: Share of ICT R&D personnel in total ICT employment by Member State (based on head counts, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3—15 provides a comparison of the distribution of ICT R&D personnel between Manufacturing and Services by Member State. In countries like Finland, Sweden, Germany and Slovenia, the Manufacturing sector plays a major role in terms of ICT R&D personnel. All four of these countries had more than 50% of their ICT R&D employees (now in full-time equivalents) working in ICT Manufacturing in 2009. In Finland, this ratio was as high as almost 75%. At the EU level, however, almost two thirds of ICT R&D jobs were in Services in 2009. In fact in 2009, 23 EU countries had more ICT R&D jobs in Services than in Manufacturing, with over 90% shares in Romania, Estonia, Portugal, Cyprus and Luxembourg.

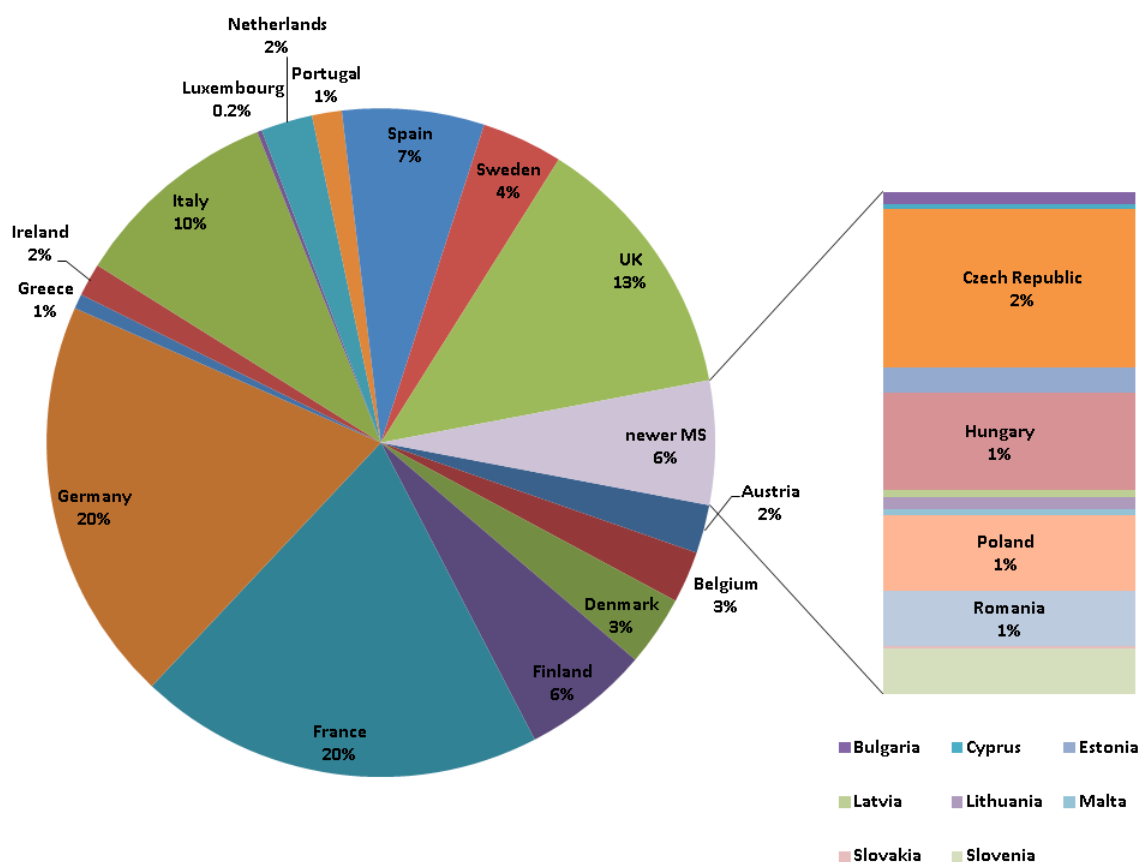
Figure 3—15: ICT Manufacturing/Services distribution of countries' shares (based on FTE, 2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 3—16 shows the distribution of ICT R&D personnel among Member States. As with other indicators, the largest EU economies took the lead in 2009. France and Germany came first with 19.6% shares each (again based on full-time equivalents), followed by the United Kingdom (13.1%) and Italy (10.1%). These four countries together employed more than 60% of ICT R&D employees in the EU in 2009. What is also remarkable is Finland's high share (6.1%). Among the main contributors, Spain, which employed almost 7% of ICT R&D employees, must also be mentioned. Another interesting fact is that each of these countries, individually, employed more ICT R&D workers than the whole group of twelve newer Member States. In this group, the Czech Republic had the highest share (1.9%).

Figure 3—16: Distribution of ICT R&D personnel among Member States (based on FTE, 2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

3.6 Comparison of Indicators

In this section, all five previously analysed indicators are compared in terms of Member State contributions (see Figure 3—17). Overall, due to the importance of their economies or to their particularly large ICT Sectors or strong ICT R&D intensities, only eight countries play significant roles in both ICT production and ICT R&D in the EU according to this particular selection of indicators. This does not mean that important ICT activities do not take place in other Member States but that a size effect makes these particular Member States stand out. A finer regional analysis would most certainly identify important ICT regions in other Member States.

These eight countries are analysed individually in this section. The other countries are grouped into other *older MS* and *newer MS*.

Unsurprisingly, the fact that emerges most clearly is the dominance of four major economies (France, Germany, Italy and the United Kingdom) in all five indicators. There are some exceptions (e.g., Finland in ICT BERD or Spain in ICT GBAORD) but these four countries together systematically contributed 50-60% in all indicators.

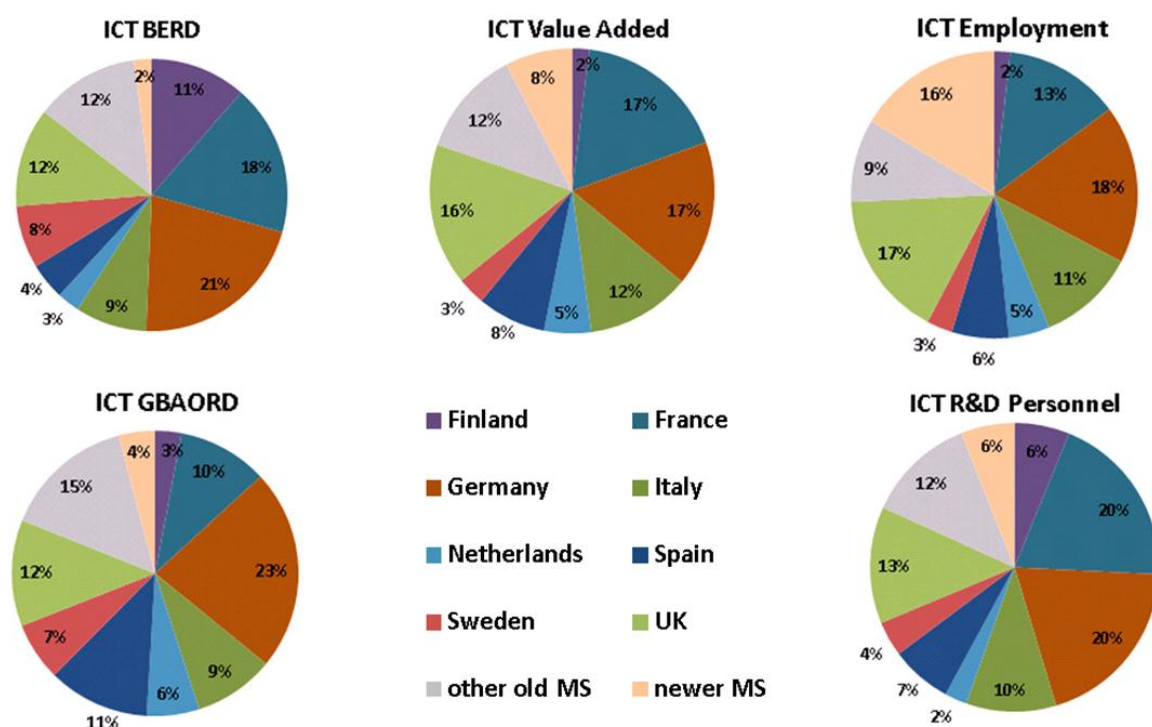
Other interesting facts (all related to 2009) can be summarized as follows:

- A comparison of ICT BERD (private funding) and ICT GBAORD (public funding) data reveals that while Finland and France contributed almost 30% to the total EU ICT

BERD, their cumulative share in ICT GBAORD was only 13%. This is in contrast to Spain which contributed only 4% to BERD but 11% to GBAORD.

- Finland produced only 2% of total EU ICT Value Added and employed only 2% of the total EU ICT sector employees, but invested 11% of total EU ICT BERD. Sweden was in a similar position, producing and employing 3% but investing 8%.
- The twelve newer Member States together produced 8% of total EU ICT Value Added. For this, they needed only 2% of total EU ICT BERD but had to employ 16% of the total EU ICT sector workforce. The share of ICT R&D Personnel working (6%), however, did not correspond to this relatively high 16% share.
- The contribution of Germany was very consistent across all five indicators (always between 17 and 23%). Similarly consistent patterns can be seen in Italy (always between 9 and 12%), the United Kingdom (always between 12 and 17%) and in the group of *other older* Member States (always between 9 and 15%).

Figure 3—17: Comparison of Value Added, Employment, BERD, GBAORD and R&D personnel by Member State (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

4. Comparison with the USA

4.1 Size of the EU ICT Sector (Value Added)

In 2009, EU ICT sector Value Added (VA), excluding the Trade and Repair sub-sectors,¹⁷ amounted to € 416 billion. In the US, it amounted to € 510 billion – 22.3% higher than in the EU. In 2008, this difference had been lower (10.5%), but by 2009, it had doubled because EU ICT VA dropped by € 31 billion, whereas US ICT VA increased by € 16 billion. This difference originated in both the Manufacturing and Services sectors. The biggest drops in the EU were recorded in *Manufacture of electronic components and boards (NACE 261)*, 41%, and *Telecommunications (NACE 61)*, 6%. The biggest increases in the US occurred in *Software publishing (NACE 5820)*, 10%, and *Computer programming, consultancy and related activities (NACE 62)*, 6%.

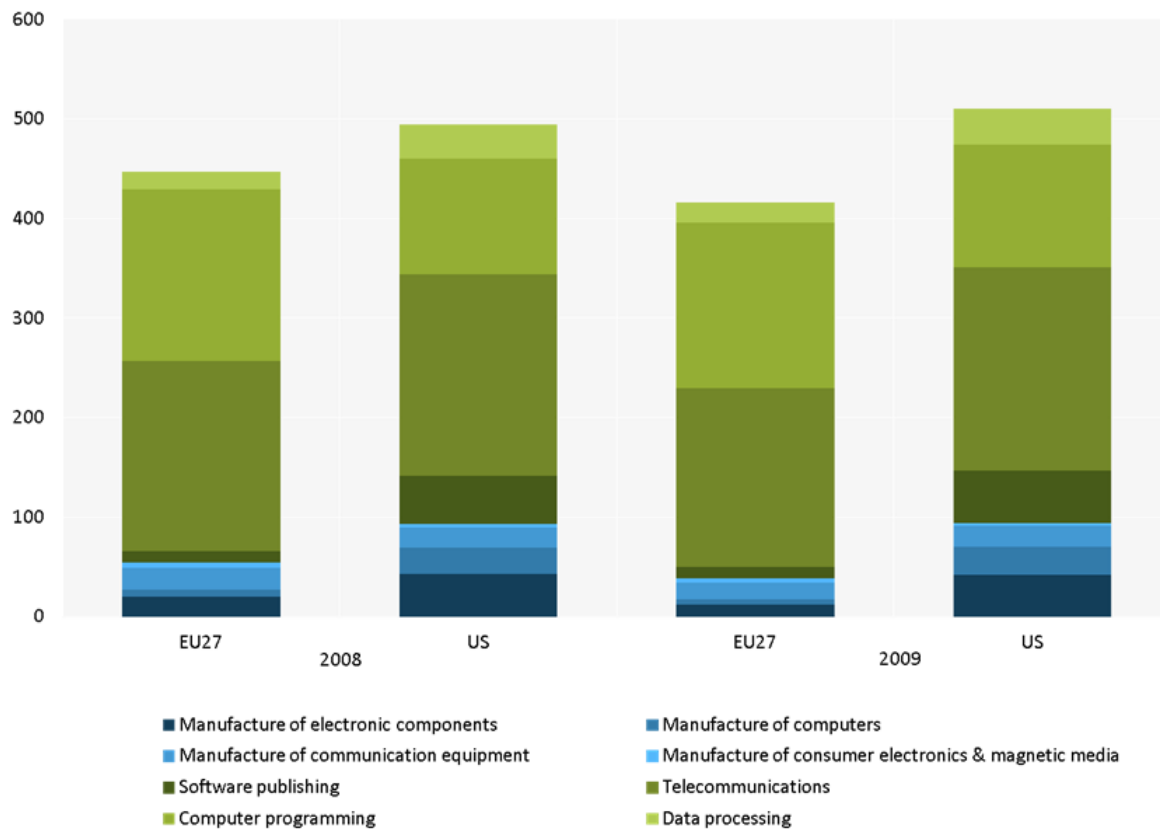
In 2009, ICT VA generated by the US Manufacturing sector amounted to € 93.5 billion, more than twice that of the EU (€ 38.2 billion). Similarly in 2008, ICT VA was € 92.6 billion in the US, almost twice that of the EU (€ 54.3 billion). The main differences between the US and the EU Manufacturing sectors lie in two sub-sectors: *Manufacture of electronic components and boards* which is almost four times larger in the US (€ 42.1 billion in 2009) than in the EU (€ 11.8 billion); and *NACE 262, Manufacture of computers and peripheral equipment* (€ 28.2 billion in the US vs. € 5.7 billion in the EU). The most important ICT Manufacturing sub-sector in the EU (*Manufacture of communication equipment [NACE 263]*) produced € 16.4 billion VA – € 4.5 billion less than the same sector in the US. On the other hand, *NACE 264 + 268 (Manufacture of consumer electronics plus Manufacture of magnetic and optical media)*¹⁸ ICT VA was higher in the EU. However, these two sub-sectors are very small, compared to the other ICT sub-sectors (€ 4.3 billion in the EU and € 2.3 billion in the US in 2009).

In 2009, Value Added in ICT Services in the US amounted to € 417 billion (more than four times the VA in Manufacturing). In comparison, VA in ICT Services in the EU was € 378 billion – € 39 billion less (and € 55 billion less in manufacturing). Thus, ICT Services VA was only 10% higher in the US than in the EU. ICT VA was higher in the US for three Services sub-sectors (*Software publishing [NACE 5820]*; *Telecommunications [NACE 61]*; and *Data processing, hosting and related activities; web portals [NACE 631]*), while it was higher in the EU for *Computer programming, consultancy and related activities*.

¹⁷ We did not consider ICT Trade and Repair sub-sectors in this comparison between the US and the EU, since data on value added in these sub-sectors are not available for the US. These sub-sectors produced 11% of the total EU ICT sector value added in 2009.

¹⁸ These two sectors have been added up due to their very small size.

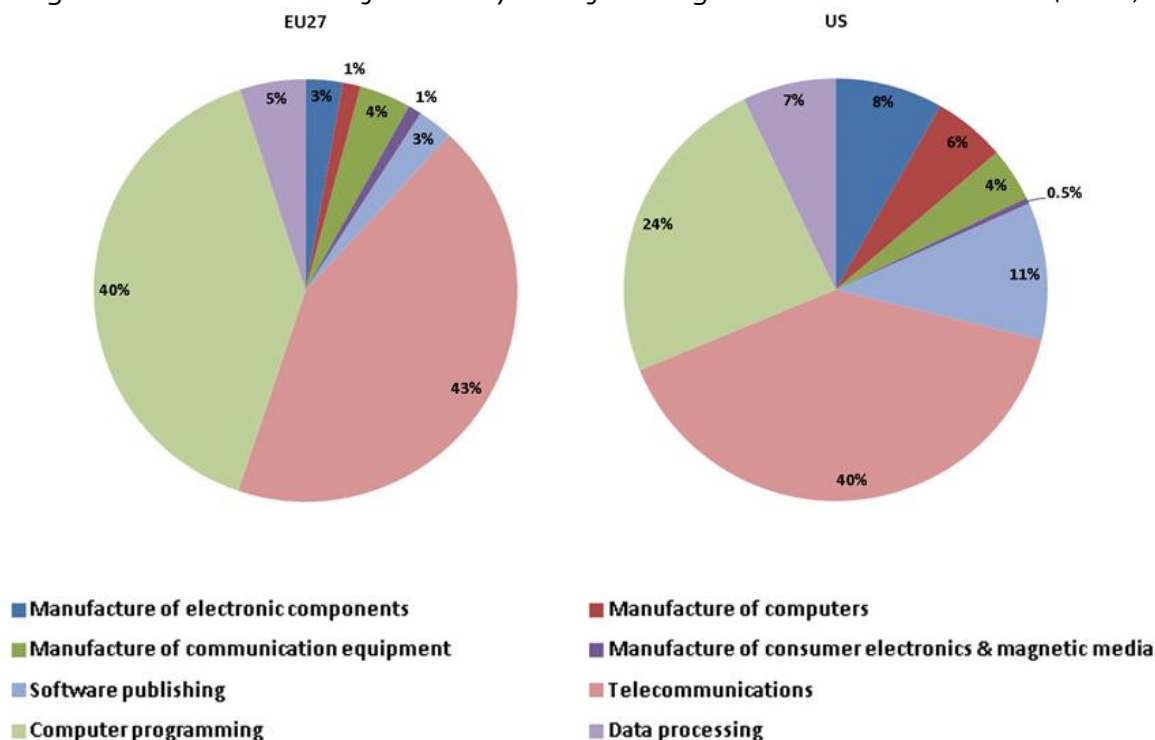
Figure 4—1: Comparison of ICT Value Added between the EU and US by sub-sectors (bn. EUR, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 4—2 compares the importance of the ICT sub-sectors in the EU and US by looking at their contributions to the total ICT Value Added. In 2009, *Computer programming, consultancy and related activities* (NACE 62) and *Telecommunications* (NACE 61) were the most important ICT sub-sectors in the EU, producing more than 80% of the total ICT VA. Other sub-sectors played a much smaller role in terms of Value Added. Similarly, in the US, these two sub-sectors were also the most important ones, although their joint contribution was about 20% lower (64%). A big difference in ICT Services was also found in *Software publishing* (NACE 5820) – 11% in the US vs. 3% in the EU. US ICT Manufacturing sub-sectors produced almost 20% of the total VA, while they only produced about 10% in the EU: the largest differences were in *Manufacturing of electronic components and boards* (NACE 261) and *Manufacture of computers and peripheral equipment* (NACE 262), while the sub-sector *Manufacture of communication equipment* (NACE 263) had the same share of ICT Value Added in the US and EU.

Figure 4—2: Distribution of ICT VA by Manufacturing and Services sub-sectors (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

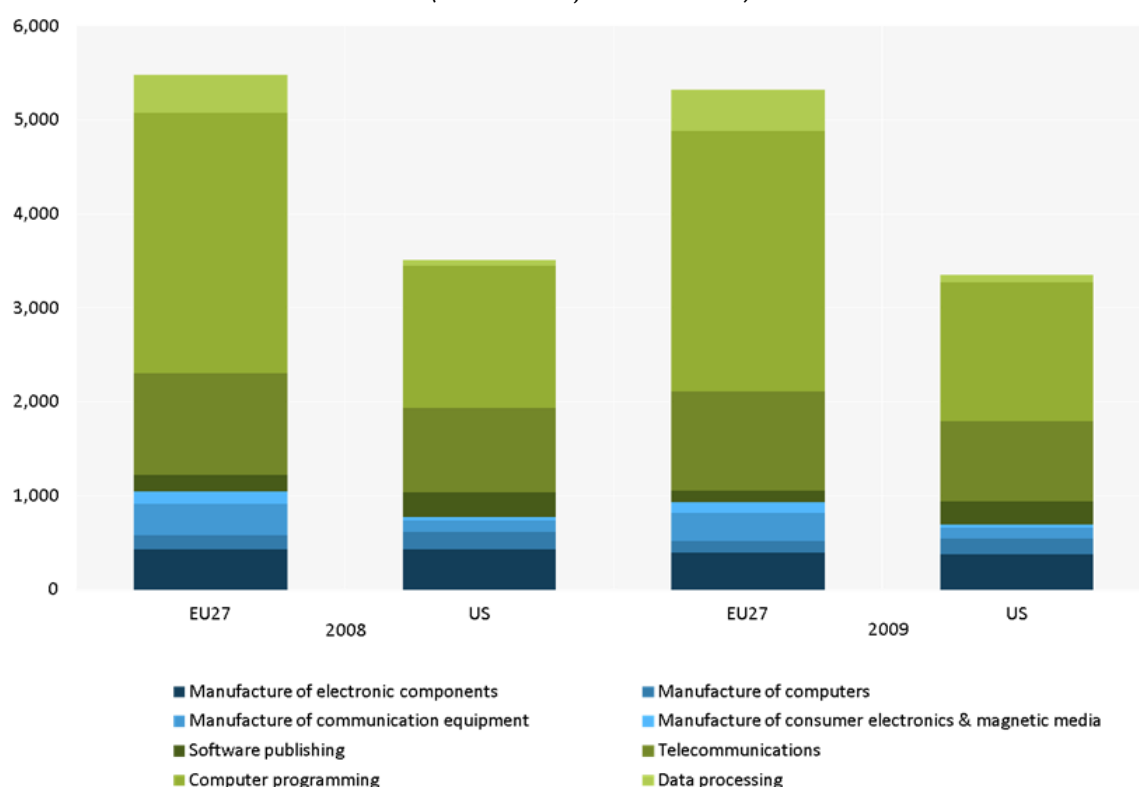
4.2 ICT Sector Employment and Labour Productivity

4.2.1 ICT Sector Employment

In 2009, ICT Value Added was 22.3% higher in the US than in the EU though employment in the ICT industries was much lower in the US than in the EU. In 2009, over 5.3 million people worked in the ICT sector in the EU as compared with 3.4 million in the US (excluding the Trade and Repair sub-sectors).¹⁹ In 2008, these figures were slightly higher (5.5 million in the EU and 3.5 million in the US). The reduction from 2008 to 2009 affected both the Manufacturing and Services sectors and almost all their sub-sectors. In the EU, only two Services sub-sectors maintained or increased employment: *Computer programming, consultancy and related activities (NACE 62)* and *Data processing, hosting and related activities; web portals (NACE 631)*. In the US, only the NACE 631 sub-sector managed an increase.

¹⁹ We did not consider ICT Trade and Repair sub-sectors in this comparison between the US and the EU, since data are not available for the US.

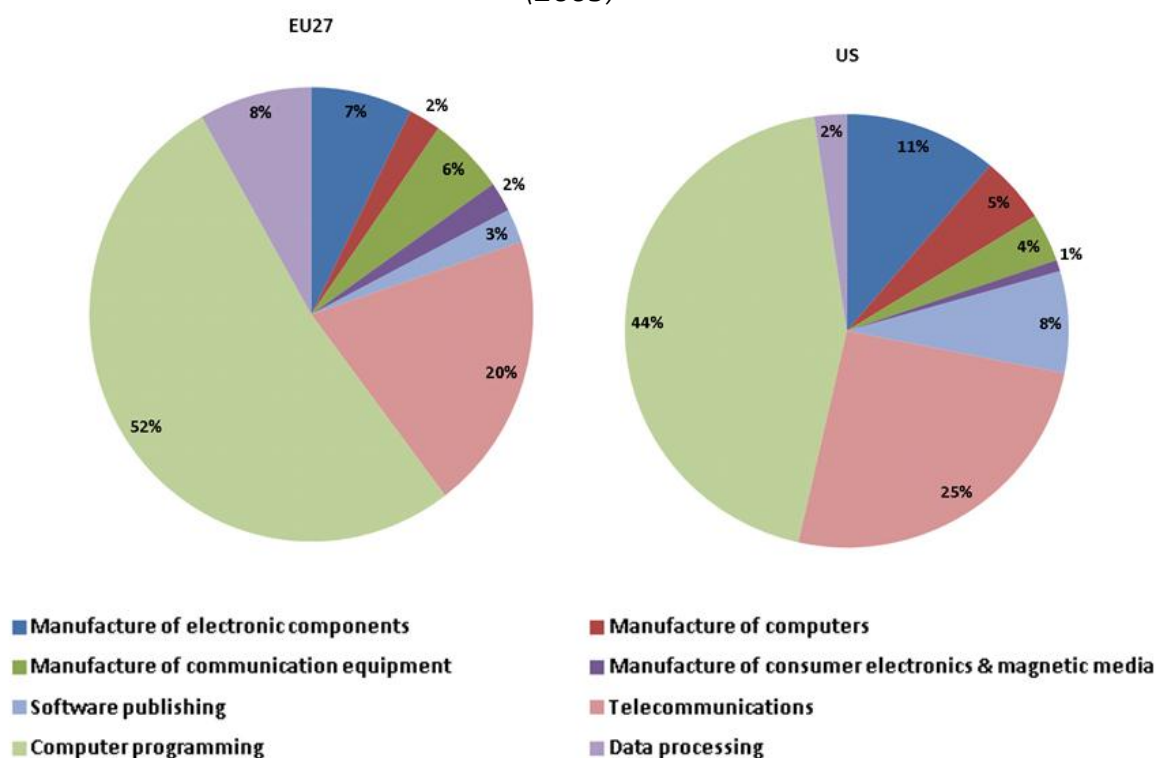
Figure 4—3: Comparison of ICT Employment between the EU and the US by sub-sectors (thousands, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 4—4 compares importance of ICT sub-sectors between the EU and US in terms of employment, by looking at their contributions to the total ICT employment. In 2009, EU ICT employment was highly concentrated in just two Services sub-sectors: *Computer programming, consultancy and related activities (NACE 62)*, which employed almost 2.8 million people, and *Telecommunications (NACE 61)*, which employed more than 1 million people. These two sub-sectors, together with *Data processing, hosting and related activities; web portals (NACE 631)*, are the main contributors to higher ICT employment in the EU than in the US. These three sub-sectors together employ 80% of all ICT sector workers in the EU. Similarly, in the US, *Computer programming, consultancy and related activities* and *Telecommunications* were also the most important ICT sub-sectors in terms of employment.

Figure 4—4: Distribution of ICT Employment by Manufacturing and Services sub-sectors (2009)



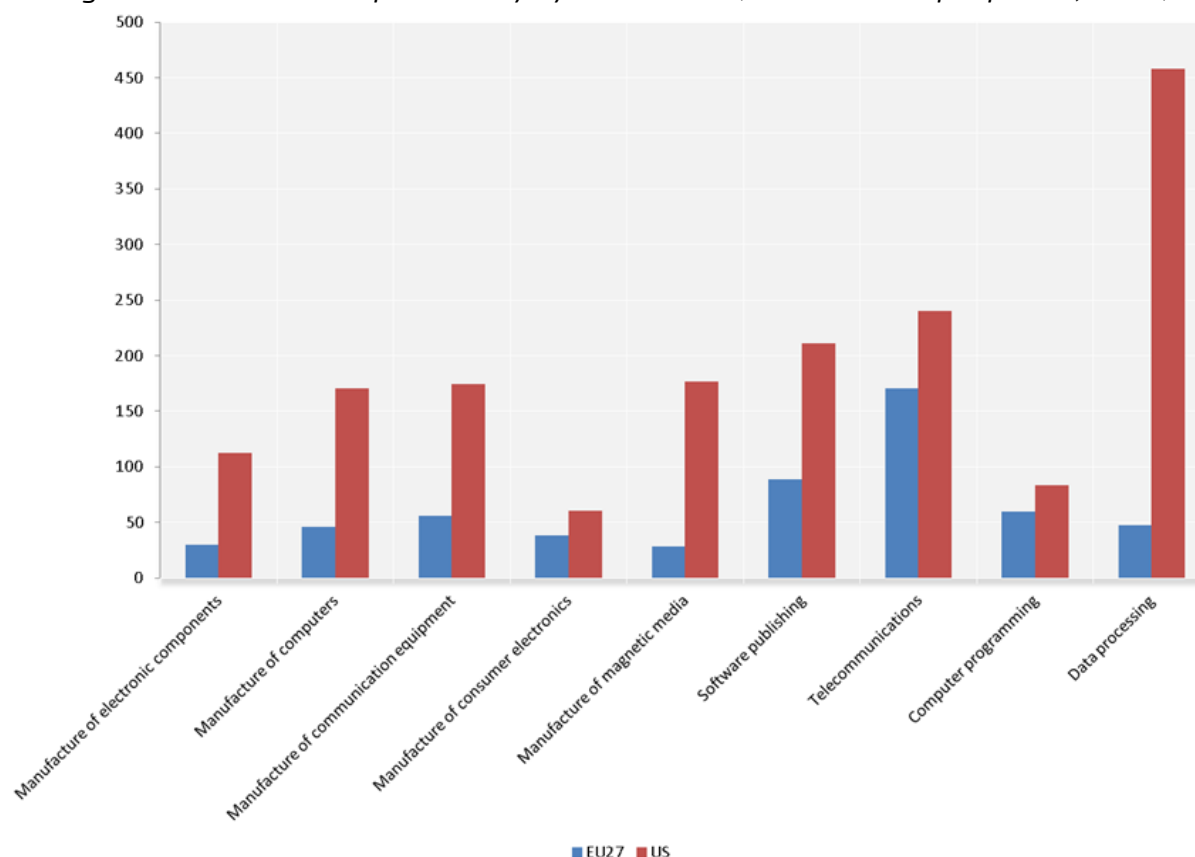
Source: Eurostat, elaborated by Ivie and JRC-IPTS.

4.2.2 ICT Sector Labour Productivity

Higher ICT Value Added in the US as compared with the EU (€ 510 billion vs. € 416 billion, 2009), together with lower US ICT employment (3.4 million vs. 5.3 million, 2009), results in much higher labour productivity in the US. In 2008, and also in 2009, US ICT labour productivity was twice that of the EU (€ 152 thousand per employee vs. € 78 thousand per employee).

The US productivity lead is clear in all ICT sub-sectors. In 2009, productivity in the sub-sector *Data processing, hosting and related activities; web portals (NACE 631)* was € 458 thousand per employee in the US. This was almost 10 times more (!) than it was in the EU (€ 48 thousand per employee).

Figure 4—5: ICT Labour productivity by sub-sectors (thousand EUR per person, 2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Between 2008 and 2009, labour productivity increased by 8% in the US, whereas it contracted in the EU by 4%. In the US, ICT labour productivity in both ICT Manufacturing and ICT Services increased by 14% and 7%, respectively. In fact, it increased in almost all US ICT sub-sectors by at least 6%, with the exception of *Manufacture of magnetic and optical media (NACE 268)* and *Data processing, hosting and related activities; web portals* sub-sectors where it dropped by 18% and 15% respectively. Recall that the latter sub-sector was by far the most labour productive ICT sub-sector.

In the EU, labour productivity decreased by 3% in ICT Services and much more intensely in ICT Manufacturing (by 21%). *Manufacture of magnetic and optical media (NACE 268)* suffered the largest decrease – 83%. This sector in the US, however, was precisely the one with the highest gain (154%). In the EU, *Software publishing (NACE 5820)* had the highest growth (36%). Only two other sub-sectors had positive growth in the EU – *Manufacture of consumer electronics (NACE 264)* with 2% and *Data processing, hosting and related activities; web portals (NACE 631)* with 7%.

4.3 ICT Sector Business Expenditures (ICT BERD)

ICT Business Expenditure on Research and Development (BERD), like ICT Value Added, was higher in the US than in the EU, with even more pronounced differences. In 2009, US ICT BERD amounted to € 62.7 billion, more than 2.5 times the EU figure (€ 24.5 billion) with a slight increase from 2008 when this ratio was 2.3 times (€ 61.2 billion vs. € 26.5 billion).²⁰

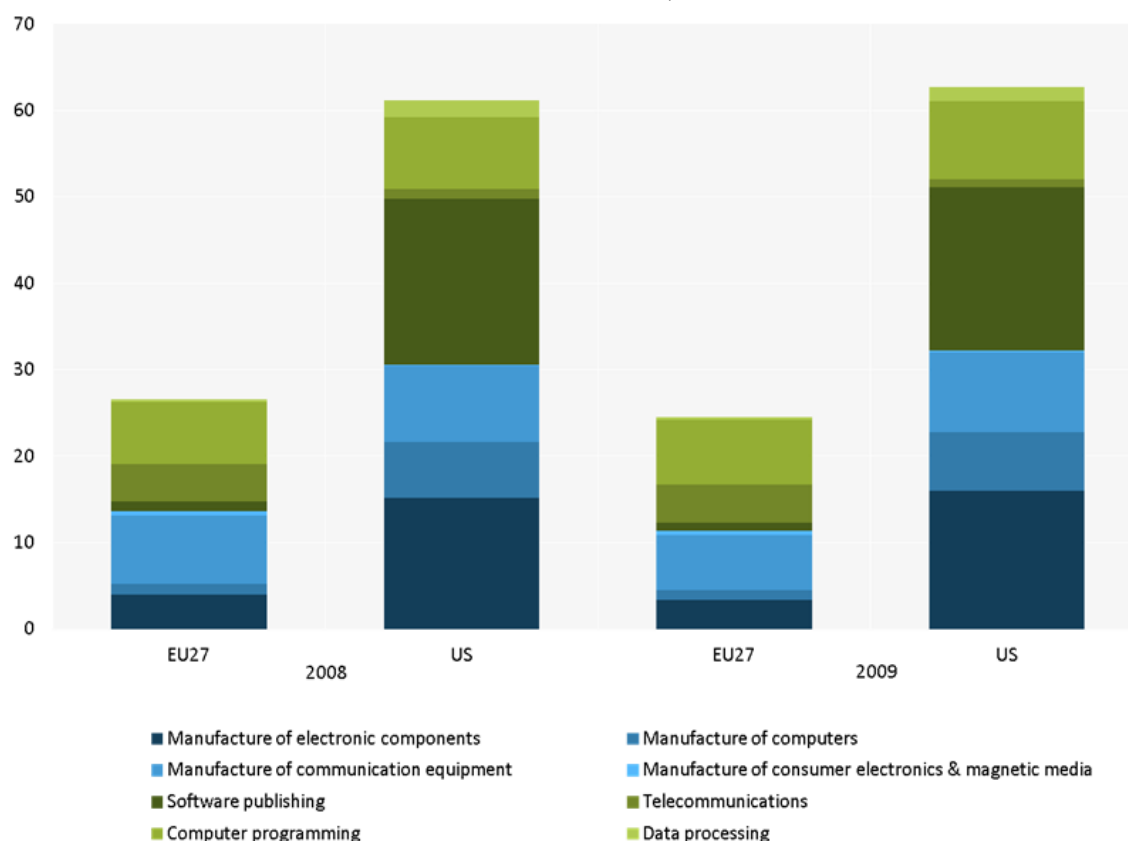
US ICT BERD was higher than the EU ICT BERD in almost all ICT sub-sectors with three exceptions: the Manufacturing sub-sectors *Manufacture of consumer electronics (NACE 264)*, € 176 million vs. € 514 million, and *Manufacture of magnetic and optical media (NACE 268)*, € 2 million vs. € 6 million, and the *Telecommunications (NACE 61) Services* sub-sector, € 0.9 billion vs. € 4.3 billion. The biggest US lead in ICT BERD was in *Software publishing (NACE 5820)*, € 18.9 billion vs. € 1 billion, and also in *Manufacture of electronic components and boards (NACE 261)*, € 16 billion vs. € 3.4 billion.

The US increase from 2008 to 2009 originated in the Manufacturing sector. ICT BERD in Manufacturing increased from € 30.6 billion in 2008 to € 32.2 billion in 2009, in contrast to ICT BERD in Services sub-sectors, which remained stable (€ 30.6 billion and € 30.5 billion). All the US Manufacturing sub-sectors have experienced an increase in ICT BERD. The reason why US ICT BERD in Services industries remained stable was that in two sub-sectors (*Software publishing [NACE 5820]* and *Telecommunications [NACE 61]*) it decreased and in another two (*Computer programming, consultancy and related activities [NACE 62]* and *Data processing, hosting and related activities; web portals [NACE 631]*) it increased, making the overall change negligible.

In contrast, ICT BERD in the EU in Manufacturing dropped between 2008 and 2009 (from € 13.6 to € 11.3 billion). The sub-sector with the biggest drop was *Manufacture of communication equipment (NACE 263)*, more than € 1.5 billion (from € 7.9 billion to € 6.3 billion). However, ICT BERD in Services sectors experienced a slight increase (from € 12.9 to € 13.2 billion), due mostly to *Computer programming and consultancy (NACE 62)* and its € 400 million ICT BERD increase.

²⁰ We did not consider ICT Trade and Repair sub-sectors in this comparison between the US and the EU, since data on value added and BERD in these sub-sectors are not available for the US. These two sub-sectors perform very little R&D, although together, they produced 11% of the total EU ICT sector value added in 2009.

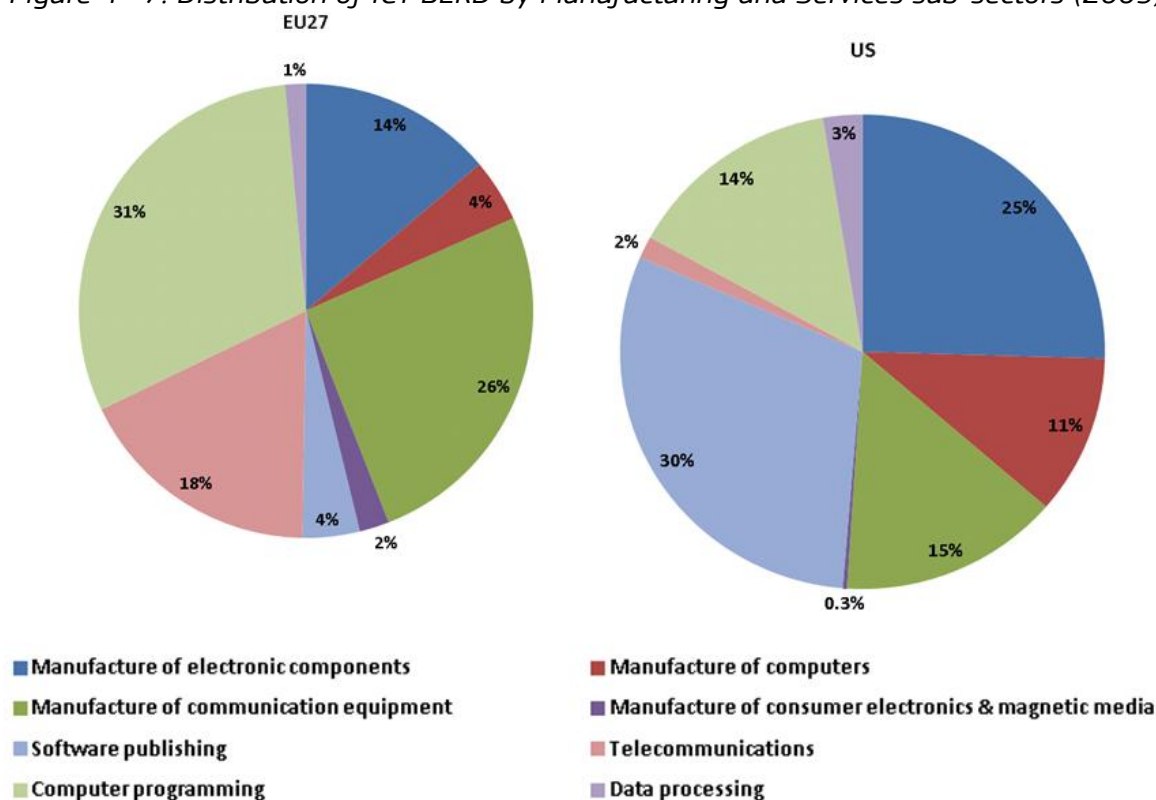
Figure 4—6: Comparison of ICT BERD between the EU and US by sub-sectors (bn. EUR, 2008-2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Figure 4—7 compares the importance of ICT sub-sectors in the EU and the US in terms of ICT BERD by looking at their contributions to the total ICT BERD. In 2009 in the EU, ICT BERD was concentrated mainly in two sub-sectors: the ICT Services sub-sector *Computer programming, consultancy and related activities* (NACE 62) and the ICT Manufacturing sub-sector *Manufacture of communication equipment* (NACE 263). These two sub-sectors produced almost 60% of the total ICT BERD in the EU. On the other hand, in the US in 2009, ICT BERD was concentrated mainly in *Manufacture of electronic components and boards* (NACE 261) and *Software publishing* (NACE 5820). It is interesting that there are big differences in the relevance of ICT sub-sectors between the EU and US. Sub-sectors that are important in the EU have at least 10% lower shares in the US, and vice versa. The most striking differences can be seen in *Computer programming, consultancy and related activities* and *Telecommunications* (NACE 61), 49% joint share of the total EU ICT BERD vs. 16% share in the US, and in *Software publishing* (4% vs. 30%).

Figure 4—7: Distribution of ICT BERD by Manufacturing and Services sub-sectors (2009)

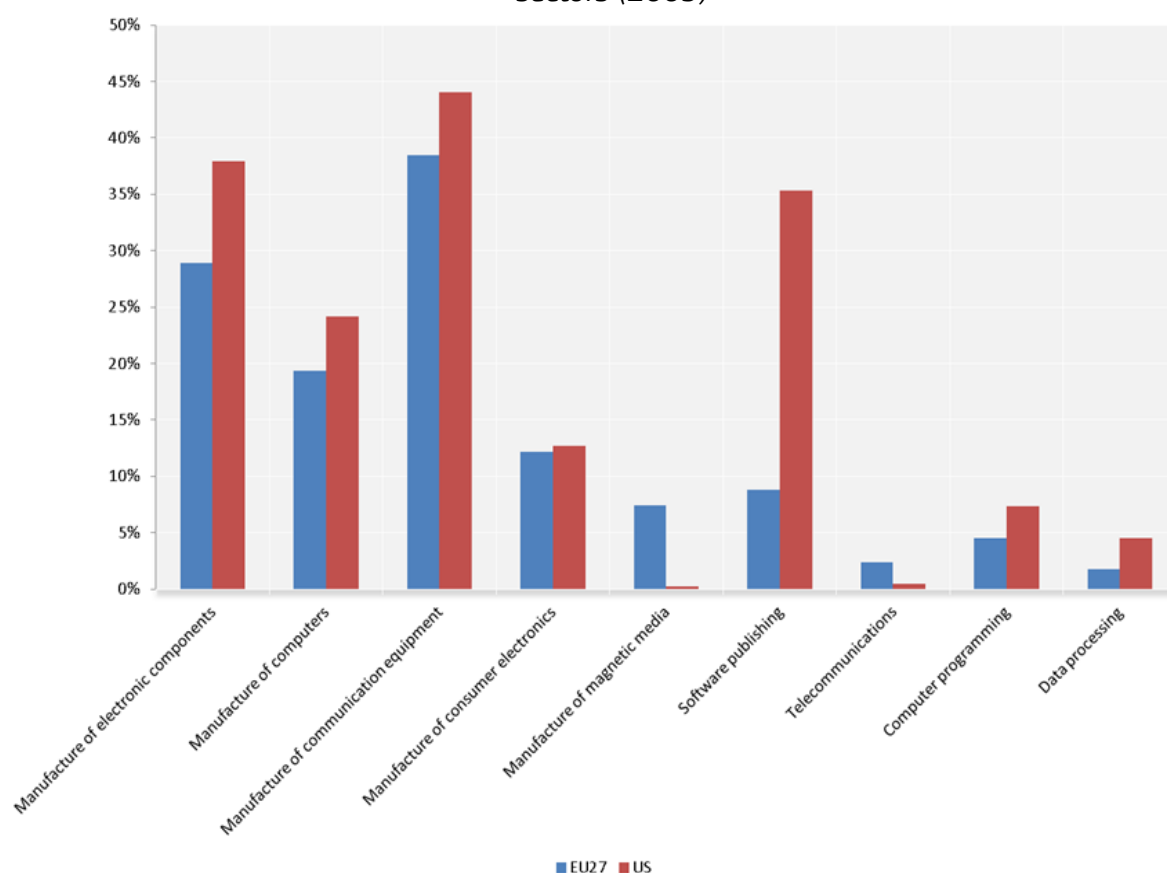


Source: Eurostat, elaborated by Ivie and JRC-IPTS.

Between 2008 and 2009, ICT BERD intensity (measured by the ratio of ICT BERD in ICT Value Added) maintained similar levels in both the US and the EU. In 2008, ICT BERD intensity was 12.4% in the US, more than twice as much as it was in the EU (5.93%). In 2009, both regions experienced a slight decrease (to 12.3% and 5.89%). In the US, this was because ICT BERD intensity fell from 7.6% in 2008 to 7.3% in 2009 in the Services sector. Even though it increased in the Manufacturing sector from 33.1% to 34.4%, this rise did not offset the overall fall. In the EU, interestingly, although ICT BERD intensity increased both in the Manufacturing sector (from 25.1% in 2008 to 29.7% in 2009) as well as in the Services sector (from 3.3% in 2008 to 3.5% in 2009), the change in corresponding sectoral weights caused again an overall fall.

Regarding sub-sectoral comparison, US ICT sub-sectors were systematically more R&D intensive than their EU counterparts, by about 5-10 percentage points (pp). The most profound difference was in *Software publishing* (NACE 5820) with more than 25pp difference. There were only two ICT sub-sectors with higher BERD intensity in the EU – *Manufacture of magnetic and optical media* (NACE 268) and *Telecommunications* (NACE 61).

Figure 4—8: Comparison of R&D intensity (ICT BERD/VA) between the EU and US by sub-sectors (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

4.4 Comparison of Indicators

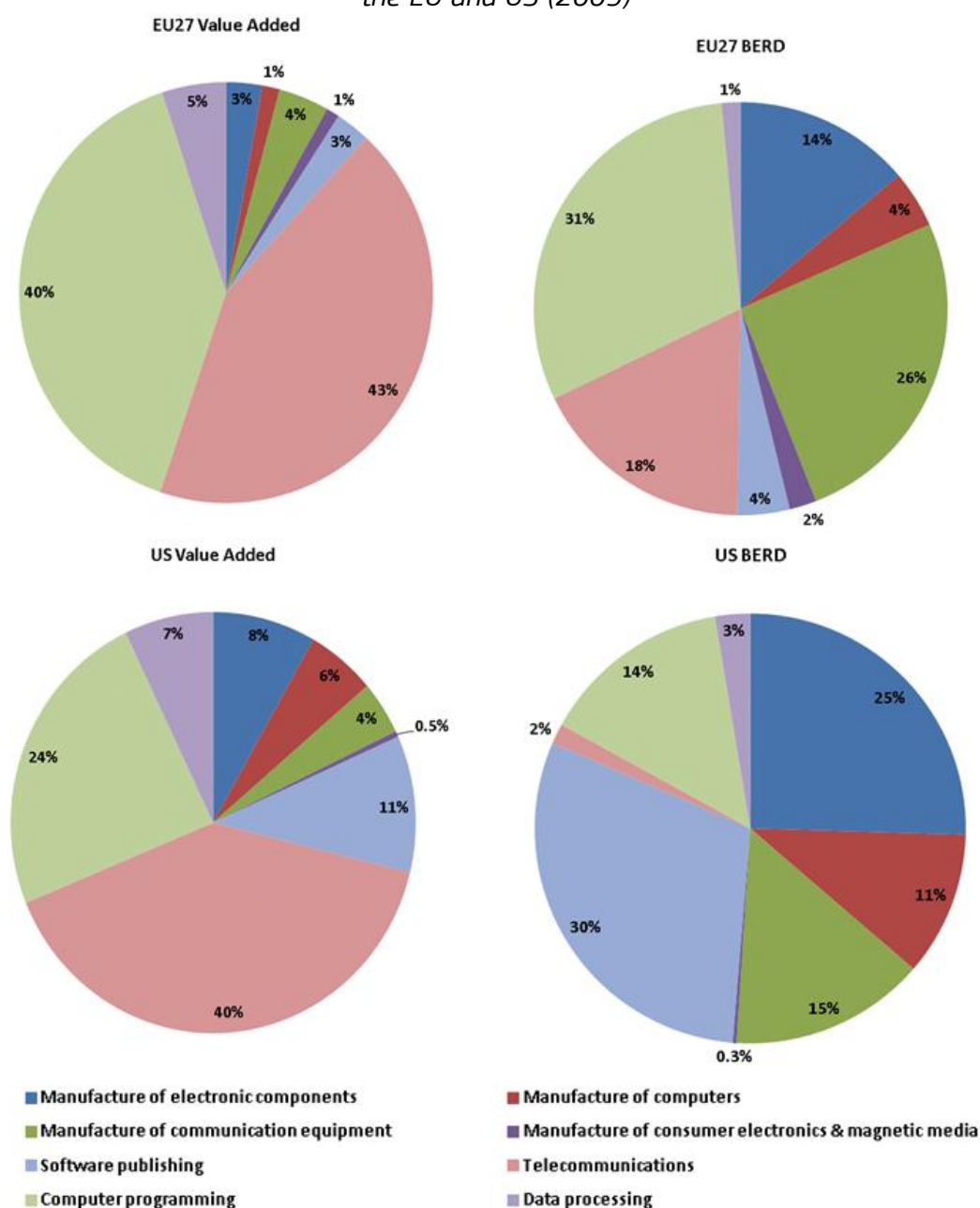
Figure 4—9 provides a comparison of sub-sectoral contributions to BERD and Value Added in the EU and the US. When we compare ICT Manufacturing with ICT Services, the two regions were very similar in 2009. In the EU, the ICT Services share in BERD was about 54% whereas in Value Added it was more than 90%. In the US, these shares were very similar—a 49% share in BERD and an 82% share in Value added. Or looking from the other side, ICT Manufacturing had about 50% shares in the total BERD in both regions but it produced less than 10% of EU ICT Value Added and less than 18% in the US.

A closer look at particular sub-sectors reveals additional interesting facts:

- In 2009, the most important ICT sub-sector in Value Added in both regions was *Telecommunications (NACE 61)*. This sub-sector produced similar shares of ICT Value Added in the EU as in the US (43% and 40% respectively). Its share of BERD was, however, much higher in the EU (18%) than in the US (2%).
- In 2009, the ICT Manufacturing sub-sector, the *Manufacture of communication equipment (NACE 263)*, produced 4% of the total ICT sector Value Added in the EU, as did the same sub-sector in the US. However, this sub-sector produced a higher share of BERD in the EU (26%) than it did in the US (15%).

- Both the *Manufacture of electronic components and boards (NACE 261)* and *Manufacture of computers and peripheral equipment (NACE 262)* ICT sub-sectors had higher Value Added and higher BERD shares in the US than in the EU.
- On the one hand, the *Computer programming, consultancy and related activities (NACE 62)* had higher shares of Value Added and BERD in the EU than it did in the US (40% of Value Added and 31% of ICT BERD in the EU, compared with 24% of Value Added and 14.5% of ICT BERD in US), On the other hand, *Software publishing (NACE 5820)* was responsible for 10.5% of US ICT Value Added and for as much as 30% of US ICT BERD, compared to 2.7% of EU ICT Value Added and 4.1% of EU ICT BERD.

Figure 4—9: Sub-sectoral comparison of the distribution of Value Added and BERD between the EU and US (2009)



Source: Eurostat, elaborated by Ivie and JRC-IPTS.

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Abstract

"The 2012 PREDICT Report: An Analysis of ICT R&D in the EU and Beyond" provides a detailed analysis of the state of Information and Communication Technologies (ICT) Research and Development (R&D) activities in the European Union.

This is the fifth edition of a series which is published annually. The 2012 edition has been, for the first time, designed to be primarily published as a web-based source of data and analyses, with downloadable data sets. The present report is therefore a compilation of the different sections of the web-based version available at:

<http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html>.

This edition is based on latest data available from official sources, such as EUROSTAT and OECD. It therefore covers years 2008 and 2009, a period marked by a deep financial and economic crisis.

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

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Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.



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