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Key Facts Report

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

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Foreword

PREDICT: Prospective Insights on R&D in ICT

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

Rationale

ICT determine competitive power in the knowledge economy. For the aggregate of the 40 economies under scrutiny in the project, almost one fourth of total Business expenditure in R&D (BERD) originates in the ICT sector alone. Besides the impact ICT uptake has on the organisation of businesses, this sector also plays an important enabling role for innovation in other technological domains. This is reflected at the EU policy level, where “A Europe fit for the digital age” was identified as one of the six European Commission priorities in 2019 and envisions Europe as a strong digital player in its own right.

Statistics and indicators

PREDICT provides indicators in a wide variety of topics, including value added, employment, labour productivity and BERD, distinguishing fine grain economic activities in ICT and Media and Content industries (up to 22 individual activities, 14 of which are at the class level, i.e. at 4 digits in the ISIC classification) and at a higher level of aggregation for all the other industries in the economy. It also produces data on government financing of R&D in ICT, and total R&D expenditure at the country level. Now-casting of more relevant data in these domains has also been performed for 2018 and 2019, and time series go back to 1995.

Team

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

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Abstract

The 2020 PREDICT Key Facts Report provides a detailed analysis of the state of ICT R&D activities in the EU28 and 12 further economies worldwide. This is the 13th edition of a series that is published annually. Like the previous editions, an online version is available at: <https://ec.europa.eu/jrc/en/predict>. The report covers the period between 1995 and 2017, providing a long-term analysis of the European Union (EU) ICT sector and its R&D, covering a whole cycle from the initial expansion years, to the double recession that began in early 2008, and the most recent evolution up to 2017. Whenever possible, the report includes nowcasted data for 2018 and 2019. The statistical information provided by the figures allows the comparison between: the ICT sector and the total economy; the ICT manufacturing sector and the ICT services sector; the four ICT manufacturing sectors, two ICT services sectors, and MC and RS sectors; EU countries; the EU and the international context (including the most relevant countries in the world economy). The report focuses especially on the ICT R&D macroeconomic dynamics.

Keywords

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

Executive Summary

New ICTs have transformed the production process of many existing economic sectors, particularly by facilitating the diffusion of robotisation and automation. These technologies, which underpin the digital transformation of economy and society, have led to the development of entirely new processes of production and retail, hence, determining new competitive powers in the knowledge economy. New sectors have been born and many others have been adapted. Moreover, their role in the phenomenon of globalization and in the fragmentation of production processes in different stages (the so called global value chains) is crucial.

ICT is a key sector in changing business organizations and in enabling innovations in many techno-economic domains. Its impact on people's everyday life is pervasive. The COVID-19 pandemic, which has profoundly affected almost every country in the world, has unveiled the crucial role played by ICT and its R&D in the control of the infected population (e.g., its intensive and extensive use in South Korea); the answer to the shortage of appropriate equipment (i.e. the use of 3D printers technology); the great stimulus given to online education; not to mention its role in reducing the cost of confinement, both in terms of human lives and lost production, thanks to the possibilities offered by teleworking. The COVID-19 outbreak has meant, among many other things, a tremendous boost to the penetration of ICTs in all areas. However, for the next two years a strong negative impact on the production of the ICT sector is expected due to both, the fall in demand as a result of confinement, as well as the sudden stop of production in many countries as a consequence of the disruption of the global supply chains.

One of the six priorities of the current European Commission (EC) strategy is a fit Europe for the digital age. Therefore, the relevance of this sector is strategic for the EC. However, this is not something new, since the relevance of this sector has been long ago recognized at the EU policy intervention level. The Digital Agenda for Europe in 2010, in the perspective of maximising its social and economic potential, identified the development of ICT as one of the seven pillars of the Europe 2020 Strategy for growth in the Union. Then, since 2015 the achievement of a Digital Single Market (DSM) took over as one of the Commission's political priorities, further strengthened by the third pillar of the new Commission's priorities: 'A Europe fit for the digital age'. The paragraphs below present main results in a very succinct way according to the three sections in which the main body of the report is structured.

Analysis of the EU28 ICT Sector

The ICT sector is one of the most dynamic sectors in the EU economy, standing out for its **high R&D intensity** and for a **productivity** that is higher than that of the whole economy. The size of the EU28 ICT sector in **2017** amounted to 630 billion euros value added (VA), employed 6.3 million people and spent 32 billion euros on R&D (BERD) business expenditures. The ICT sector represented **4.1% of the EU28 total value added, 2.7% of total employment, 15.2% of total BERD**, and 18.1% and 20.4% of the R&D personnel and researchers in the EU28, respectively.

The **development from 1995 until 2017** shows that the EU28 ICT sector multiplied its value added in real terms by a factor of 3.8, while the one of the total economy increased by 1.5. The growth of employment was much more moderate: the number of persons employed in ICT in 2017 is 1.5 times the number of persons employed in the same sector in 1995. Labour productivity in the ICT sector grew much faster than labour productivity in the total economy. The value reached in 2017 is 2.5 times the value of 1995 and, according to the estimations carried out in this project, the same trend is maintained also in 2018 and 2019. Business expenditure in R&D (BERD) in the ICT sector presents a behaviour that is more dynamic than the one of the total economy. From 1995 to 2017, its value multiplied by a factor of 3.5, and estimated values indicate that this trend has continued in 2018 and 2019. In the same period, the BERD of the total economy only grew 1.9 times. Nevertheless, BERD intensity (measured as the BERD/GDP ratio in nominal terms) presents a decrease in the period 1995-2017.

Public funding of R&D is measured through GBARD. The part of GBARD devoted to funding ICT-related expenditures, i.e., ICT GBARD, grew in the ICT sector by 4.8% annually in nominal terms between 2006 and 2018, whereas in the total economy, it only grew at an annual rate of 2.8% (in nominal terms).

Analysing the **ICT sub-sectors** reveals that the more dynamic behaviour of the ICT sector in the EU28 is mostly due to the ICT services sector. ICT manufacturing experienced a sharp contraction from the beginning of the economic crisis, in 2007, in VA and BERD. In the ICT manufacturing sector, employment halved between 1995 and 2019. The combined trends of VA and employment produced a higher growth rate of ICT manufacturing labour productivity than what is observed in ICT service sectors. Regarding research

expenditure, in the last two years before the economic crisis, the ICT manufacturing sector had a share (10%) of total BERD higher than the one of ICT services (8.6%). Since the beginning of the crisis, ICT manufacturing has followed a continuous declining path, while ICT services sector has shown an increase.

The most important ICT sub-sectors presenting the highest shares over the total economy are two ICT services sub-sectors Computer and related activities and Telecommunications, and the Media and content (MC) sector. In terms of research activity, the sub-sector Computer and related activities is always the one showing, by far, the highest amount of private business expenditure (BERD), but the sub-sector Manufacture of communications equipment has the highest research intensity. Telecommunications is the sub-sector with the highest labour productivity, it is around 2.5 times higher than in the overall economy.

The ICT sector in the EU28 Member States

In 2017 the countries with **largest ICT share** (ICT sector VA/GDP) in the EU were Ireland¹, Malta, Sweden, Cyprus, Romania, Finland, Estonia and Hungary, all above 5.0%. In terms of employment, the largest EU28 ICT sectors in relative size were Malta, Estonia, Hungary, Ireland, Luxembourg and Finland, with a share over total employment higher than 3.5%. On the other hand, Finland was the country with the highest ICT sector BERD intensity (ICT sector BERD/ICT sector VA) in 2017 (13.3%), followed by Austria, Sweden, Belgium and France (all above 7%).

In the **2006-2017 period**, the ICT sector had a positive VA growth in most of the countries of the EU28 (with the only exceptions of Greece and Finland), with the highest growth rates in real terms showed by Bulgaria, Poland and Romania (all above 8%). Regarding employment growth, Finland, Greece, Italy and Ireland are the countries presenting negative values, meaning that employment in ICT has decreased. On the opposite side, the countries presenting the most positive growth are three eastern countries (Estonia, Bulgaria and Latvia) and Luxembourg. In the same period, Denmark, Poland and Romania were the EU28 countries with the highest growth rate in labour productivity. Poland and Slovakia presented the highest growth rates of BERD.

ICT sector **BERD intensity** (measured as ICT sector BERD/ICT sector VA) is very high in Finland (the only country with more than 10%), followed by Austria, Sweden and Belgium. The countries with the highest values of public funding of R&D (GBARD) in the ICT sector over VA are Belgium, Italy, Denmark, Germany and Finland. Finally, the weight of ICT GBARD over total GBARD is especially high in Cyprus, Ireland, Latvia, Sweden, Finland and Hungary.

The EU28 ICT sector in the international context

This section compares 12 major ICT economies² with the EU28. The US and China have the biggest ICT sectors amounting to 800 and 788 billion euros value added (VA) respectively in 2017. Europe ranks third with 630 billion euros. India and China are the countries showing the most **dynamic behaviour during the 2006-2017 period**. Specifically, both countries presented the largest growth rates in VA. In terms of employment, India shows the largest growth, followed by Australia, Brazil and China. In labour productivity growth China stands out, followed by India, Taiwan and South Korea. China had also the most dynamic behaviour in research expenditure (BERD). Compared with those of the Asian countries, the ICT sector of the EU and the US has shown modest growth rates in all dimensions. Only in the two variables related to public funding of R&D (GBARD and ICT GBARD) in ICT, the EU28 has been more dynamic than the US.

Taiwan is the country in which the ICT sector has the **highest share** over the total economy (16.3%). Taiwan always presents the largest shares, usually followed by South Korea. The third position is claimed by the US for ICT sector share of VA and BERD, Japan in employment. The **EU's position** depends on the selected variable. In VA the EU28 occupies the 7th position and in BERD it is 10th, behind China and India in both variables. For all variables considered, the ICT sector in the US has a higher share than in the EU28. The country with the largest labour **productivity** per hour worked in the ICT sector, ICT manufacturing and ICT services is the US, followed by Taiwan, Norway, Switzerland and the EU28. The lowest per hour productivity level is observed in China, Brazil and India. However, India is the country in which the ICT sector has the highest ratio of labour productivity per hour worked as compared to labour productivity in the total economy (almost 4 times higher). Brazil, China and South Korea follow. For the EU28, the same ratio is slightly lower

¹ Ireland has not published official data for VA since 2014 and this last available data year is used for country comparisons.

² Australia, Brazil, Canada, China, India, Japan, Norway, Russia, South Korea, Switzerland, Taiwan and United States.

than the one of the US (1.43 for the EU and 1.69 for the US), meaning that in the EU28 the gap between ICT sector productivity and total productivity is lower.

The US has the highest ICT sector **research expenditure** (BERD) of 84 bn EUR PPS in 2017, followed by China with 47 bn EUR PPS and Europe takes third place with 32 bn EUR PPS. South Korea has the highest **BERD intensity** (ICT sector BERD/ ICT sector VA), followed by Taiwan, the US, Norway and Japan. The EU28 occupies the ninth position. In South Korea and Taiwan, the ICT manufacturing sub-sector is the one with the highest BERD intensity, when compared to ICT services or the rest of the economy, while in Japan and in the US, the non-ICT sector is the one with the highest BERD intensity.

The distinction by **ICT sub-sectors** makes it possible to confirm that the strength of Taiwan and South Korea relies on *Manufactures of electronic components*. Additionally, the ICT sectors in Japan, China and Russia are concentrated in manufactures. For the rest of countries, including the EU28 and the US, the most important sub-sector being *Computer and related activities*. In the US, public research funding (GBARD) is concentrated exclusively in *Telecommunications*, while in the EU28 it is more focused on *Computer and related activities*. Labour productivity per employed person in the US is higher than in the EU28 for all sub-sectors considered.

The evidence presented here confirms that the centre of gravity of ICT is moving towards the East. China and India had been showing a very dynamic behaviour in all variables in the 2006-2017 period, challenging the traditional view of those countries as the *factories of the world*. The information provided in this report indicates that China is quickly moving to a new scenario betting hard on higher value added activities –such as those within the ICT producing sector– as well as investing an increasing amount of resources in R&D. The data for all R&D related variables indicate that China wants to play a prominent role in the world economy. Up to now the US is still the leading country in the world. But China (due to the size of its economy) is already threatening a leading position. The EU28 is not improving its overall position in the international context. The results presented here call for a reflection on the current relative future position of the EU28's ICT sector in the international landscape.

Introduction

The 2020 edition of the PREDICT Key Facts Report is based on the latest data available from official sources such as the Statistical Office of the European Communities (Eurostat) and the Organisation for Economic Co-operation and Development (OECD).³ The 2020 PREDICT Report covers the period between 1995 and 2017. It provides a long-term analysis of the European Union (EU) ICT sector and its Research and Development (R&D), covering a whole cycle from the initial expansion years, to the double recession that began in early 2008, and the most recent evolution up to 2017. Whenever possible, the Report includes nowcasted data for 2018 and 2019. Consequently, the report does not include information related to the effect of the COVID-19 on the EU ICT sector, which will most probably imply a structural break. The EU aggregate (EU28) in the PREDICT Dataset refers to the 28 countries that were part of the EU at the end of 2019, the last year included, and therefore it includes the United Kingdom. The data for this aggregate are presented for the period from 1995 to 2019, regardless of the legal status of all the 28 countries as Member State of the EU in the respective year. This is implemented in order to allow a comparison of the same aggregate over time.

In order to provide statistical support for the comprehension of main economic ICT trends, this report focuses on the dynamics of corresponding economic processes of production. Hence, the collected data refers to the *production* of ICT goods and services, and of related R&D activities. However, the report does not address the analysis about the use that is made of ICT goods and services by the society. In addition to the ICT sector, the report also provides information for two additional sectors that are closely related: *Media and content* and *Retail sale via mail order houses or via Internet*.

The main body of the report presents a selection of figures and tables accompanied by short comments summarizing the main findings. The report is structured in three sections. Section 1 focuses on the analysis of the EU28 ICT sector and presents the evolution of the EU ICT sector, including its R&D expenditures since 1995. In section 2, the ICT sector and sub-sectors of EU Member States are compared, starting from 2006. In section 3, the analysis is extended to non-EU countries, therefore considering the position of EU in the international landscape. The Annex provides additional information for readers interested in getting a deeper insight.

The information in the three sections is organized in a way that makes possible to follow the track of the most relevant facts for each of the variables which integrate the PREDICT Dataset. These variables are: (i) Value added (VA); (ii) Employment; (iii) Labour productivity, both in terms of persons and of hours worked; (iv) Business expenditures on R&D (BERD); (v) BERD intensity (BERD/GDP); (vi) R&D Researchers (RERD); (vii) R&D personnel (PERD); (viii) Public funding of R&D (GBARD), and (ix) ICT GBARD, which is the part of GBARD devoted to fund ICT-related expenditures in any industry of the economy (see Box 1). Throughout the report the term *billion* refers to a one thousand million.

PREDICT analyses follow the OECD definition of the ICT sector (OECD, 2007)⁴, which is based on the Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2⁵. This definition of the ICT sector was adopted in 2006, and since 2008 all Member States have been required to refer to it when reporting ICT sector data. Regarding the *Media and content* sector⁶, which has been included in the report because of its relevancy and its increasing inter-relation with the ICT sector, PREDICT also follows the OECD definition (OECD, 2011). The 2020 edition of the PREDICT Key Facts Report is based on the *operational definition*, shown in Box 2. The latter differs from the OECD definition, as it does not include the ICT trade industry (NACE Rev. 2 465) and *Manufacture of magnetic and optical media* (NACE Rev. 2 268). *The adoption of the operational definition allows* the comparison of data over a long-term period and with non-EU countries. This would not have been possible with the comprehensive definition, due to lack of data for the two above mentioned sectors (especially for non-EU countries). In the 2020 PREDICT Dataset, information according to the more comprehensive OECD definition is also available for the EU28 and its Member States.

³ This Key Fact Report mainly uses the information included in the PREDICT 2020 database. However, some additional information is needed, i.e. Value added, Employment, BERD, RERD and PERD for the EU28, in the years not covered by the routine data collection and not nowcasted for the whole EU28. This additional information is taken from Eurostat.

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

⁵ The period covered in the PREDICT database required the development of a methodology to reclassify NACE Rev. 1.1 data for ICT R&D over the period 1995-2007 according to NACE Rev. 2 classification. This methodology is provided in Mas, Robledo, Pérez, Stančík, Turlea and Desruelle (2012).

⁶ The Media and content industries are those “engaged in the production, publishing and/or the electronic distribution of content products”, OECD (2011).

Box 1. Definition of GBARD and ICT GBARD

GBARD and ICT GBARD

GBARD (Government budget allocations for R&D) is -according to Frascati Manual (OECD, 2015)- an approach for measuring government funding of R&D using data from government budgets. This type of funder-based approach for reporting R&D involves identifying all the budget items that may support R&D activities and measuring, or estimating, their R&D content.

ICT sector GBARD is the part of total GBARD assigned to ICT producing industries

ICT GBARD is the part of GBARD devoted to fund ICT-related expenditures in any industry of the economy, not only those belonging to the ICT producing sector.

ICT sector ICT GBARD is the part of ICT GBARD assigned to ICT producing industries.

This report considers data for different levels of sectoral disaggregation. The total economy and the following sectors are considered: *ICT*, *Media and content* (MC), and *Retail sale via mail order houses or via Internet* (RS). For the ICT sector, the distinction between ICT manufacturing and ICT service sectors is considered. In addition, ICT manufacturing is further disaggregated into four sub-sectors: (i) *Electronic components and boards*, (ii) *Computers and peripheral equipment*, (iii) *Communication equipment*, and (iv) *Consumer electronics*. Moreover, the ICT services sector is disaggregated into two sub-sectors: (i) *Telecommunications* and (ii) *Computer and related activities*.

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

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

Whenever possible, the information provided in the report allows to easily compare: (i) the ICT sector with the total economy; (ii) the ICT manufacturing sector with the ICT services sector; (iii) each of the four ICT manufacturing, two ICT services, MC and RS sectors' performance; (iv) the pace of EU countries; and (v) the position of the EU28 in the international context (including the role of the most relevant countries in the current worldwide economy landscape).

The analyses developed in this report make possible to answer questions as, for instance, the following ones. Is the ICT sector still a highly dynamic economic sector? Which is its role in the creation of employment? Is ICT manufacturing still the key sector for R&D expenditures? In which sector is productivity increasing faster? Within the EU28, which country is taking the lead? Which ones are falling behind? Is the US still the leading country in terms of innovation and technological progress? Has the gravitational centre of the world economy moved towards Asia, and away from the EU28?

The main body of the report contains 25 figures (including detailed information for each variable) and 3 tables summarizing the main statistical information. The Annex offers 74 additional figures providing more detailed information about the EU28 ICT sector and its R&D. The Annex is organized in four sub-sections. Sub-section 4.1 refers to the ICT sector and its R&D in the EU28; sub-section 4.2 provides an analysis of the EU28 ICT sub-sectors. Sub-section 3 offers the information by EU28 Member States. Sub-section 4.4 offers the comparison with other non-EU economies. Details regarding the development of the 2020 PREDICT Dataset are contained in the 2020 PREDICT Dataset Methodology.

1 The EU28 ICT sector

In 2017 the EU28 ICT sector VA was 630 billion euros, it employed 6.3 million people and spent 32 billion euros on R&D business expenditures (BERD). The ICT sector represented 4.1% of the EU28 value added in 2017, 2.7% of the employment, 15.2% of total BERD, and 18.1% of the R&D personnel and 20.4% of the researchers (see Table 1). The ICT GBARD in the EU28 was 6.7 billion euros, which represented 6.9% of total public funding in R&D (total GBARD) and 0.04% of total GDP.

The ICT sector in 2017 was more dynamic than the whole EU28 economy in value added (6.5%), employment (4.7%), GBARD (4.9%) and ICT GBARD (7.0%). The ICT sector in the EU28 has shown a more dynamic behaviour than the total economy since 1995. The gap is especially noticeable for Value Added (VA) and business expenditures in R&D (BERD).

From 1995 until 2017, the EU28 ICT sector multiplied its VA in real terms by a factor of 3.8, while the one of the total economy increased by 1.5. The growth of employment was much more moderate: the number of persons employed in ICT in 2017 is 1.5 times the number of persons employed in the same sector in 1995. According to PREDICT estimates, both variables continued to grow in 2018 and 2019. Labour productivity in the ICT sector (both in terms of persons and hour worked) grew much faster than labour productivity in the total economy. The value reached in 2017 is 2.5 times the value of 1995 and, according to the estimations carried out in this project, the same trend is maintained also in 2018 and 2019. Business expenditure in R&D in the ICT sector presents a behaviour that is more dynamic than the one of the total economy. From 1995 to 2017, its value multiplied by a factor of 3.5, and estimated values indicate that this trend has continued in 2018 and 2019. In the same period, the BERD of the total economy only grew 1.9 times. On the other hand, BERD intensity (measured as the BERD/GDP ratio in nominal terms) presents a decrease in the period 1995-2017 and the PREDICT estimations reveal the same trend also for the two following years. In turn, the number of researchers evolved at a similar rate in the ICT sector as in the total economy, increasing by a factor of 2.1 since 1995, while the number of R&D personnel increased, once again, at a faster rate in the ICT sector. Public funding of R&D is measured through GBARD. The part of GBARD devoted to funding ICT-related expenditures, i.e., ICT GBARD, grew in the ICT sector by 4.8% annually in nominal terms between 2006 and 2018, whereas in the total economy, it only grew at an annual rate of 2.8% (in nominal terms).

Table 1: Summary table of ICT indicators by sub-sector. Operational definition. EU28

a) 2017

NACE Rev. 2	Description	VA	Employment	BERD	GBARD	ICT GBARD	RERD	PERD
		(Millions of current EUR)	(thousand persons employed)	(Millions of current EUR)	(Millions of current EUR)	(Millions of current EUR)	(thousand full-time equivalent)	(thousand full-time equivalent)
261-264	ICT manufacturing industries	54,235.2	621.6	10,057.2	372.3	79.4	51.3	71.7
261	Manufacture of electronic components and boards	27,728.9	324.1	5,201.7	170.1	18.2	23.8	33.1
262	Manufacture of computers and peripheral equipment	6,065.2	80.6	1,076.2	68.9	28.5	5.9	8.7
263	Manufacture of communication equipment	15,099.1	156.3	3,324.8	110.2	29.0	19.3	26.0
264	Manufacture of consumer electronics	5,341.9	60.7	454.6	23.2	3.7	2.3	3.9
582, 61, 62, 631, 951	ICT services industries	575,810.8	5,711.7	22,033.6	3,534.9	1,823.8	156.5	246.4
61	Telecommunications	177,404.2	1,034.5	3,768.6	1,501.8	460.8	21.3	30.9
582, 62, 631, 951	Computer and related activities	398,406.6	4,677.2	18,265.0	2,033.1	1,363.0	135.1	215.5
261-264, 582, 61, 62, 631, 951	ICT total	630,046.0	6,333.4	32,090.8	3,907.2	1,903.2	207.7	318.1
	Total economy	15,409,885.0	235,899.8	210,651.0	97,866.7	6,722.7	1,017.0	1,757.9

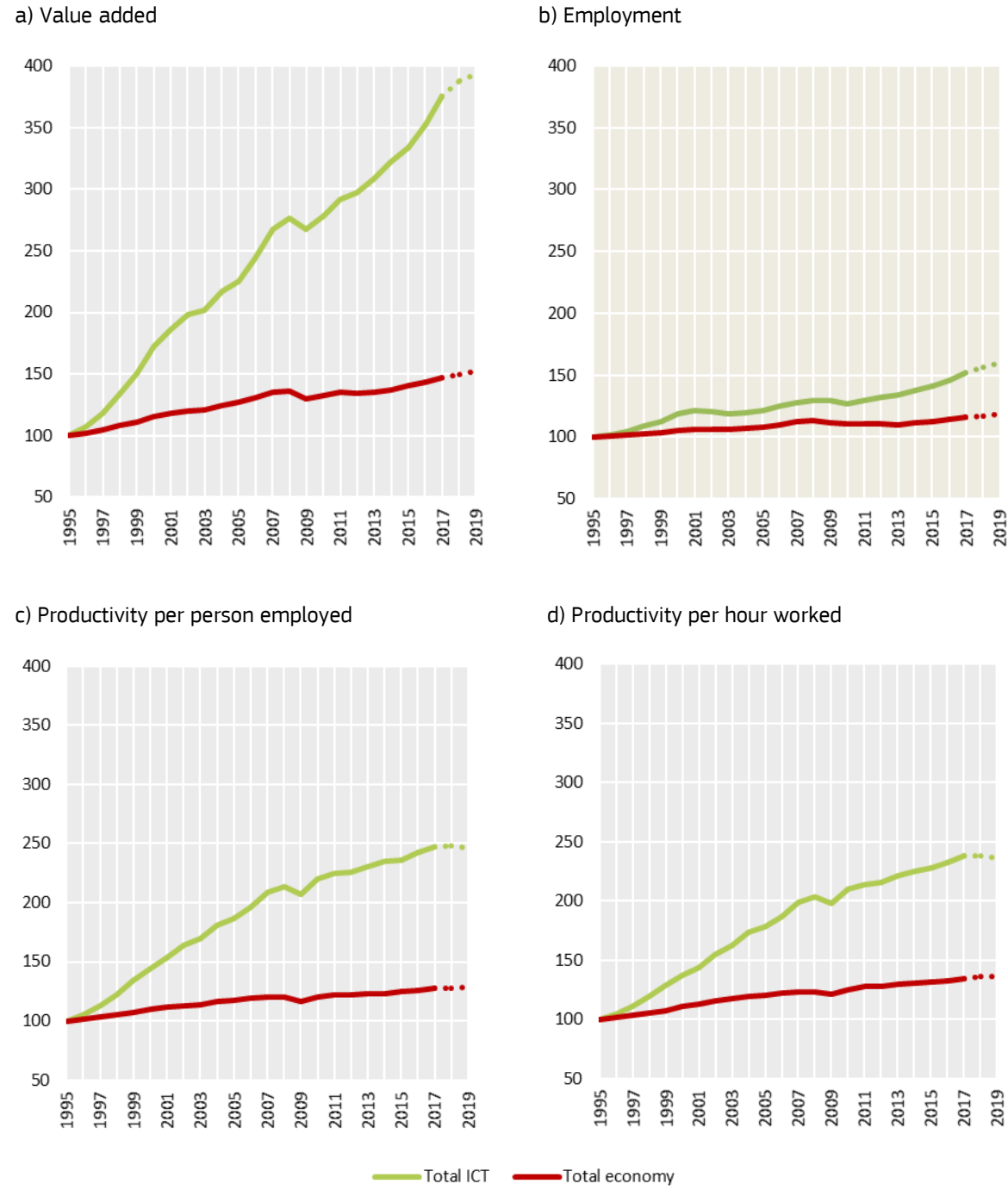
b) Annual growth rates (%), 2016-2017

NACE Rev. 2	Description	VA	Employment	BERD	GBARD	ICT GBARD	RERD	PERD
261-264	ICT manufacturing industries	1.2	2.7	-4.7	11.5	11.5	-14.1	-12.8
261	Manufacture of electronic components and boards	-2.3	4.5	6.4	11.5	11.5	4.4	1.9
262	Manufacture of computers and peripheral equipment	0.2	-0.2	-1.2	11.5	11.5	-8.5	-7.5
263	Manufacture of communication equipment	3.0	3.0	-20.1	11.5	11.5	-31.3	-29.0
264	Manufacture of consumer electronics	18.6	-3.0	9.8	11.5	11.5	-4.4	4.9
582, 61, 62, 631, 951	ICT services industries	7.1	4.9	9.2	4.3	7.1	13.0	11.1
61	Telecommunications	3.3	-1.0	4.4	-4.1	-4.1	8.5	5.1
582, 62, 631, 951	Computer and related activities	8.9	6.3	10.3	11.4	11.4	13.7	12.1
261-264, 582, 61, 62, 631, 951	ICT total	6.5	4.7	4.4	4.9	7.2	4.8	4.7
	Total economy	2.6	1.6	5.6	2.0	2.6	6.7	6.2

Note: Monetary variables are expressed in real terms. GBARD and ICT GBARD growth rates for ICT sectors are practically the same because the 2015 LFS weights are used for calculations from that year onwards. For further details see the methodological report.

Source: 2020 PREDICT Dataset

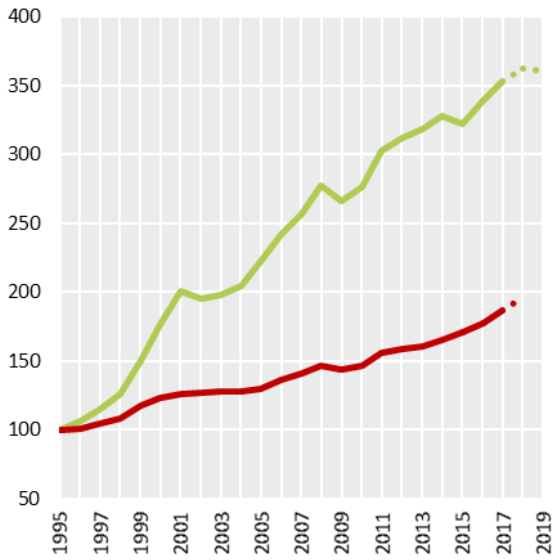
Figure 1: Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28 (1995-2019, Index 1995=100)



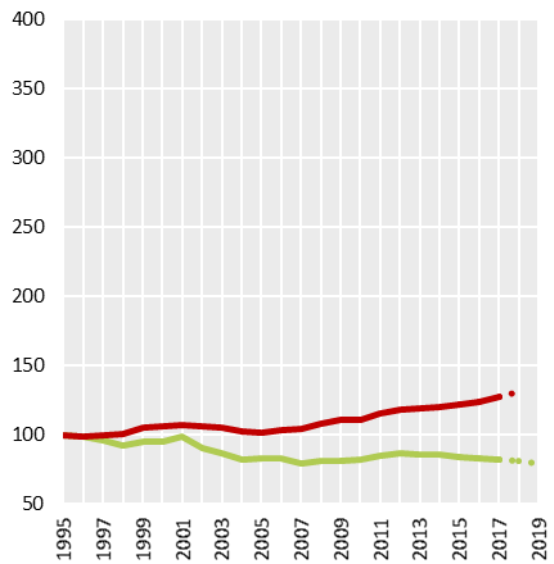
Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.
 Source: 2020 PREDICT Dataset and Eurostat.

Figure 1 (cont.): Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28 (1995-2019, Index 1995=100)

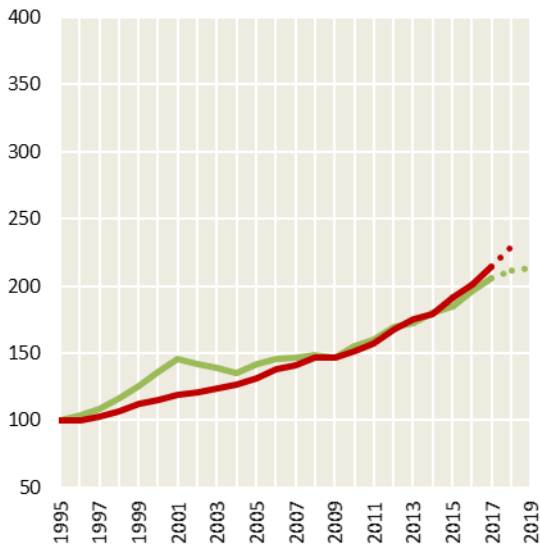
e) BERD



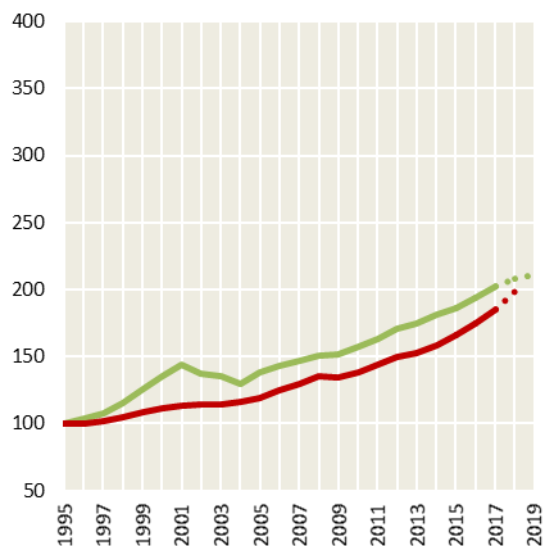
f) BERD intensity (BERD/VA)



g) RERD



h) PERD

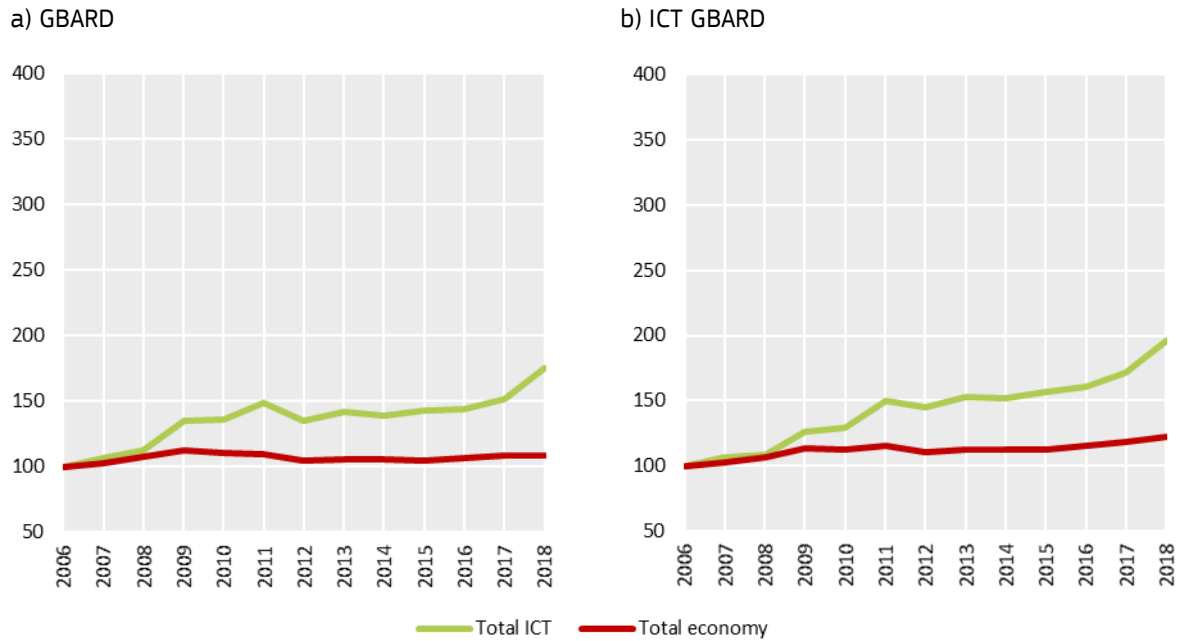


— Total ICT — Total economy

Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

Figure 2: Total economy and ICT sector: GBARD and ICT GBARD in the EU28 (2006-2018, Index 2006=100)



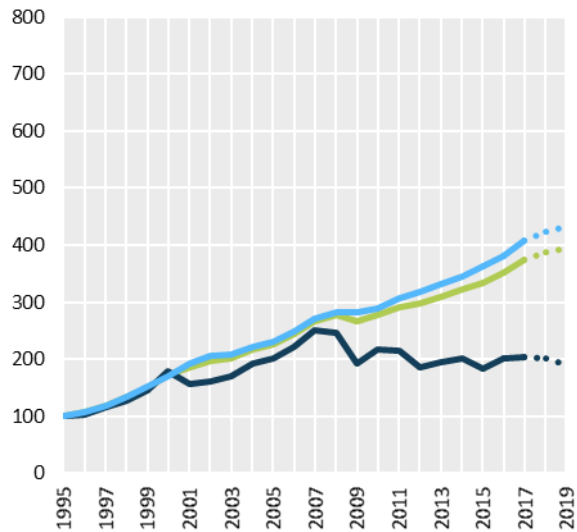
Note: GBARD and ICT GBARD are expressed in real terms. ICT GBARD is the part of GBARD (Government budget allocations for R&D) devoted to fund ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector (see Box 1 in the Introduction).

Source: 2020 PREDICT Dataset.

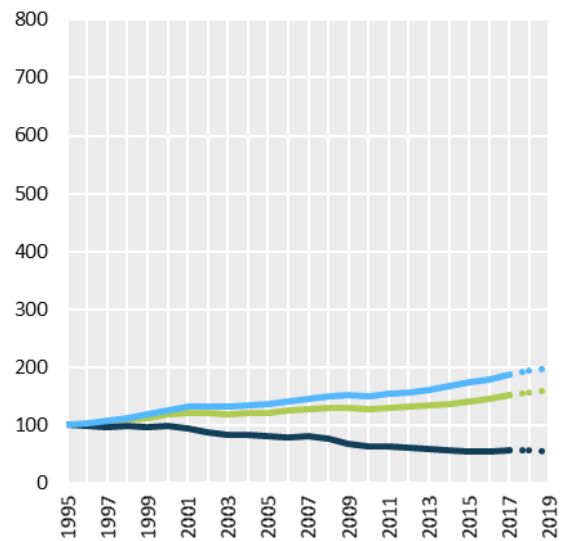
Public funding in R&D also had a more dynamic behaviour in the ICT sector than in the total economy. This result applies to both total GBARD assigned to ICT producing industries as well as to ICT GBARD (Figure 2) which considers ICT related expenditures (see box 1 in the introduction). In the first case, it multiplied its level between 2006 and 2018 by a factor of 1.8, while for total economy it did so by only 1.1. In the case of ICT GBARD, the corresponding values are 2.0 and 1.2.

Figure 3: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28 (1995-2019, Index 1995=100)

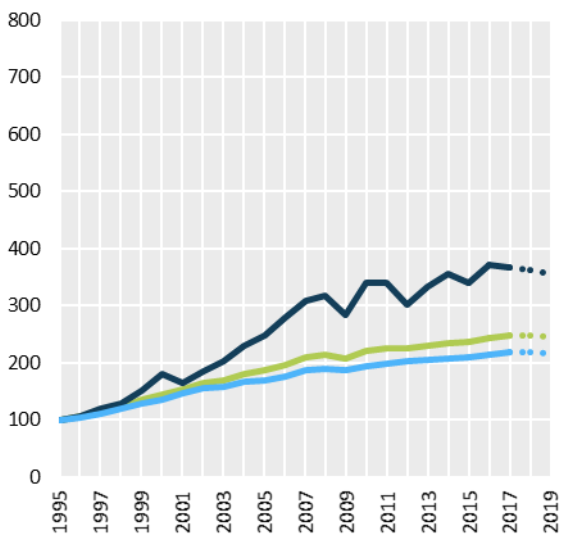
a) Value added



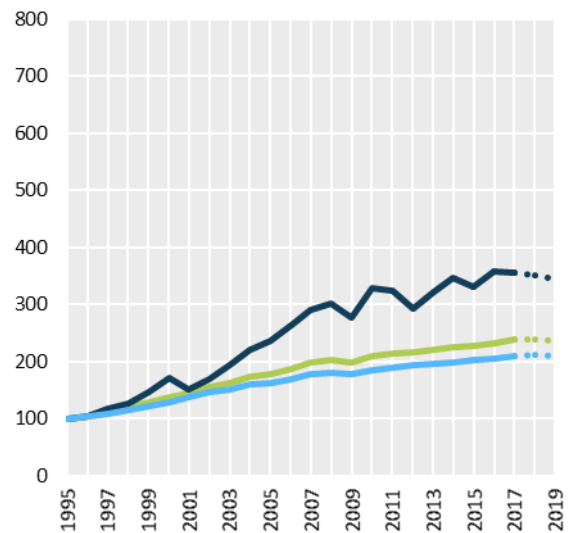
b) Employment



c) Productivity per person employed



d) Productivity per hour worked



— Total ICT — ICT manufacturing — ICT services

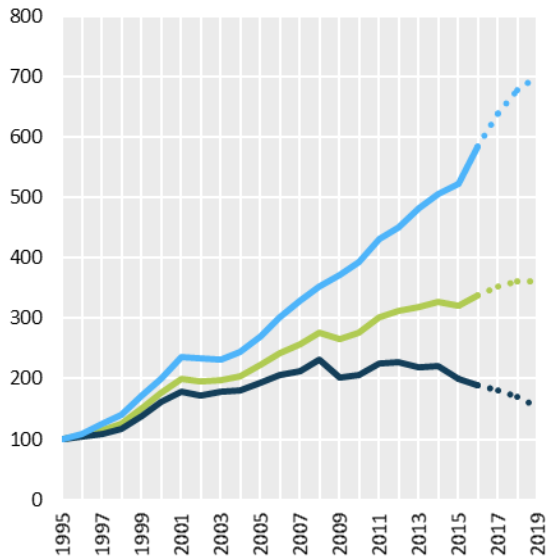
Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset.

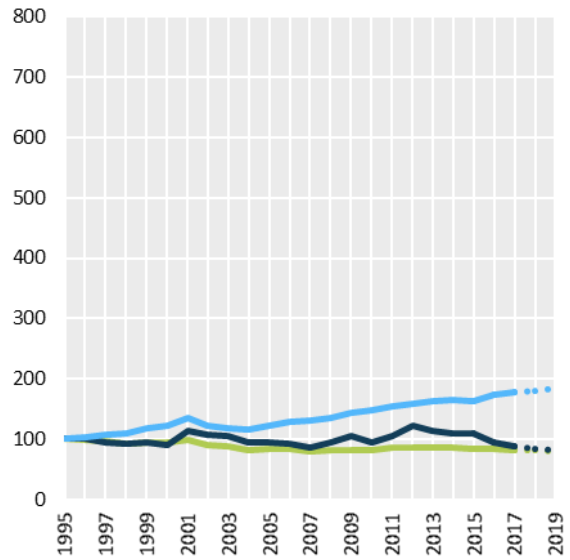
The more dynamic behaviour of the ICT sector in the EU28 is mostly due to the ICT services sector (Figure 3). The more dynamic behaviour shown by the ICT sector has its origin in the ICT services sector. From 1995 to the aftermath of the crisis, value added in ICT manufacturing and ICT services sectors grew at a similar rate. Since then, ICT manufacturing has slowed down, while ICT services VA have continued growing. In the case of BERD, the increase in ICT services also surpasses that of ICT manufacturing. In terms of labour, while employment growth in the ICT services sectors was higher than for the total economy, ICT manufacturing employment suffered an almost continuous fall, at least since 1999. As a result, labour productivity in ICT manufactures presented a much higher rate of growth than in ICT services.

Figure 3 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28 (1995-2019, Index 1995=100)

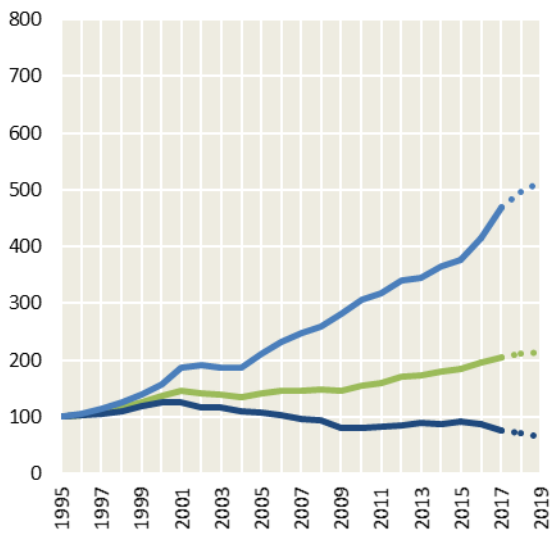
e) BERD



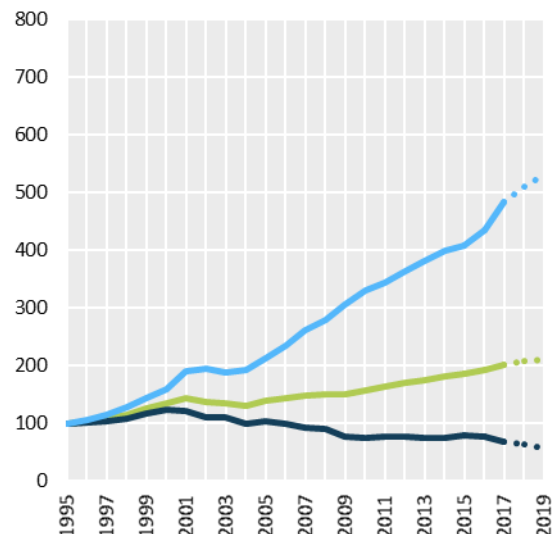
f) BERD intensity (BERD/VA)



g) RERD



h) PERD

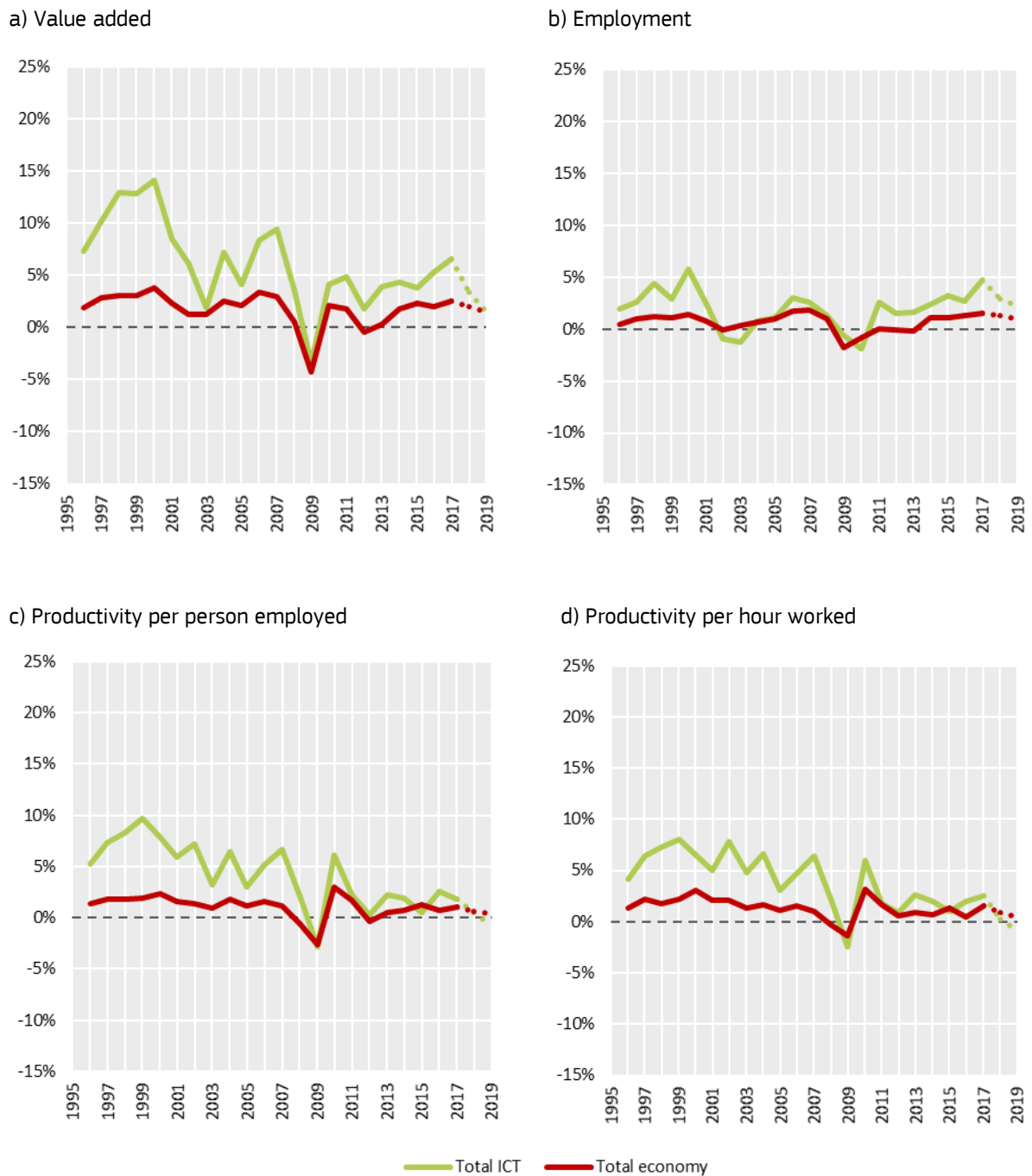


— Total ICT — ICT manufacturing — ICT services

Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset.

Figure 4: Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28. Annual growth rates (1995-2019)

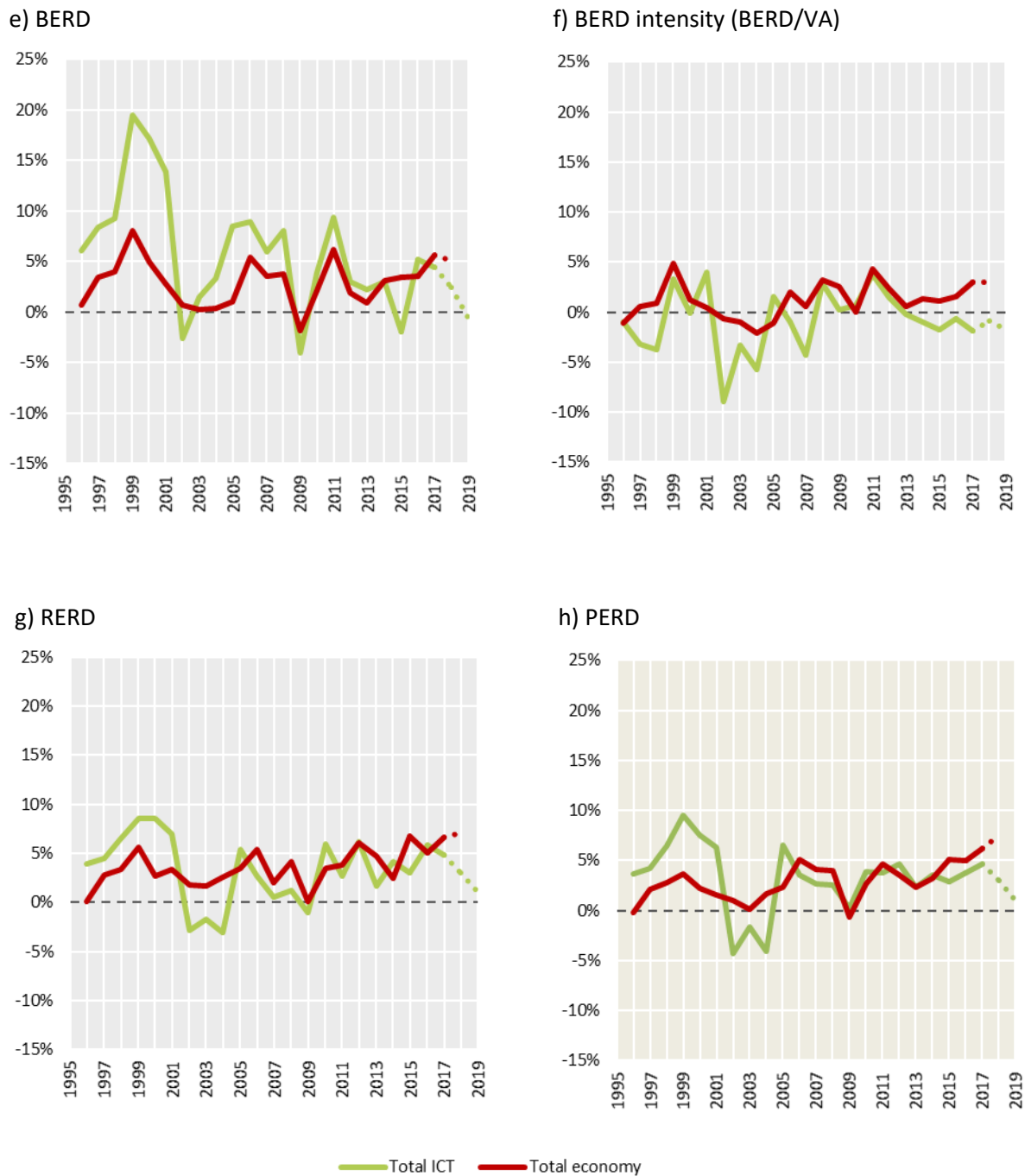


Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset.

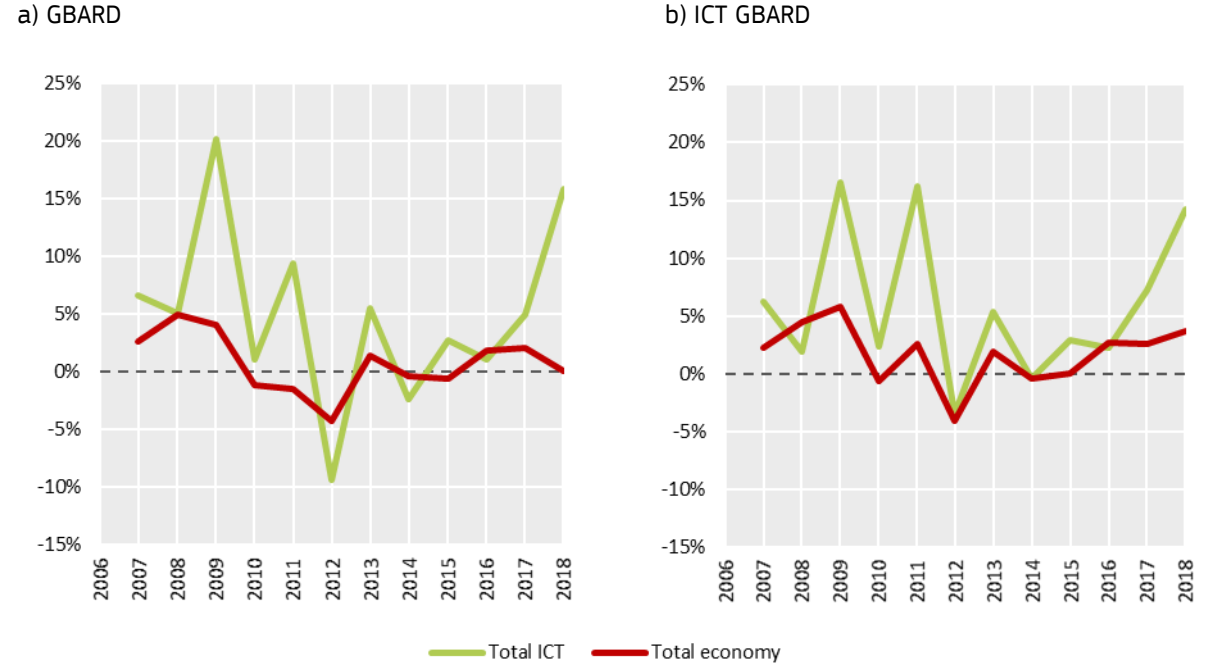
In terms of annual rates of change, all variables grew at a faster rate in the ICT sector than in the total economy, especially between 1995 and 2008 (Figure 4). The only exceptions were R&D researchers and R&D personnel, which presented lower rates during the first years of the century. Since the crisis started, the dynamics of the ICT sector has been similar to the total economy. In 2017 ICT sector VA, employment, labour productivity per hour worked, and R&D personnel (PERD) registered an accelerated growth. However, ICT sector productivity per person employed, BERD and R&D researchers (RERD) slowed down. The estimated figures for the ICT sector for 2018-2019 show a deceleration for all the variables.

Figure 4 (cont.): Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28. Annual growth rates (1995-2019)



Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.
 Source: 2020 PREDICT Dataset.

Figure 5: Total economy and ICT sector: GBARD and ICT GBARD in the EU28. Annual real growth rates (2006-2018)

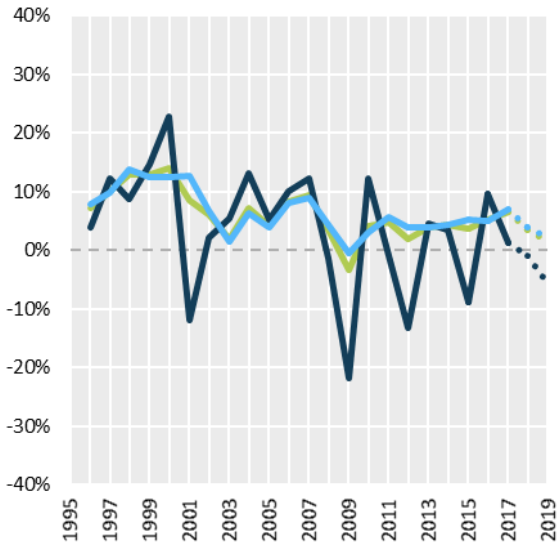


Source: 2020 PREDICT Dataset.

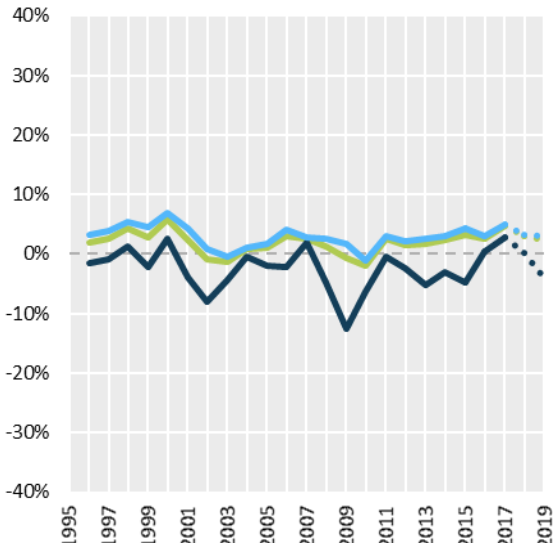
The real growth rate of GBARD in the ICT sector (Figure 5) has been higher (albeit more volatile) than for the total economy throughout the period, with the only exceptions being 2012, 2014 and 2016. A similar result can be observed for ICT GBARD. Since 2017 GBARD and ICT GBARD show an upturn for the ICT sector after the decrease in 2016, while slightly increasing for the total economy in ICT GBARD, but decreasing in GBARD.

Figure 6: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28. Annual growth rates (1995-2019)

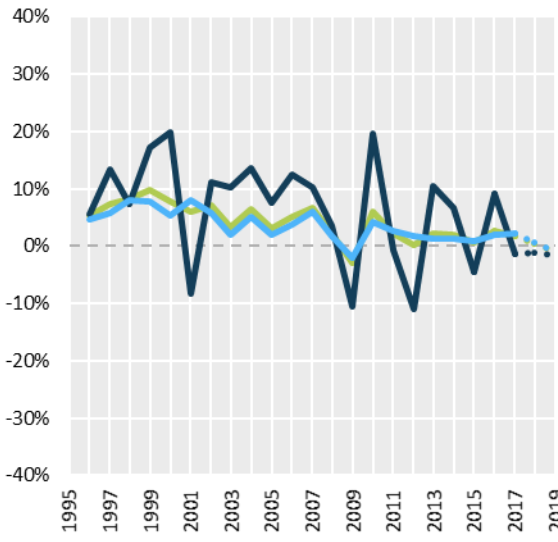
a) Value added



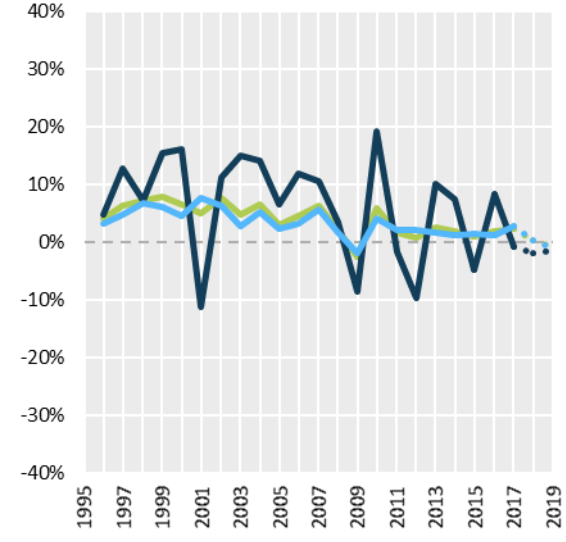
b) Employment



c) Productivity per person employed



d) Productivity per hour worked

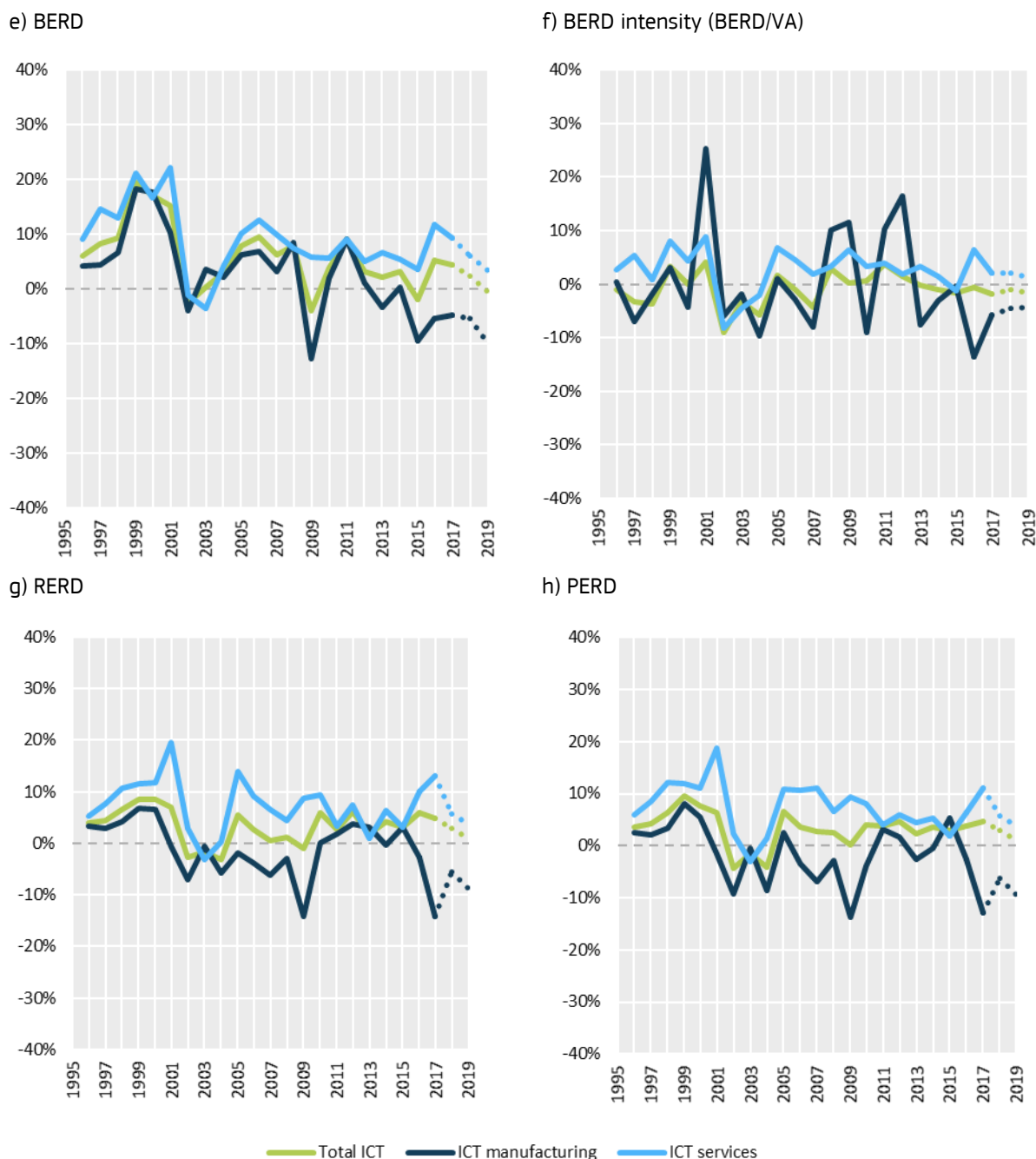


— Total ICT — ICT manufacturing — ICT services

Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.
Source: 2020 PREDICT Dataset and Eurostat.

The cyclical profile (as measured by the annual growth rates) for total ICT producing sectors follows that of ICT services sectors due to their higher weight in the aggregate. The latter shows a much more stable growth rate than the ICT manufactures producing sector. This result holds for VA, employment, labour productivity, BERD and BERD intensity, but is less apparent for R&D researchers and personnel. In the case of those two variables, volatility applies to both, ICT service and ICT manufacturing. However, the growth rate is always higher for ICT services (Figure 6).

Figure 6 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU28. Annual growth rates (1995-2018)

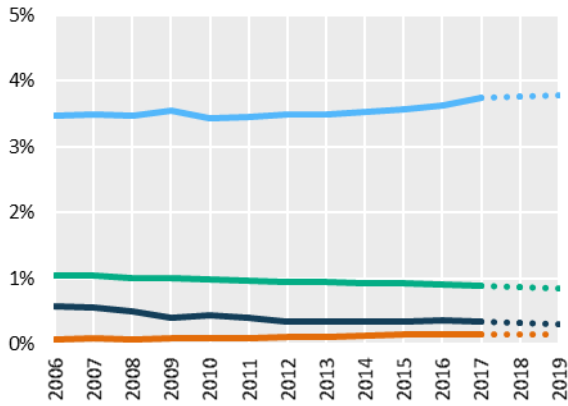


Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

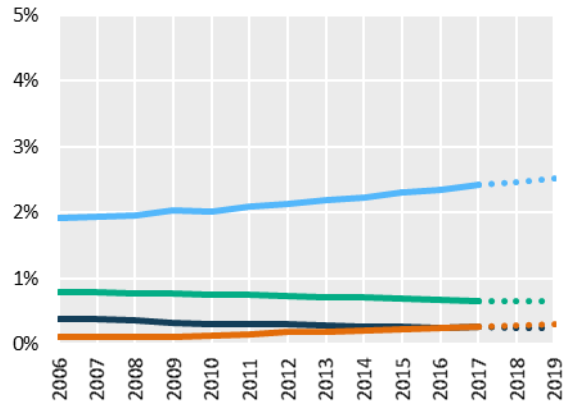
Source: 2020 PREDICT Dataset and Eurostat.

Figure 7: ICT manufacturing, ICT services, MC and RS sectors share of the total economy in the EU28 (percentages, 2006-2019)

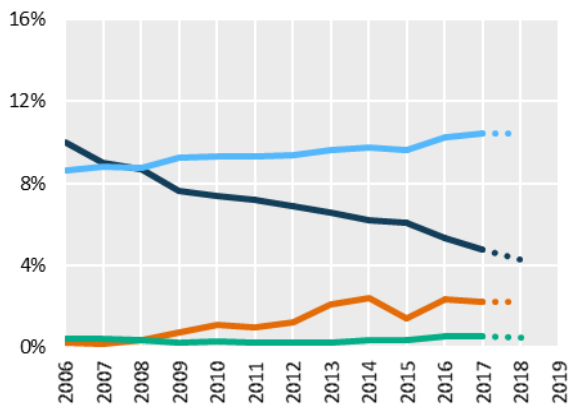
a) Value added



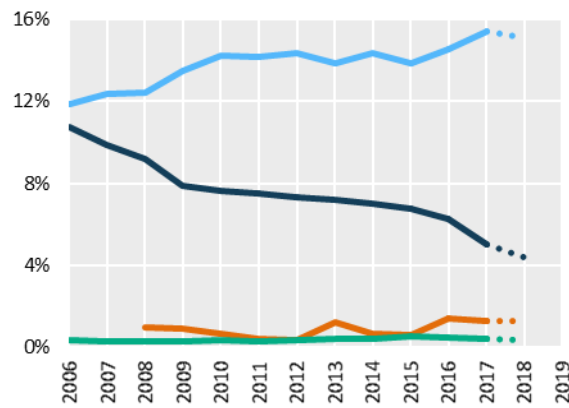
b) Employment



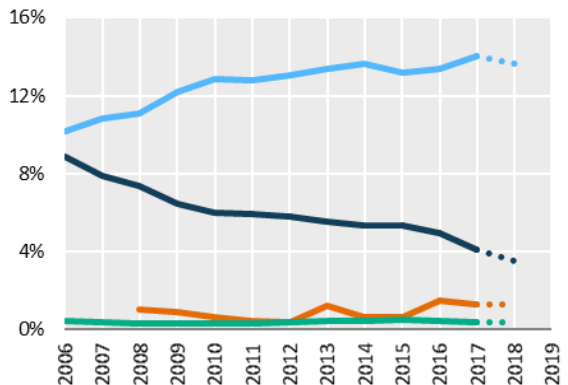
c) BERD



d) RERD



e) PERD



— ICT manufacturing
— ICT services
— RS
— MC

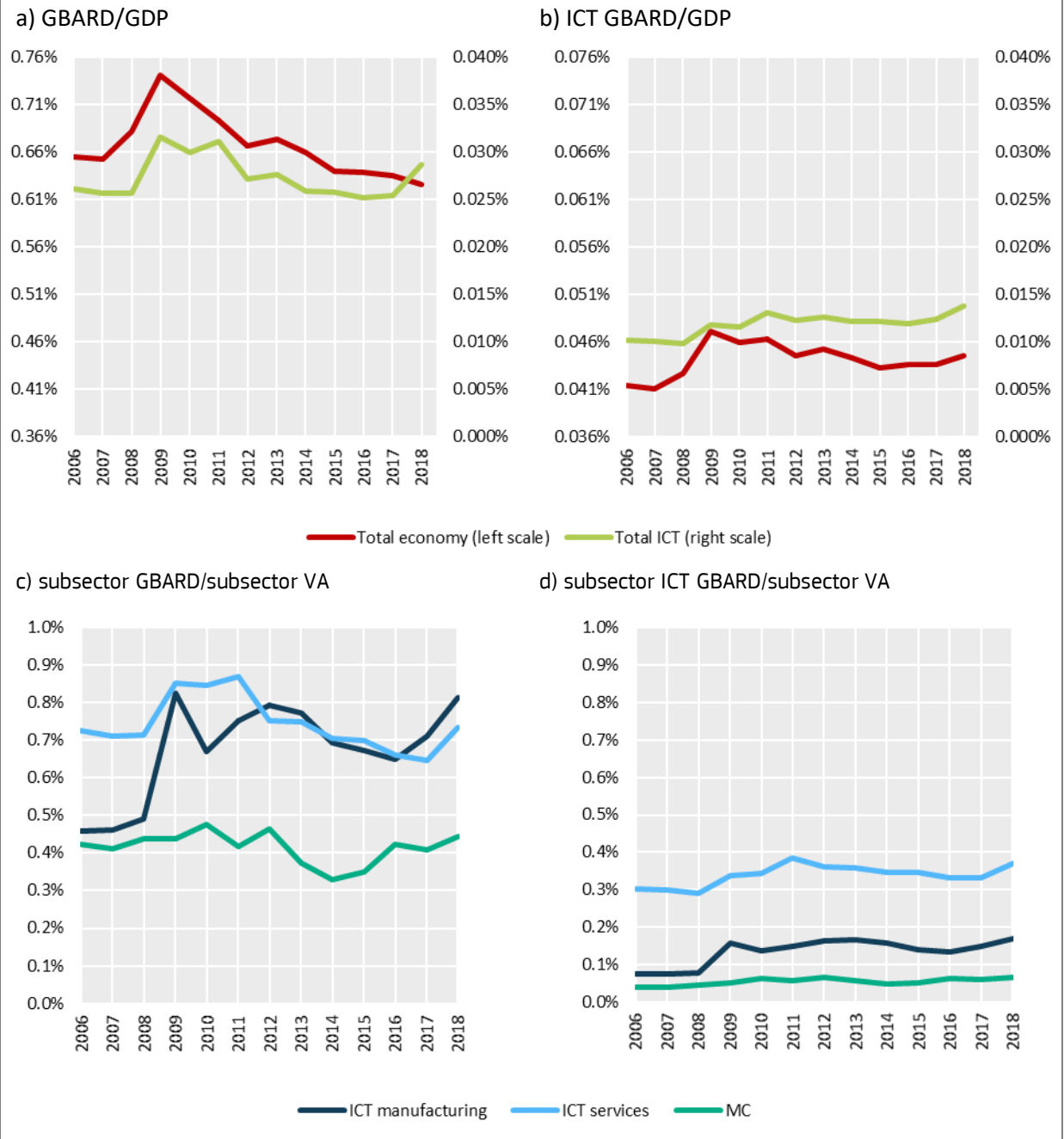
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

In 2017 employment showed a positive growth both in ICT manufacturing and ICT services. In the case of VA, productivity, R&D researchers and R&D personnel growth rates were positive for ICT services and negative for ICT manufactures, whereas growth rates of BERD were positive for ICT manufacturing and negative for ICT services. For 2018 and 2019, the provisional values point to a downward trend for both ICT sectors, with the only exception of RERD in ICT manufacturing sector.

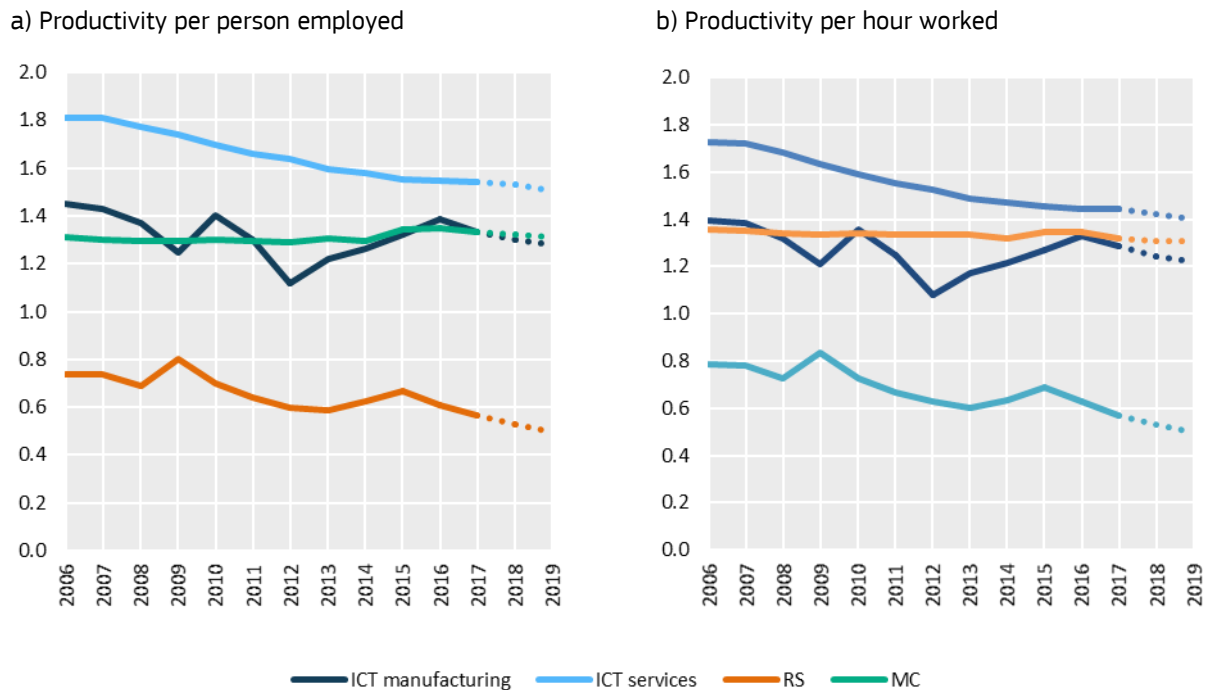
In 2017 the VA generated by the ICT service sector represented 3.7% of GDP, following a slightly positive trend, while ICT manufactures only reaches 0.3%, showing a declining evolution (Figure 7). The ICT producing sectors altogether amounted to 4.0% of GDP. The weight of the media content sector in GDP is twice that of ICT manufactures and also shows a declining trend. The share of the retail sector via mail order houses or via Internet (RS) is almost negligible in the EU28 but shows a positive trend in the most recent years. In terms of employment, the weight of all ICT-related sectors is lower (2.6%). In line with other variables already analysed, ICT manufacturing has suffered a severe fall in terms of R&D researchers, R&D personnel and also BERD. It is interesting to observe how the retail share is relatively higher in BERD than in other variables.

Figure 8: Total economy, ICT sector, ICT manufacturing, ICT services and MC sector. GBARD and ICT GBARD intensities in the EU28 (percentages, 2006-2018)



Total GBARD represented 0.63% of GDP in 2018 and 0.029% in the ICT sector. The first one has suffered a severe downturn since 2009, year in which it was equal to 0.74% (Figure 8). This decline is not observed (at least not as strongly) for the ICT sector. ICT GBARD presents a similar evolution. In 2018 GBARD in the ICT manufacturing sector amounted to 0.81% of its value added, a percentage slightly higher than in the ICT services, and almost doubling that of the MC sector. For ICT GBARD, the ICT services sector clearly dominates. The RS sector does not receive any GBARD or ICT GBARD funding.

Figure 9: ICT manufacturing, ICT services, MC and RS sectors productivity as a ratio over total economy productivity in the EU28 (2006-2019)



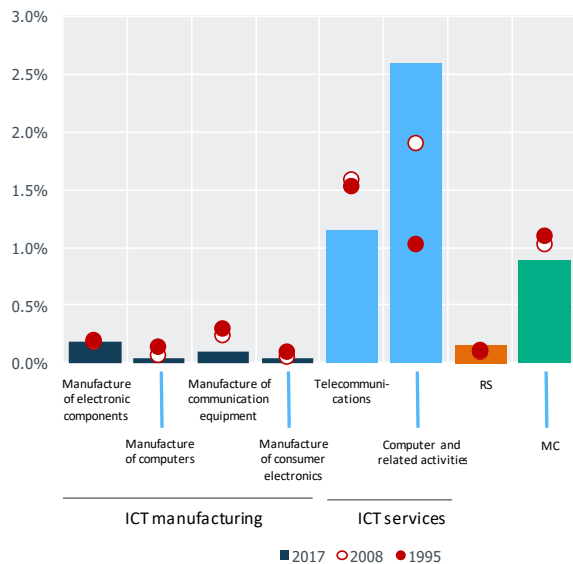
Note: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

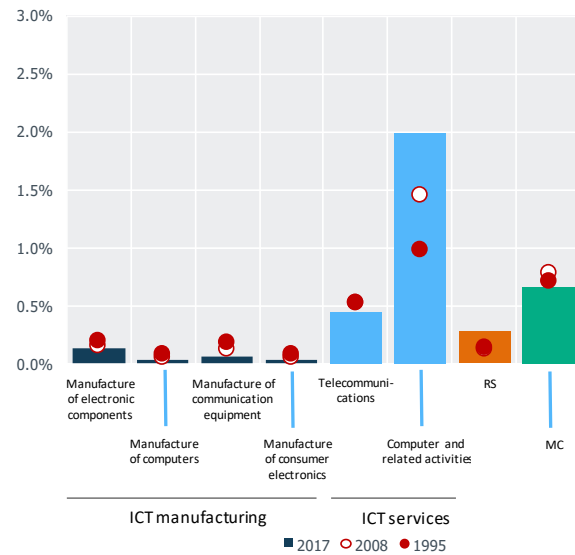
Labour productivity is higher in the ICT service sector than in total economy, and similar in ICT manufacturing and MC sectors. In all three cases, it is higher than in the RS sector. This result applies to both productivity in terms of persons and in terms of hours worked (Figure 9). It is worth noting that all the sectors have followed a declining path since 2006, with the only exception of the slight recovery of productivity per person for the MC sector. The estimations for 2018 and 2019 show a downward trend for all sectors.

Figure 10: ICT sector, MC and RS sector share of total economy by sub-sector in the EU28 (percentages, 1995, 2008, 2017)

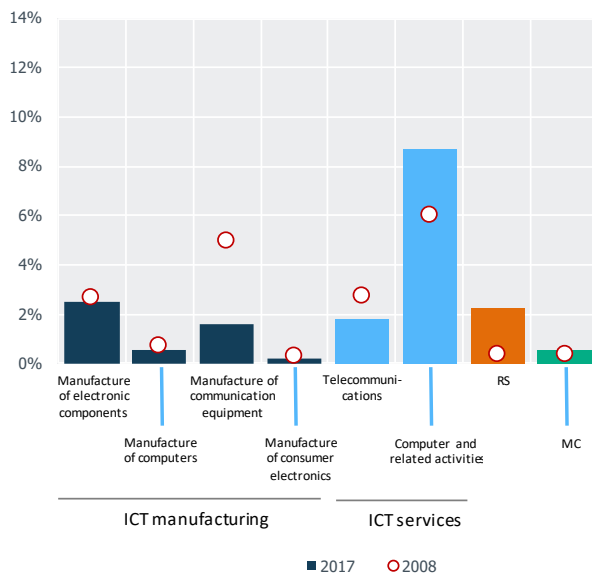
a) Value added



b) Employment



c) BERD



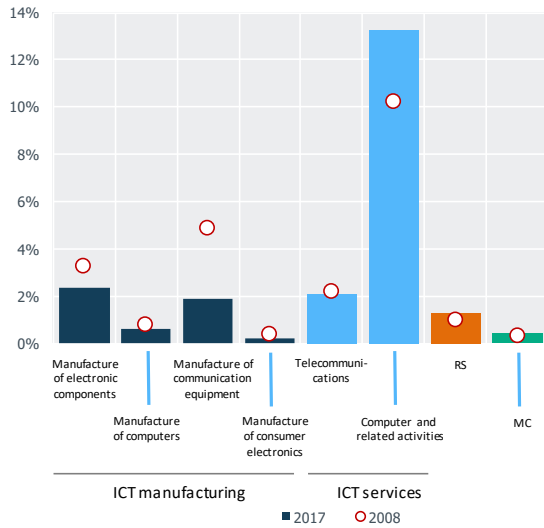
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet.

Source: 2020 PREDICT Dataset.

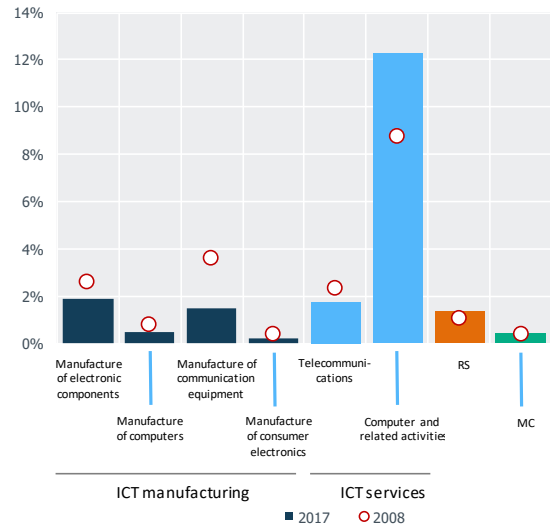
Computer and related activities is the ICT service sector with the highest weight over the total economy in all PREDICT variables in 2017 (2018 for GBARD and ICT GBARD) (Figure 10): VA (2.6%), employment (2.0%), Public funding (GBARD) (2.1%) and BERD (8.7%), and especially ICT GBARD (20.3%), R&D researchers (13.3%) and R&D personnel (12.3%). *Telecommunications* is the second in importance in the case of VA, employment, public funding (GBARD), and ICT GBARD. *Manufacture of electronic components* is second in importance in BERD, R&D researchers and R&D personnel. The *Media and content* sector has important shares in terms of VA and employment (0.89% and 0.66% respectively) in 2017. However, these values were higher in 1995. Its weight in terms of R&D variables is almost negligible.

Figure 10 (cont.): ICT sector, MC and RS sector share of total economy by sub-sector in the EU28 (percentages, 1995, 2008, 2017)

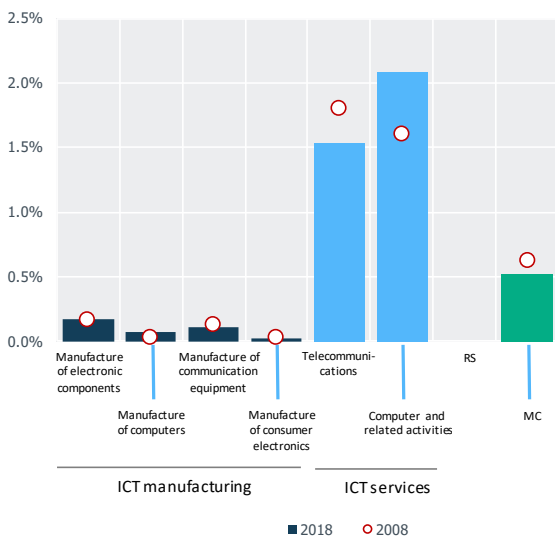
d) RERD



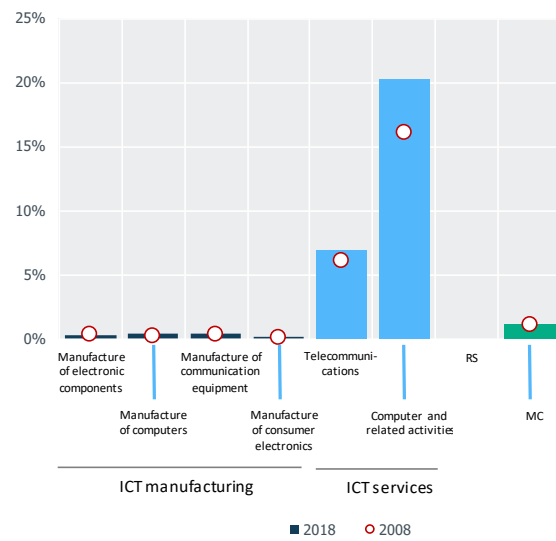
e) PERD



f) GBARD



g) ICT GBARD

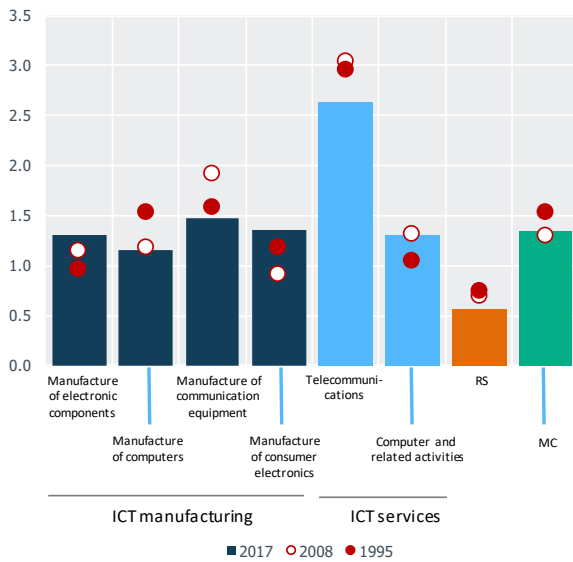


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. 2017 for GBARD and ICT GBARD. RS sector is not available.

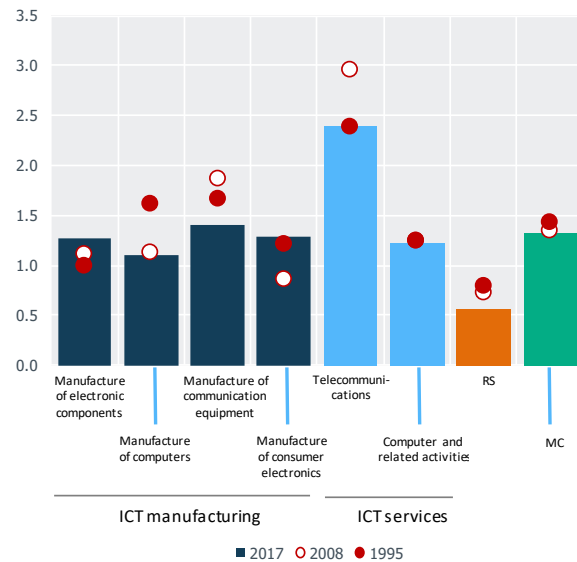
Source: 2020 PREDICT Dataset.

Figure 11: ICT sub-sectors, MC and RS sector productivity as a ratio over productivity in total economy in the EU28 (1995, 2008, 2017)

a) Productivity per person employed



b) Productivity per hour worked



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

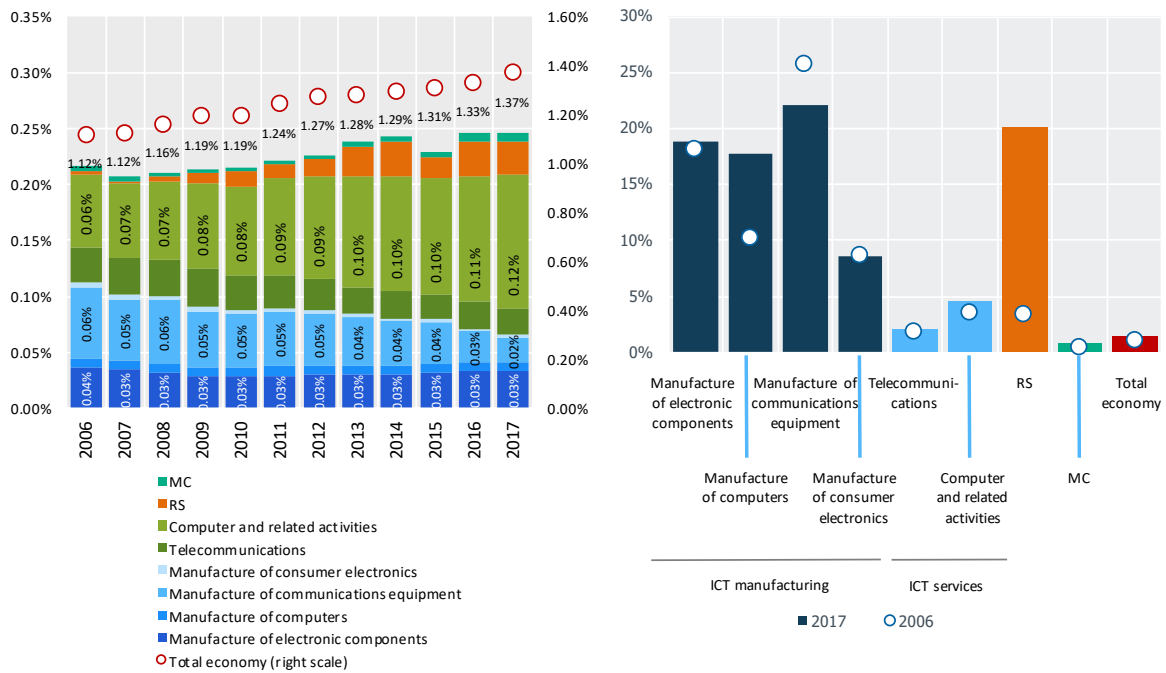
Source: 2020 PREDICT Dataset.

All sub-sectors belonging to the ICT sector have higher labour productivity than the total economy, both in terms of persons and hours worked, with the only exception of RS. *Telecommunications* has the highest ratio, followed by *Manufacture of communication equipment*, *Manufacture of consumer electronics* and *Media and content* (Figure 11). However, only the sectors of *Manufacturing of electronic components*, *Manufacturing of consumer electronics* and *Computer and related activities* (in terms of persons employed) have increased the gap since 1995. For the rest it has narrowed.

Figure 12: Total economy, ICT manufacturing, ICT services, RS and MC sectors BERD intensity in the EU28 (percentages, 2006-2017)

a) BERD/GDP

b) Subsector BERD/subsector VA (2006, 2016)



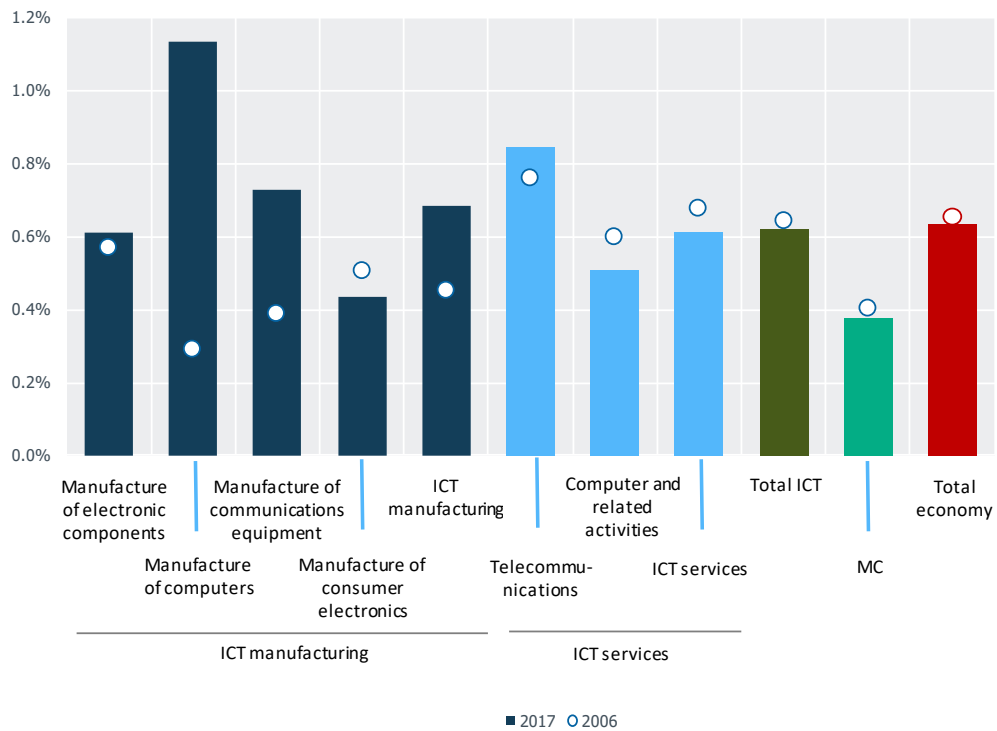
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet.

Source: 2020 PREDICT Dataset.

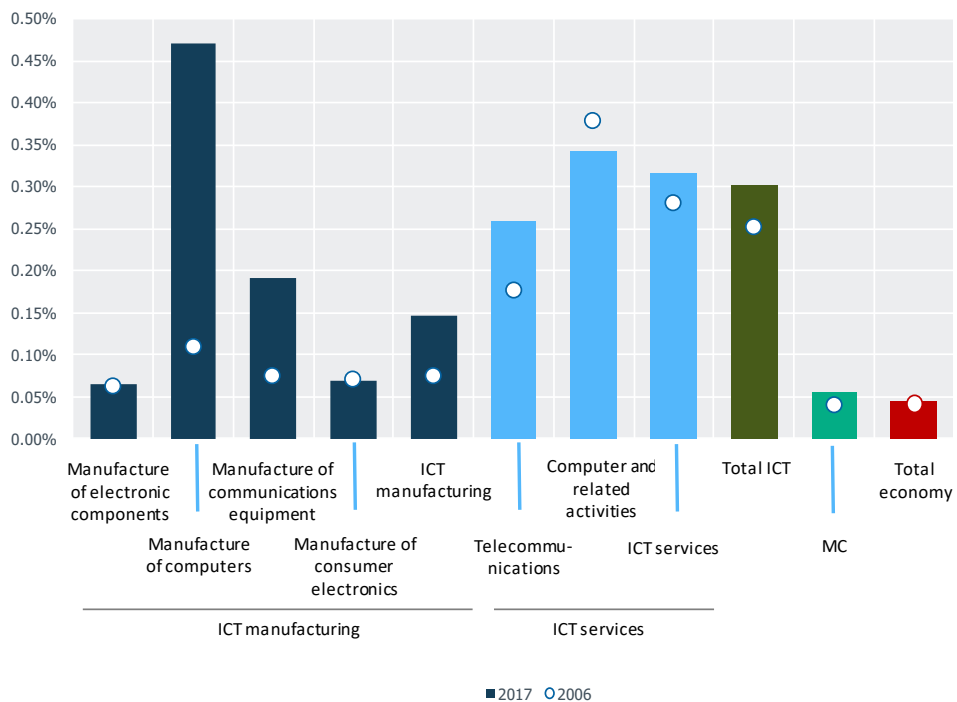
In 2017 the share of BERD over GDP amounted to 1.4% for the total economy and 0.21% in ICT, 0.01% in MC and 0.03% in RS sectors. The highest share is the one of *Computer and related activities* (0.12%) (Figure 12). BERD intensity for each sub-sector (sub-sector BERD/sub-sector VA) is higher in *Manufacture of communications equipment* (22.0%), followed by RS sector (20.1%) and *Manufacture of electronic components* (18.8%) and *Manufacture of computers* (17.7%). For almost all sub-sectors, BERD intensity was higher in 2017 than in 2006, with the only exception of *Manufacture of communications equipment* and *Manufacture of consumer electronics*.

Figure 13: ICT manufacturing and ICT services, GBARD and ICT GBARD in the EU28 (percentages, 2006, 2017)

a) GBARD intensity (sub-sector GBARD/sub-sector VA)



b) ICT GBARD intensity (sub-sector ICT GBARD/sub-sector VA)

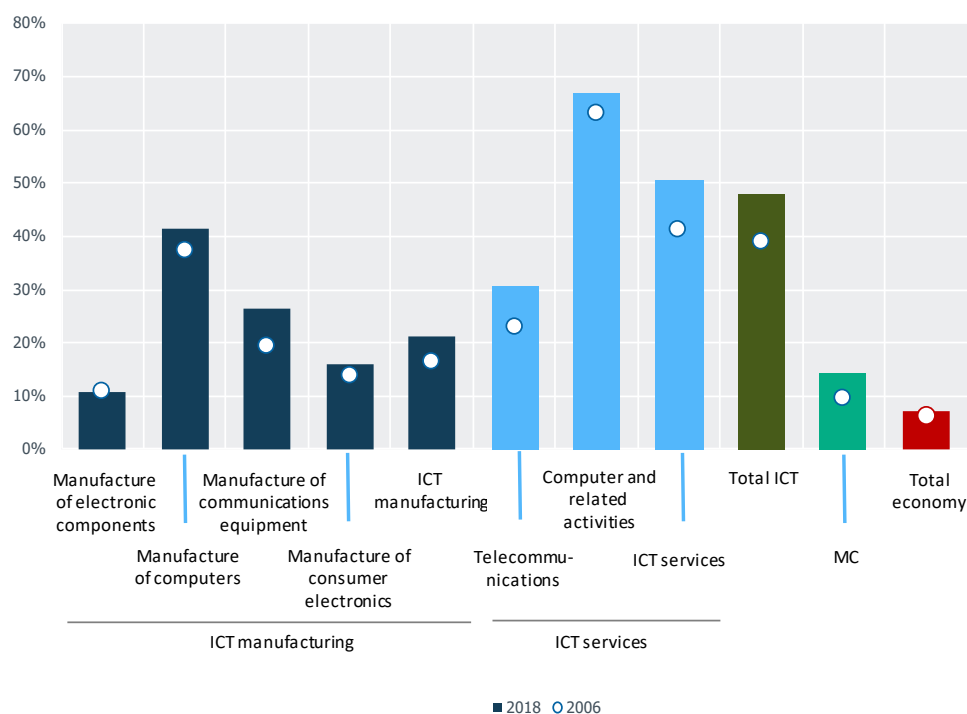


Note: MC: Media and Content.

Source: 2020 PREDICT Dataset.

Figure 13 (cont.): ICT manufacturing and ICT services, GBARD and ICT GBARD in the EU28 (percentages, 2006, 2017)

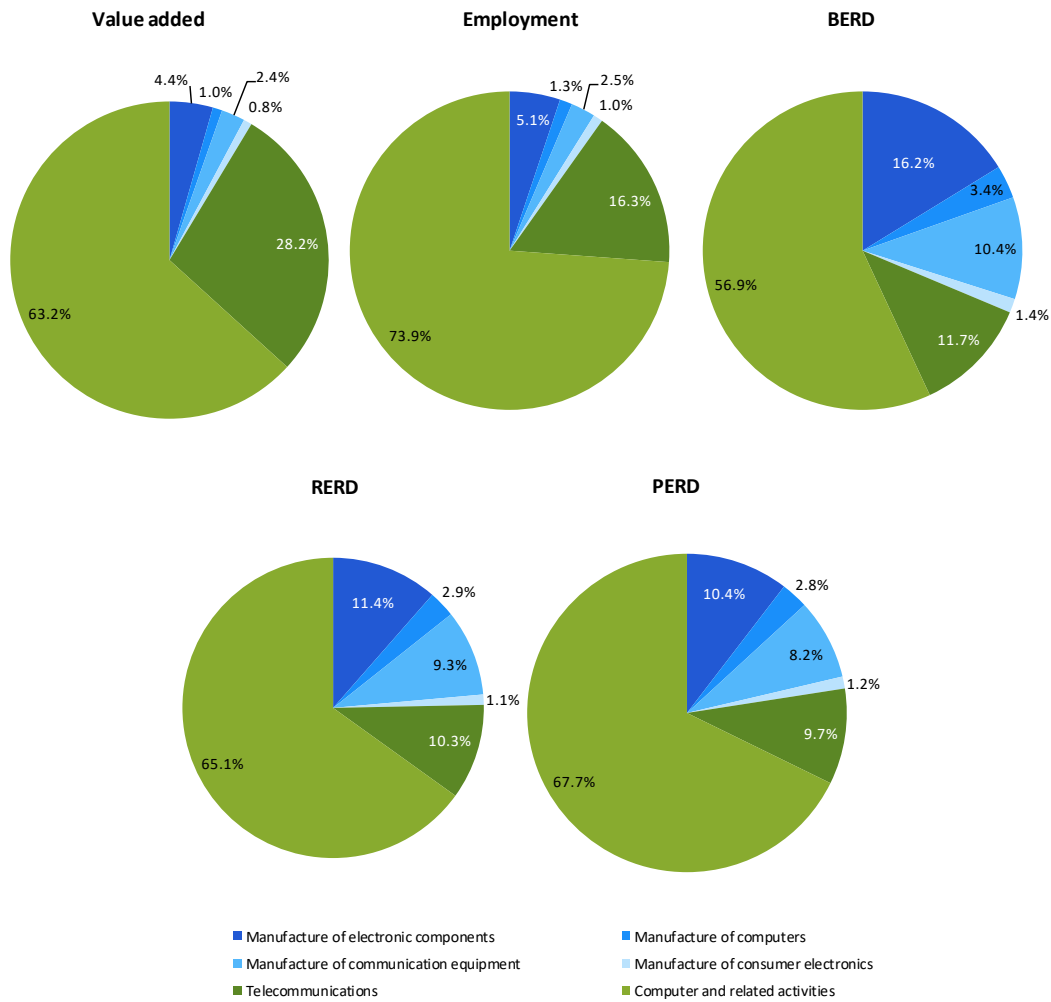
c) Sub-sector ICT GBARD / sub-sector GBARD



Note: 2018 for GBARD and ICT GBARD.
Source: 2020 PREDICT Dataset.

In 2017 GBARD intensity (defined as sub-sector GBARD/sub-sector VA) was higher in ICT manufacturing (0.69) than in ICT services (0.61) (Figure 13). In addition, while in the former it had increased since 2006, in the latter it had decreased. For the MC sector, this ratio is much lower and remained stable. *Manufacture of computers* and *Telecommunications* are the sub-sectors with the highest ratio. ICT GBARD intensity is higher in ICT services, more than twice that of ICT manufacturing, about six times higher than that of the MC sector and seven times that of total economy. The highest value for this variable is reached by *Manufacture of computers*, followed by *Computer and related activities* and *Telecommunications*. Finally, ICT GBARD over GBARD in the ICT sector amounted to 48.0% in 2018, a percentage almost seven times higher than for the total economy. *Computer and related activities* was, again, the sub-sector with the highest ratio.

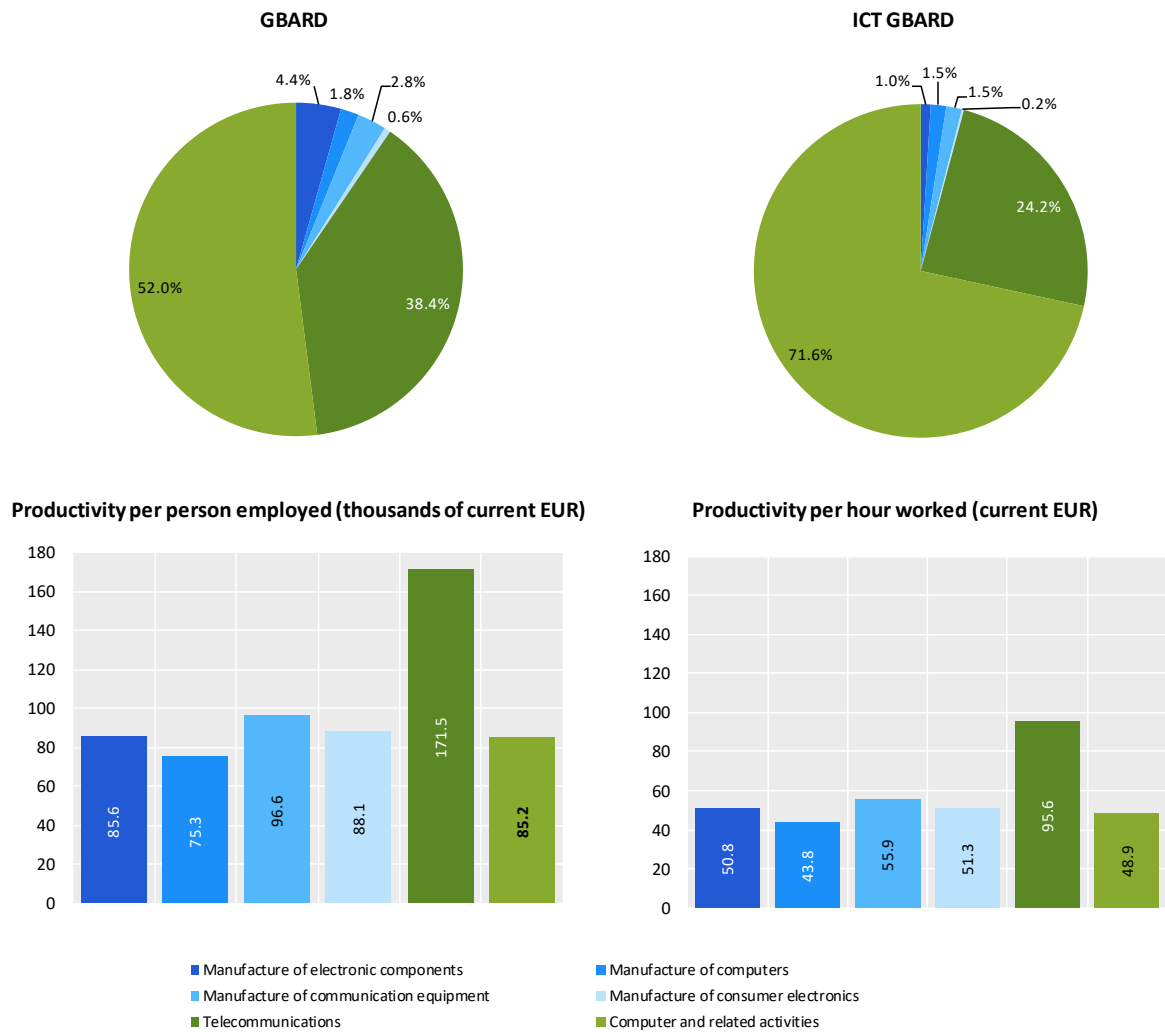
Figure 14: Overview of PREDICT variables: value added, employment, BERD, RERD, PERD, GBARD, ICT GBARD and labour productivity by ICT sub-sector in the EU28 (2017)



Source: 2020 PREDICT Dataset.

The *Computer and related activities* sub-sector presents the largest share in the seven indicators, with values between 52.0% (GBARD) and 73.9% (Employment) in 2017 (Figure 25). The *Telecommunications* sub-sector led labour productivity, both productivity per person employed and productivity per hour worked.

Figure 14 (cont.): Overview of PREDICT variables: value added, employment, BERD, RERD, PERD, GBARD, ICT GBARD and labour productivity by ICT sub-sector in the EU28 (2017)



Note: ICT GBARD is the part of GBARD (Government budget allocations for R&D) devoted to fund ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector (see Box 1 in the introduction).

Source: 2020 PREDICT Dataset.

2 The ICT sector in the EU28 Member States

Table 2: Summary table of total ICT sector by EU28 Member States

a) 2017

	VA	Employment	BERD	GBARD		ICT GBARD		RERD	PERD
	ICT sector (Millions of current EUR PPS)	ICT sector (1000 persons employed)	ICT sector (Millions of current EUR PPS)	ICT sector (Millions of current EUR PPS)	Total Economy (Millions of current EUR PPS)	ICT sector (Millions of current EUR PPS)	Total Economy (Millions of current EUR PPS)	ICT sector (1000 Full Time Equivalent)	ICT sector (1000 Full Time Equivalent)
Austria	10,627.8	106.6	994.8	81.3	2,612.2	36.1	221.7	6.2	9.0
Belgium	12,902.0	102.6	1,110.3	235.4	2,640.8	117.2	258.9	5.7	10.2
Bulgaria	4,903.5	86.8	195.0	9.6	221.3	6.6	15.7	2.2	2.8
Croatia	2,763.6	38.4	62.5	4.5	553.0	3.1	46.9	0.3	0.9
Cyprus	1,171.6	9.0	28.7	0.1	70.7	0.0	20.5	0.1	0.2
Czech Republic	13,428.7	157.6	624.6	73.7	1,724.6	45.3	155.4	5.8	9.0
Denmark	6,928.4	78.0	381.2	49.3	1,975.8	28.0	118.9	3.3	4.5
Estonia	1,591.1	28.9	82.9	12.4	186.8	8.0	17.5	0.6	0.8
Finland	9,356.6	94.7	1,246.8	98.4	1,520.9	53.4	183.0	8.0	10.6
France	88,990.7	797.6	6,982.7	356.8	12,362.7	115.6	530.9	45.7	53.5
Germany	113,343.4	1,105.7	6,074.1	871.3	28,361.3	360.1	1,638.5	27.6	47.5
Greece	6,300.2	53.5	196.7	22.2	1,069.4	6.5	67.0	2.5	3.2
Hungary	10,211.1	179.9	181.9	43.9	705.9	21.0	80.4	3.0	3.8
Ireland	18,266.4	83.5	809.6	58.2	650.8	20.8	101.5	4.9	7.4
Italy	56,817.4	595.1	2,363.9	758.9	8,918.0	297.3	641.9	13.0	34.4
Latvia	1,713.1	29.9	11.9	4.7	86.3	2.6	10.7	0.2	0.2
Lithuania	2,046.1	24.9	42.6	5.8	208.4	3.0	9.4	0.4	0.8
Luxembourg	1,450.3	16.6	24.0	24.2	301.3	9.3	29.5	0.1	0.2
Malta	841.9	10.5	26.3	0.3	26.4	0.2	0.3	0.3	0.5
Netherlands	26,081.0	249.8	1,156.6	125.1	4,435.0	64.0	369.3	10.3	18.0
Poland	27,338.7	382.2	1,313.2	205.6	2,880.1	106.4	177.4	17.3	21.5
Portugal	6,803.8	90.1	355.5	18.4	863.0	7.4	38.1	4.5	5.9
Romania	19,163.6	217.1	135.8	39.2	698.9	19.8	46.0	0.7	2.1
Slovakia	5,191.0	68.4	78.9	15.7	424.6	9.5	15.1	0.7	1.0
Slovenia	1,730.1	26.0	76.4	4.7	209.2	1.9	12.2	1.0	1.6
Spain	36,509.1	411.1	992.5	390.1	6,627.3	180.3	548.3	8.1	16.4
Sweden	19,351.7	168.7	1,802.1	48.5	2,929.3	25.2	365.7	13.2	14.2
United Kingdom	93,628.2	1,111.2	3,150.2	307.6	11,204.2	168.5	748.0	22.0	38.0
EU28	630,046.0	6,333.4	32,090.8	3,907.2	97,866.7	1,903.2	6,722.7	207.7	318.1
EU27_2020	527,745.4	5,225.8	29,114.4	3,631.3	86,971.3	1,747.5	5,998.9	185.7	280.1

Note: 2014 for Ireland ICT sector VA

Source: 2020 PREDICT Dataset

Table 2 (cont.): Summary table of total ICT sector by EU28 Member States

b) Annual growth rates (%), 2016-2017

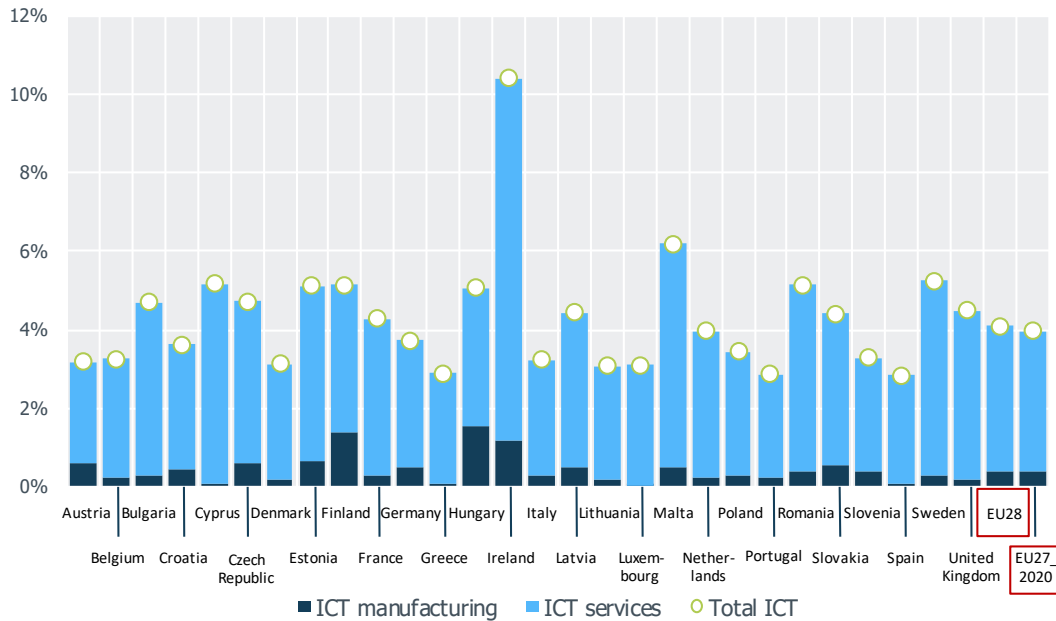
	VA	Employment	BERD	GBARD	ICT GBARD		RERD	PERD	
	ICT sector	ICT sector	ICT sector	ICT sector	Total Economy	ICT sector	Total Economy	ICT sector	ICT sector
Austria	4.0	3.7	3.3	-6.8	-0.6	-7.2	-1.7	6.8	3.9
Belgium	8.0	4.5	16.8	14.8	7.3	14.1	9.9	-2.7	10.2
Bulgaria	7.7	5.2	-0.6	0.9	10.5	-5.7	1.7	18.0	-7.5
Croatia	5.2	-7.6	46.3	78.9	1.0	86.6	6.1	1.9	42.4
Cyprus	24.2	8.1	15.4	-7.7	2.7	-7.7	2.9	18.8	20.6
Czech Republic	5.0	2.2	18.8	19.1	8.0	20.2	9.6	10.2	9.5
Denmark	1.8	3.5	-29.6	65.2	0.5	60.6	8.5	-20.7	-26.0
Estonia	15.2	5.6	-8.3	-6.0	-4.9	-5.1	-3.1	34.8	18.1
Finland	8.0	3.0	3.0	8.7	1.9	8.9	3.2	-1.5	0.6
France	7.6	5.7	10.9	-15.1	-3.6	-15.1	-5.6	3.1	2.5
Germany	5.2	3.7	-3.2	5.4	5.3	5.1	4.0	-16.2	-13.1
Greece	-1.7	6.1	34.3	-41.6	-7.1	-51.9	-17.5	84.4	51.9
Hungary	8.8	5.3	27.0	29.3	-6.2	34.3	-4.2	23.7	29.0
Ireland	12.1	2.4	5.1	-11.2	1.6	-11.0	2.0	10.8	4.0
Italy	4.3	0.8	4.7	14.2	0.0	15.8	5.8	12.4	18.7
Latvia	7.2	8.1	88.6	48.1	10.8	46.7	24.1	43.5	39.7
Lithuania	9.2	-2.0	172.1	8.0	3.8	6.9	3.6	78.0	118.8
Luxembourg	-9.5	7.1	45.3	9.3	6.9	-1.9	10.7	-2.2	-21.2
Malta	18.8	10.8	17.6	139.9	2.7	140.0	83.4	-4.1	-4.2
Netherlands	5.5	5.1	-1.5	1.0	-0.6	1.4	-0.7	-5.0	7.2
Poland	7.8	5.8	-1.0	98.8	15.4	137.0	69.7	43.7	53.2
Portugal	4.0	9.9	18.4	-4.5	-0.9	-4.5	-1.6	14.3	17.4
Romania	13.1	8.8	-32.7	-24.7	-28.0	-18.1	-26.9	-37.4	-7.7
Slovakia	1.4	4.8	24.8	12.0	0.2	13.8	13.4	29.6	18.8
Slovenia	4.6	4.2	15.8	6.8	3.1	7.8	-0.2	68.9	17.2
Spain	7.8	6.2	-1.9	11.2	-2.3	14.7	0.2	3.5	1.6
Sweden	2.8	2.5	15.7	-16.7	4.4	-21.2	0.2	20.9	1.0
United Kingdom	5.8	4.6	3.4	-3.0	4.0	4.5	2.4	6.3	2.9
EU28	6.5	4.7	4.4	4.9	2.0	7.2	2.6	4.8	4.7
EU27_2020	7.7	4.7	4.9	6.8	1.5	8.3	2.4	4.6	4.9

Note: Monetary variables are expressed in real terms. 2013-2014 for Ireland ICT sector (VA and BERD)

Source: 2020 PREDICT Dataset

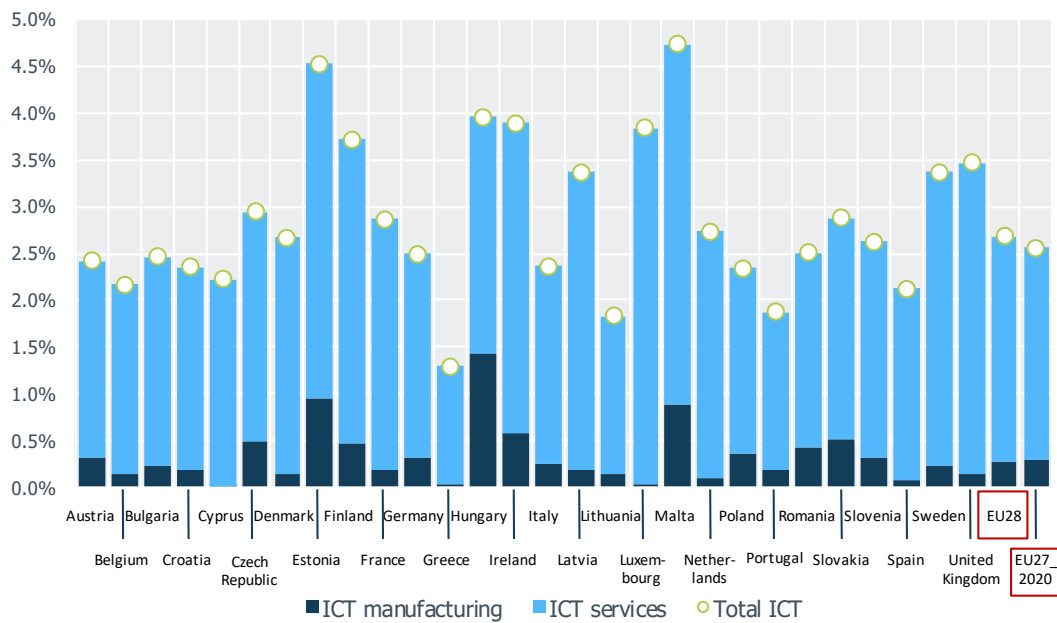
Figure 15: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD , GBARD and ICT GBARD by EU28 Member State (2017)

a) ICT sector VA share of GDP



Note: 2014 for Ireland.

b) ICT sector employment share of total employment



Source: 2020 PREDICT Dataset.

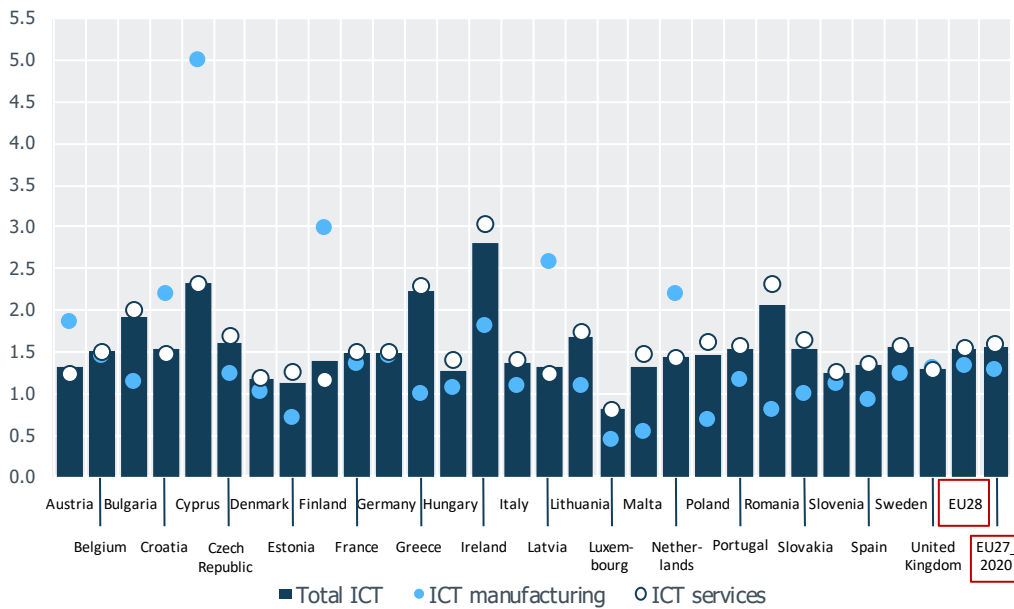
In 2017 the largest ICT sectors in the EU28 in relative size (ICT sector VA / GDP) were Ireland⁷, which is, by far, the EU28 country with the highest share (10.4%), multiplying the EU28 average by a factor of 2.6 (Figure 14). Malta, Sweden, Cyprus, Romania, Finland, Estonia and Hungary, all above 5.0% also stand out. In terms of employment, the largest EU28 ICT sectors in relative size were Malta, Estonia, Hungary, Ireland, Luxembourg and Finland, with a share over total employment higher than 3.5%. Ireland also had the highest ratio of productivity in the ICT sector over total productivity. All in all, the productivity of EU countries in the ICT service sector is higher than in ICT manufactures. On the other hand, Finland was the country with the highest ICT sector BERD intensity in 2017 (13.3% of ICT sector VA), followed by Austria, Sweden, Belgium, France and Denmark.

The most dynamic European countries in 2017 were: Cyprus, Malta, Estonia and Romania in VA; Malta, Portugal, Romania and Latvia in employment; and Lithuania, Latvia and Croatia, in BERD. The share of BERD in the ICT sector over total BERD is very uneven among EU28 countries. Besides Cyprus and Malta, three countries stand out in this variable: Estonia, Finland and Bulgaria. In the case of RERD and PERD, Malta, Cyprus, Ireland, Finland and Estonia were the countries with the highest share (above 35%) of the ICT sector over the total. The countries with the highest ICT GBARD in relation to GDP were Finland and Sweden, where it represented the 0.1%. In terms of ICT GBARD, the largest EU28 ICT sectors in relative size were Malta, Slovakia, Poland and Italy. The share of the ICT sector GBARD over total GBARD is also very uneven among EU28 countries; Ireland, Belgium, Italy and Luxembourg show the highest shares.

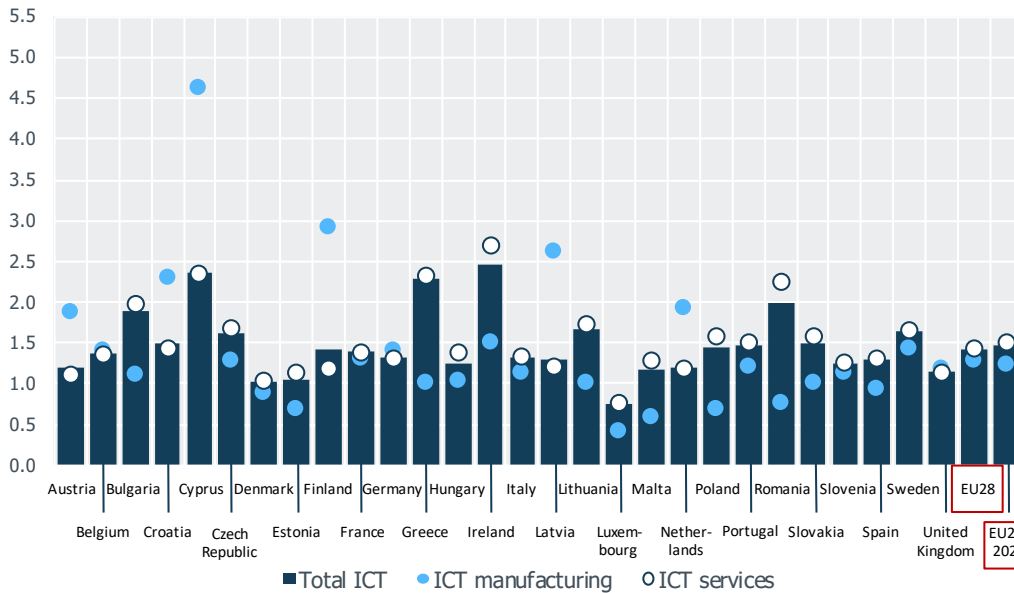
⁷ Ireland has not published official data for VA since 2014.

Figure 15 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU28 Member State (2017)

c) ICT sector productivity per person employed ratio over total economy productivity



d) ICT sector productivity per hour worked ratio over total economy productivity

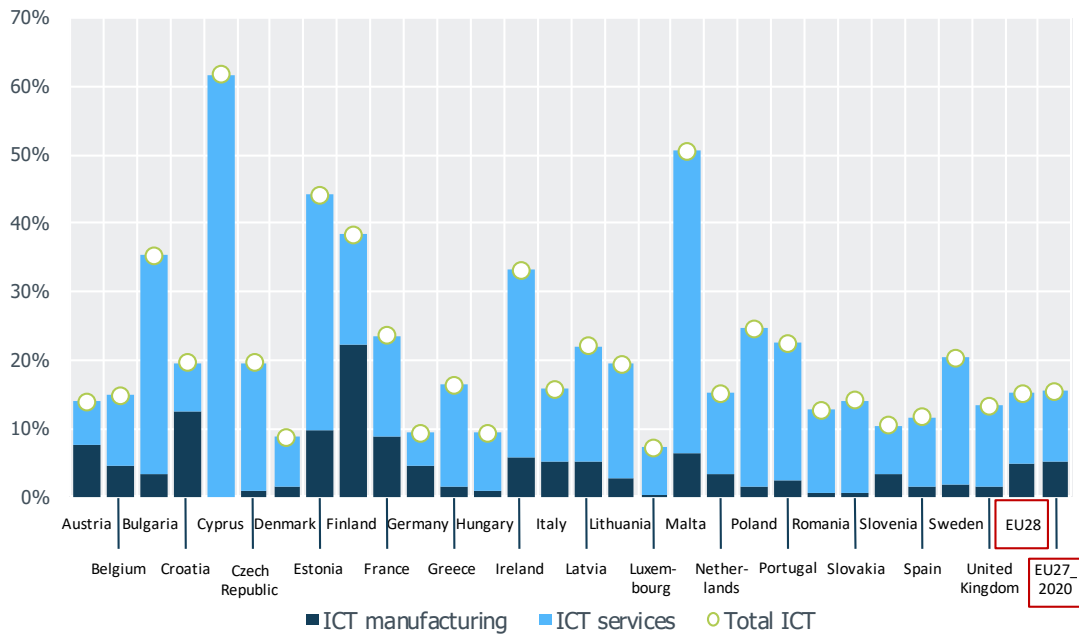


Note: 2014 for Ireland.

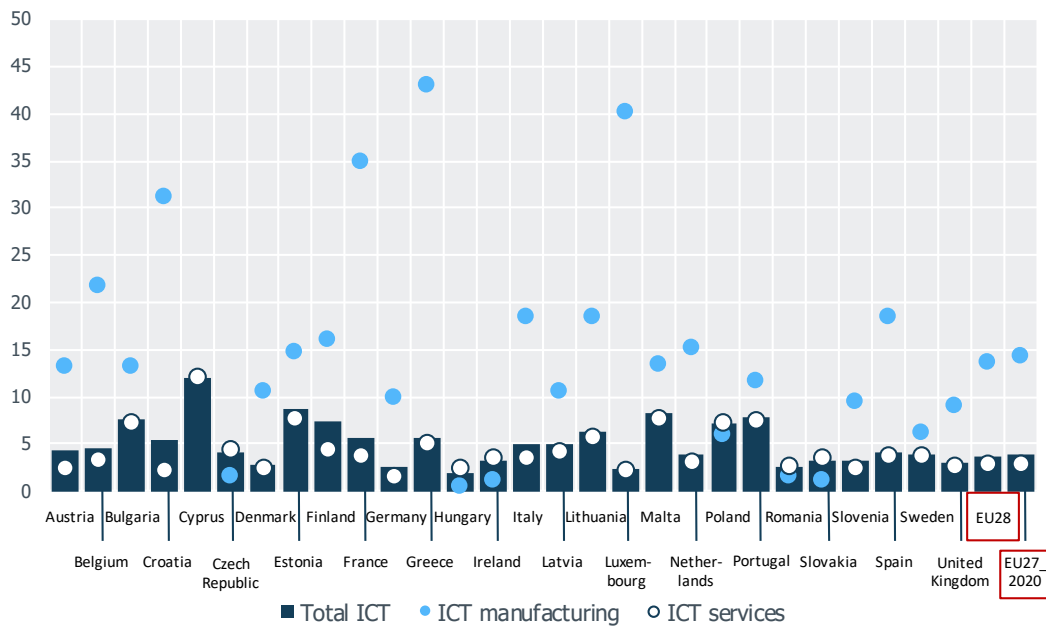
Source: 2020 PREDICT Dataset.

Figure 15 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU28 Member State (2017)

e) Share of ICT sector BERD on total BERD



f) ICT sector BERD intensity (BERD/VA) ratio over total BERD intensity

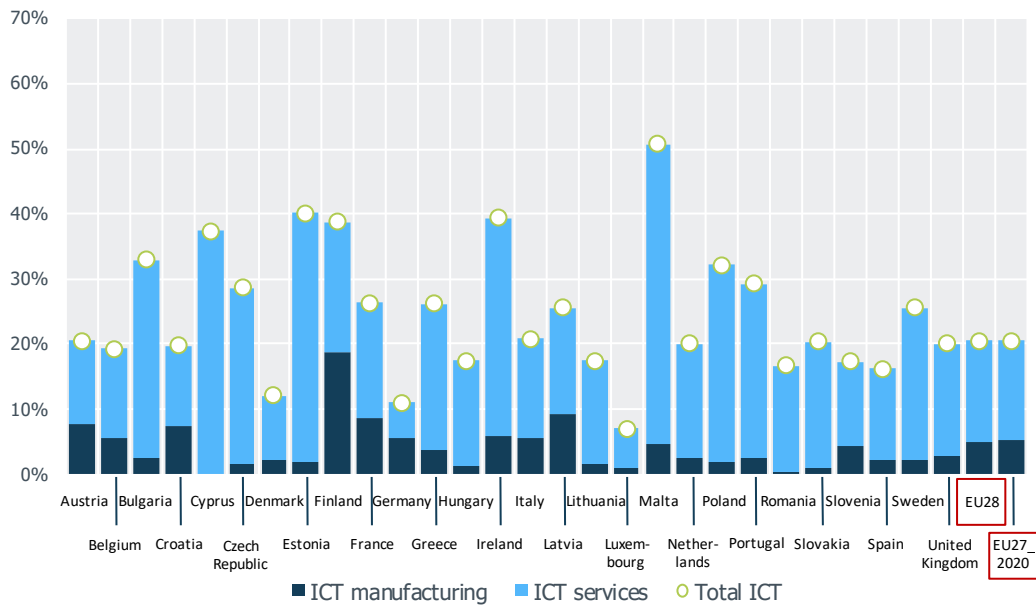


Note: 2014 for Ireland.

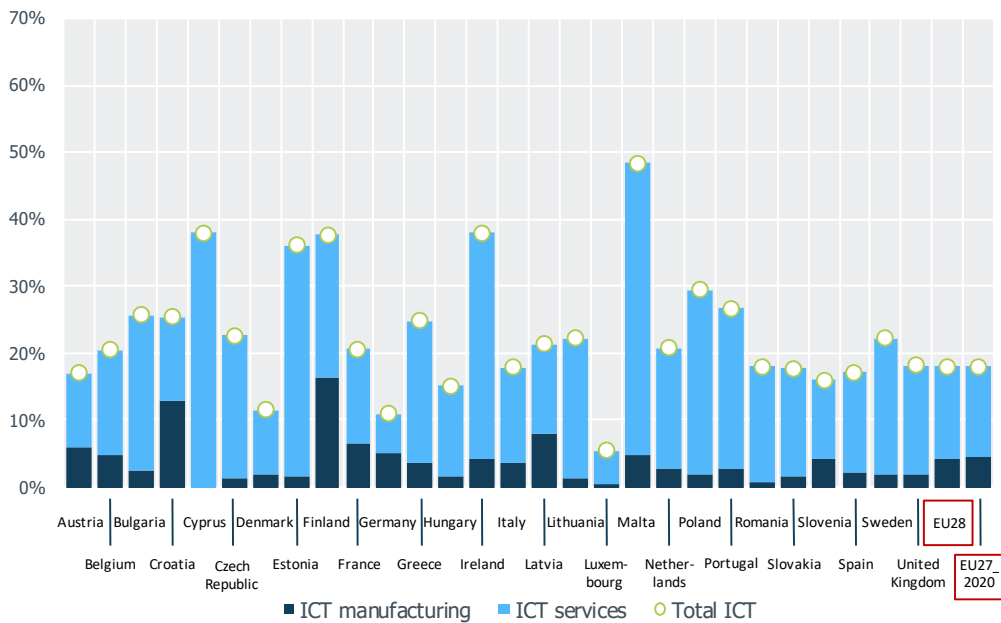
Source: 2020 PREDICT Dataset.

Figure 15 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU28 Member State (2017)

g) ICT sector RERD share of total RERD



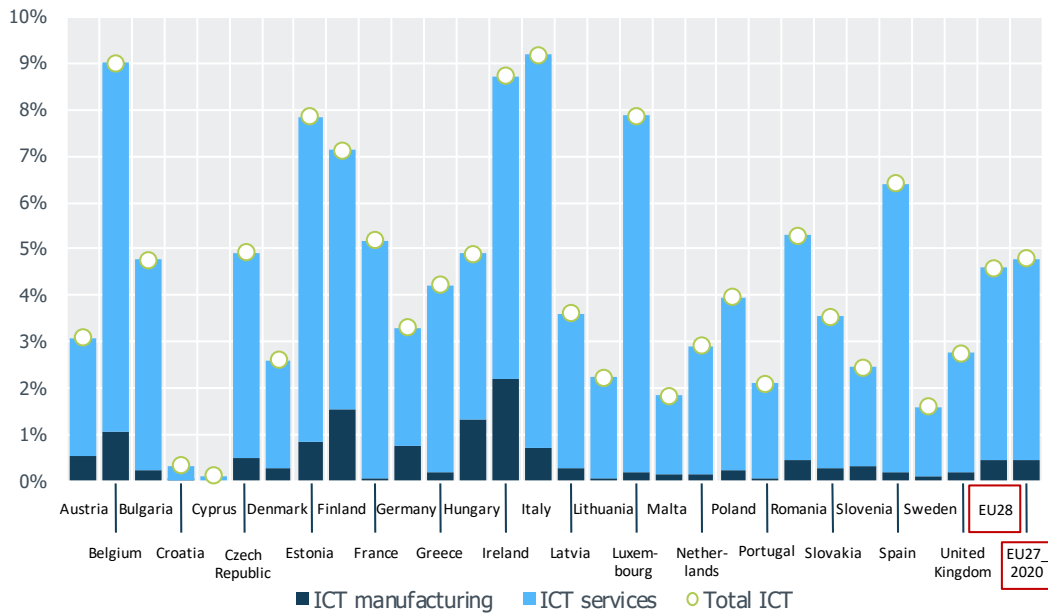
h) ICT sector PERD share of total PERD



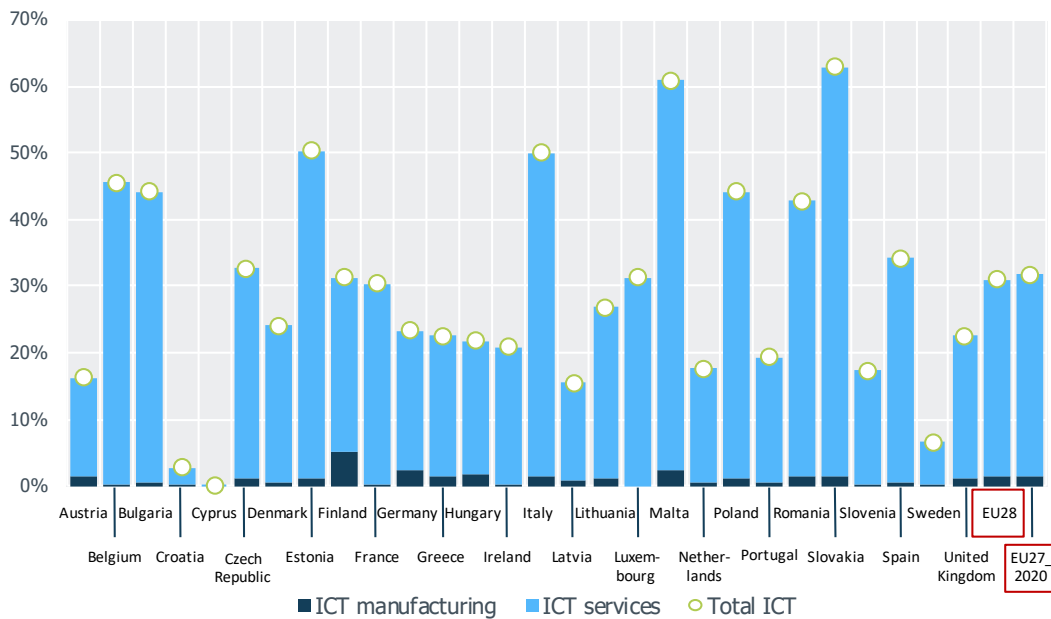
Source: 2020 PREDICT Dataset.

Figure 15 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU28 Member State (2017)

i) ICT sector GBARD share of total GBARD



j) ICT sector ICT GBARD share of total ICT GBARD

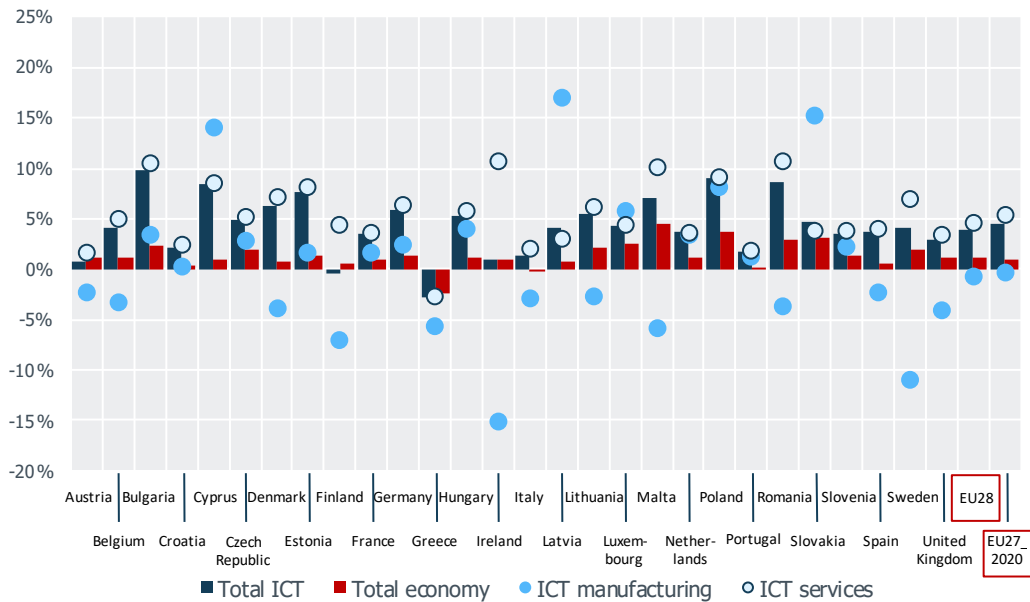


Note: 2018 for GBARD and ICT GBARD.

Source: 2020 PREDICT Dataset.

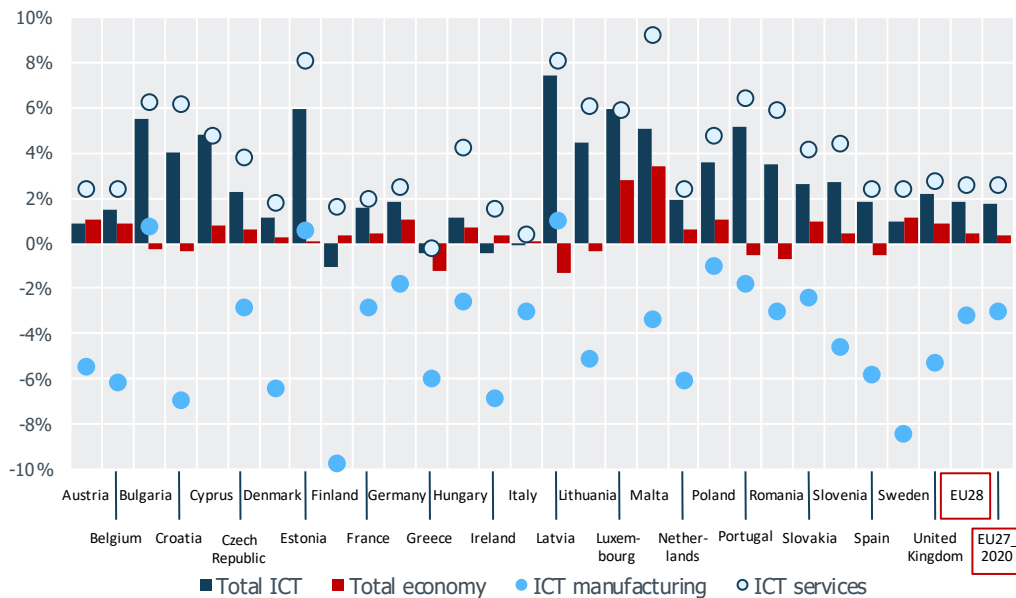
Figure 16: Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU28 Member State. Mean annual growth rates (%) (2006-2017)

a) VA



Note: 2006-2014 for Ireland.

b) Employment

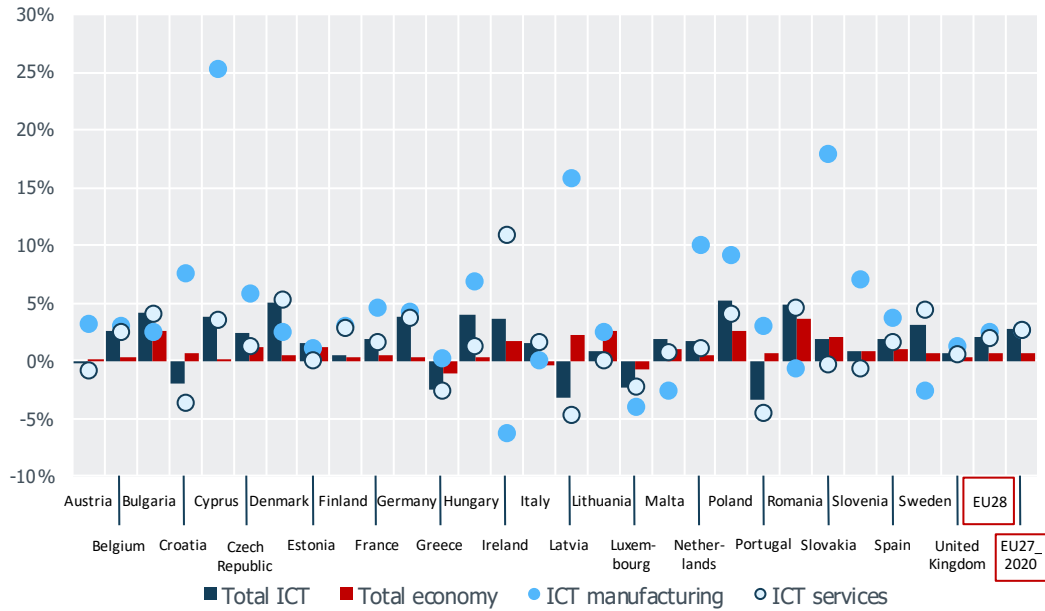


Note: Monetary variables are expressed in real terms.

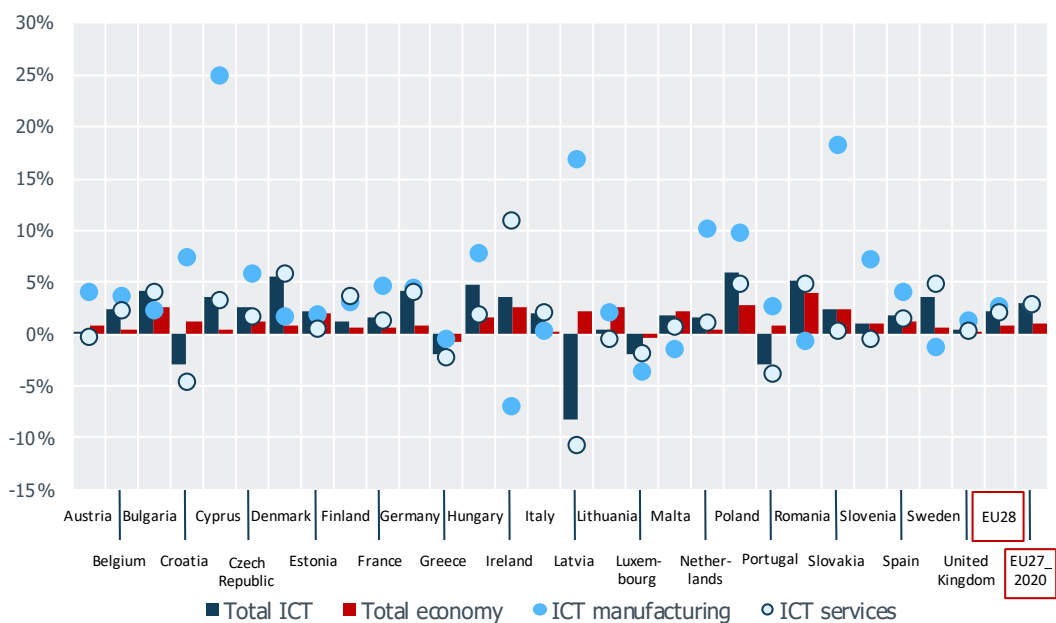
Source: 2020 PREDICT Dataset.

Figure 16 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU28 Member State. Mean annual growth rates (%) (2006-2017)

c) Productivity per person employed



d) Productivity per hour worked

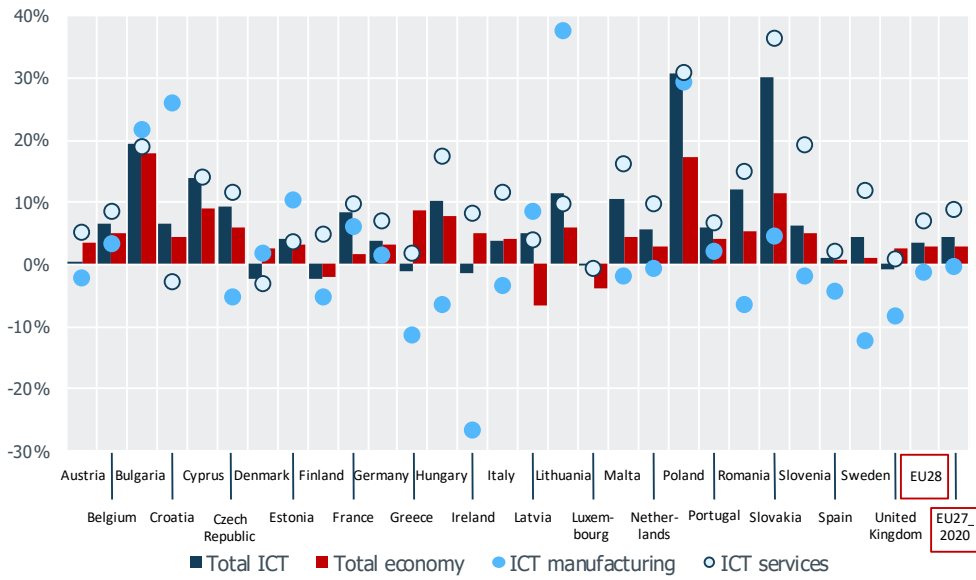


Note: Monetary variables are expressed in real terms. 2006-2014 for Ireland.

Source: 2020 PREDICT Dataset.

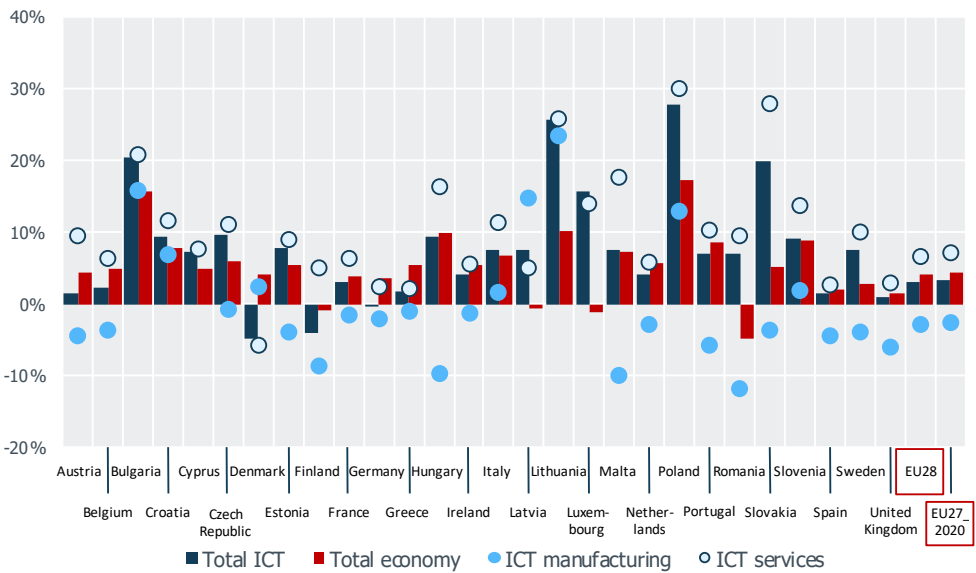
Figure 16 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU28 Member State. Mean annual growth rates (%) (2006-2017)

e) BERD



Note: 2006-2014 for Ireland.

f) RERD

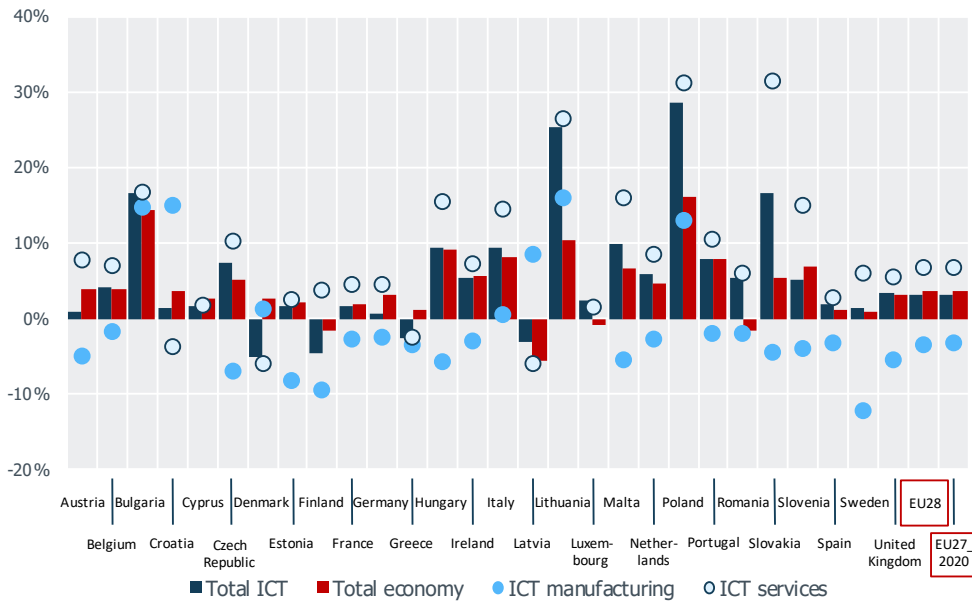


Note: Monetary variables are expressed in real terms.

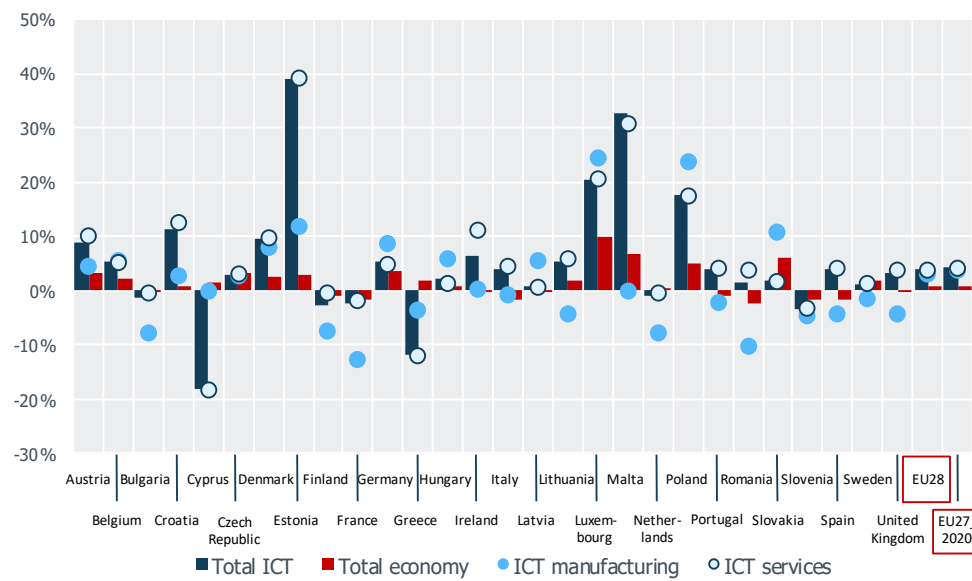
Source: 2020 PREDICT Dataset.

Figure 16 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU28 Member State. Mean annual growth rates (%) (2006-2017)

g) PERD



h) GBARD

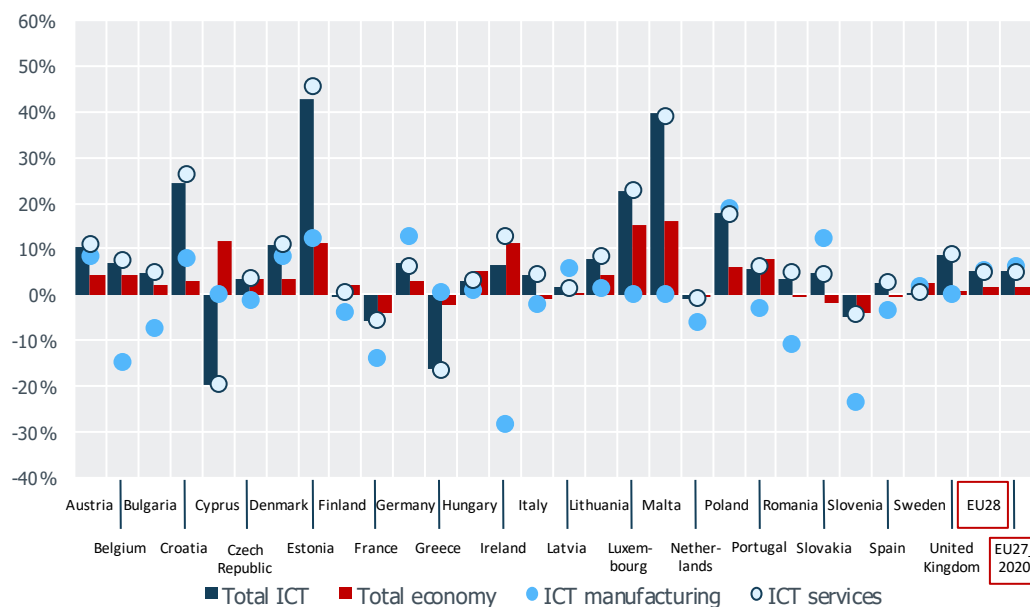


Note: Monetary variables are expressed in real terms. 2008-2017 for Croatia and 2006-2014 for Ireland.

Source: 2020 PREDICT Dataset.

Figure 16 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU28 Member State. Mean annual growth rates (%) (2006-2017)

i) ICT GBARD



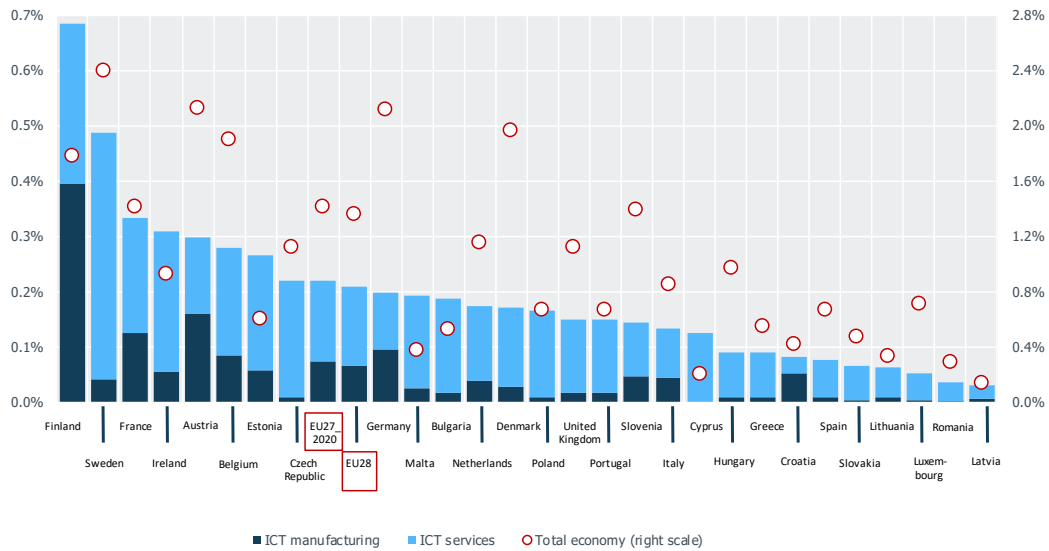
Note: Monetary variables are expressed in real terms. 2008-2017 for Croatia and 2006-2014 for Ireland.

Source: 2020 PREDICT Dataset.

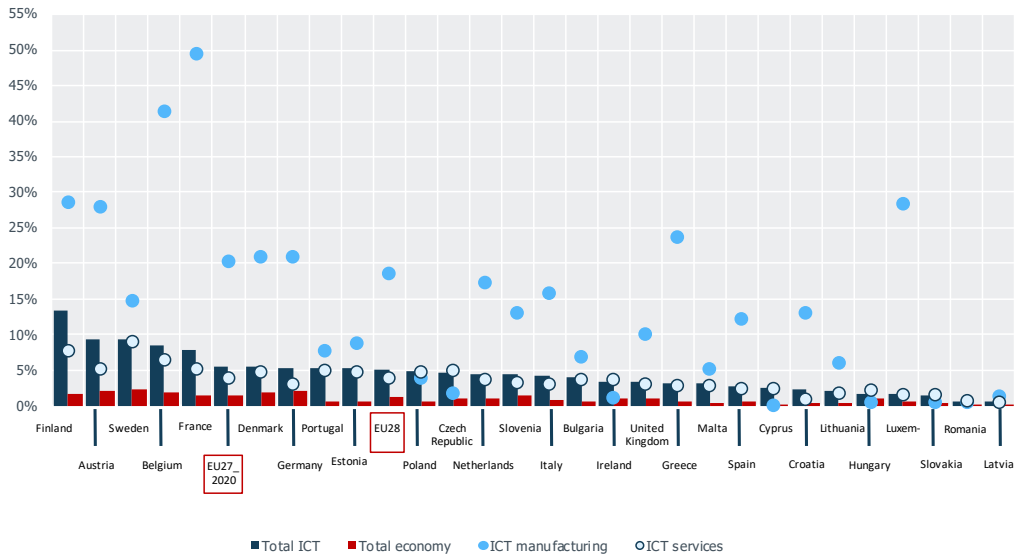
In all EU28 countries (with the sole exceptions of Greece, Finland and Austria), ICT sector VA growth was higher than GDP during the 2006-2017 period (Figure 15). Thirteen, out of 28 EU countries, experienced a negative change in ICT manufacturing, and only Greece also suffered a negative change in ICT services VA. Most of the countries experienced positive growth rates in the ICT sector employment, and higher than in total employment. However, for the ICT manufacturing sector the fall in employment was general. Labour productivity also grew at a faster rate in the ICT sector than in the total economy in almost all EU28 countries, both in terms of persons and per hour worked. For most of the countries analysed, labour productivity growth was higher in ICT manufacturing than in ICT services. For the EU28, growth of BERD in the ICT sector was faster than for the total economy, and also faster in ICT services than ICT manufactures. The countries with the highest growth rate of BERD in the ICT sector were Poland and Slovakia, while Denmark, Ireland, Finland, Greece, Luxembourg and United Kingdom showed a negative change. Growth rates in R&D researchers (RERD) and R&D personnel (PERD) in the ICT sector were especially high in Lithuania, Poland, Bulgaria and Slovakia. GBARD in the ICT sector grew at the fastest rate in Luxembourg, Malta, Poland and Estonia, and sharply decreased in Cyprus and Greece.

Figure 17: BERD intensity by EU28 Member State (2017)

a) BERD/GDP



b) ICT sector BERD/ICT sector VA



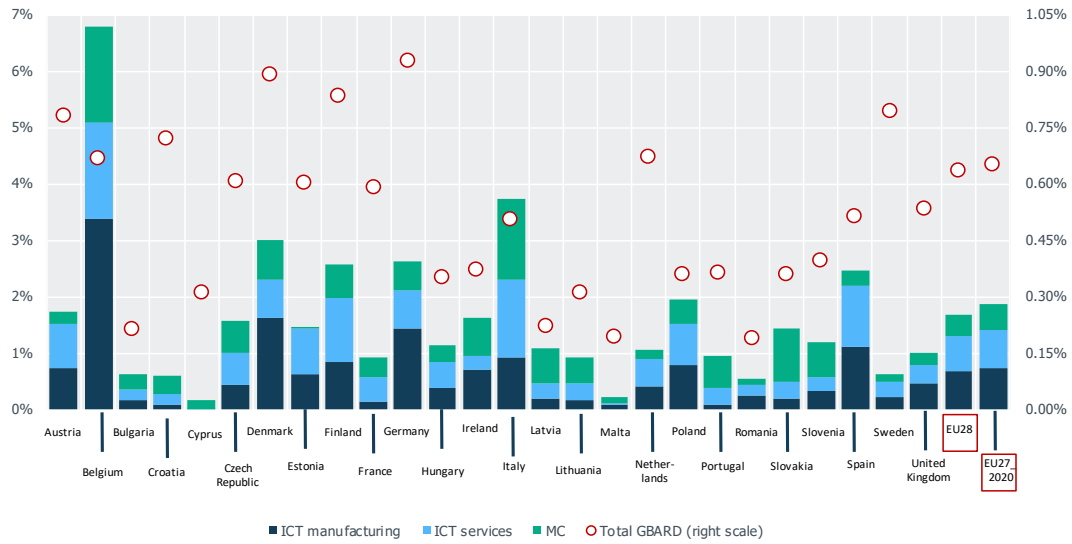
Note: 2014 for Ireland

Source: 2020 PREDICT Dataset.

BERD intensity (BERD/GDP) is very different among EU28 countries. Sweden and Austria showed the highest ratio for the total economy in 2017. In the case of the ICT sector, Finland and Sweden stand out (Figure 16). For ICT sectors, BERD intensity (defined as ICT sector BERD/ICT sector VA) is higher than for the total economy, and higher in ICT manufactures than in ICT services. Finland and Austria are the countries with the highest ratio for the ICT sector.

Figure 18: ICT manufacturing, ICT services, MC and Total GBARD and ICT GBARD by EU28 Member State (2017)

a) GBARD intensity (sub-sector GBARD/sub-sector VA)



b) ICT GBARD intensity (sub-sector ICT GBARD/sub-sector VA)

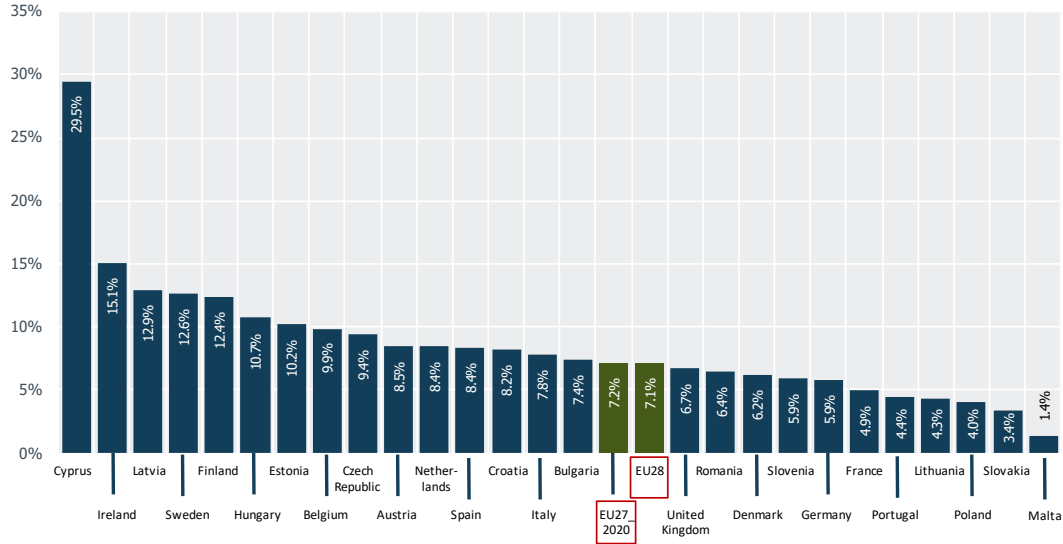


Note: 2014 for Ireland. Data for Greece and Luxembourg no reliable.

Source: 2020 PREDICT Dataset.

Figure 18 (cont.): ICT manufacturing, ICT services, MC and Total GBARD and ICT GBARD by EU28 Member State (2017)

c) ICT GBARD/GBARD



Note: 2017 for GBARD and ICT GBARD. Data for Greece and Luxembourg not reliable.

Source: 2020 PREDICT Dataset.

GBARD intensity (defined as sub-sector GBARD/sub-sector VA) is very different among EU28 countries for the total economy, and for ICT manufactures also, ICT services and MC sector (Figure 17). In the case of the total economy, the highest values (above 0.8%) correspond to Germany, Denmark and Finland. For ICT manufacturing, ICT services and MC, Belgium, Italy and Denmark stand out. Similar results are observable also for ICT GBARD where, again, Belgium and Finland stand out for the highest values of the sum of the three sub-sectors. However, in this case, Finland and Sweden are the two countries with the highest ICT GBARD intensity in the total economy. Finally, the ratio between ICT GBARD and total GBARD reaches the highest values in Cyprus, Ireland, Latvia, Sweden and Finland.

3 The EU28 ICT sector in the international context

In the international context, the EU28 holds an intermediate position in value added, employment and BERD. Whereas the EU28 ICT sector accounted for 4.1% of total VA in the economy and 2.7% of employment in 2017, the ratios in Taiwan (16.3% in VA, 9.1% in employment), South Korea (9.2%, 4.5%), Japan (5.8%, 3.3%) or even in the US (5.9%, 2.7%) were notably higher. Europe also lagged behind the leaders according to its BERD intensity (BERD/VA) in the ICT sector. In 2017, the EU28 ICT sector BERD intensity (5.1%) has been much lower than in South Korea (20.2%), Taiwan (11.9%) and the US (10.6%). China (6.0%) and Australia (5.7%) show BERD intensity levels similar to the EU28 (Table 3). In 2017, the annual growth of the EU28 ICT sector VA (6.5%) was modest, ranking sixth out of the 13 countries analysed, lagging far behind China (13.0%), Australia (8.8%), and Taiwan (7.2%). In terms of employment growth in the ICT sector, the EU28 (4.7%) comes third among the countries included in PREDICT. The EU28 ICT BERD growth in 2017 (4.4%) was among the lowest of all the countries available, and the difference with the more dynamic countries is remarkable: Australia (15.7%), China (13.2%) and Taiwan (12.1). In 2017, ICT GBARD (ICT GBARD/GDP) in the EU28 (0.04%) was lower than in the US (0.05%) and Japan (0.06%). The EU28 ICT GBARD grew at a rate of 2.6%, while in the US it decreased by 2.9% and in Japan it increased by 0.6%.

Table 3: Summary table of ICT indicators for the EU28 and other economies

— a) 2017

	VA	Employment	BERD	GBARD		ICT GBARD		RERD	PERD
	ICT sector	ICT sector	ICT sector	ICT sector	Total Economy	ICT sector	Total Economy	ICT sector	ICT sector
	(Millions of current EUR PPS)	(thousand persons employed)	(Millions of current EUR PPS)	(Millions of current EUR PPS)	(Millions of current EUR PPS)	(Millions of current EUR PPS)	(Millions of current EUR PPS)	(thousand full-time equivalent)	(thousand full-time equivalent)
Australia	28,626.2	377.2	1,645.6	-	-	-	-	10.2	18.6
Brazil	61,509.5	1,275.1	1,526.6	-	-	-	-	16.6	23.6
Canada	45,523.5	513.4	3,071.2	-	-	-	-	34.9	45.2
China	788,412.1	15,988.9	47,223.9	-	-	-	-	209.3	562.9
EU28	630,046.0	6,333.4	32,090.8	3,907.2	95,687.1	1,903.2	6,537.4	207.7	318.1
EU27_2020	527,745.4	5,225.8	29,114.4	3,631.3	85,493.0	1,747.5	5,847.6	185.7	280.1
India	341,949.0	6,082.0	2,067.6	-	-	-	-	11.8	22.3
Japan	208,433.9	2,249.1	16,933.4	-	23,404.9	-	2,361.0	131.9	141.9
Korea	127,518.7	1,203.3	25,766.4	-	-	-	-	125.9	140.0
Norway	7,283.6	73.0	731.9	-	-	-	-	5.7	7.7
Russia	61,612.2	1,065.2	938.7	-	-	-	-	5.8	10.4
Switzerland	15,804.8	151.8	-	-	-	-	-	-	-
Taiwan	135,391.2	1,037.2	16,121.5	-	-	-	-	72.5	132.9
United States	800,565.9	4,431.0	84,968.9	1,812.3	90,114.1	546.0	7,137.0	353.7	-

Note: 2016 for Canada (VA), 2014 for Brazil (BERD, RERD and PERD) and 2013 for India (BERD, RERD and PERD). ICT sector PERD for United States not included because of lack of homogeneous data. ICT sector for United States (GBARD and ICTGBARD) includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

Source: 2020 PREDICT Dataset

Table 3 (Cont.): Summary table of ICT indicators for the EU28 and other economies

b) Annual growth rates (%), 2016-2017

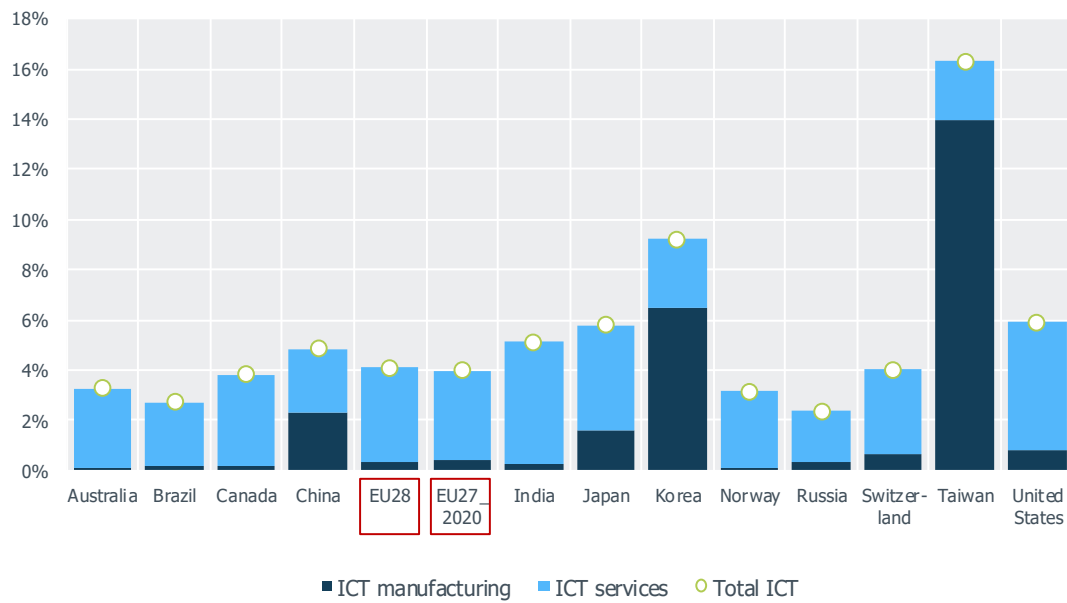
	VA	Employment	BERD	GBARD		ICT GBARD		PERD	PERD
	ICT sector	ICT sector	ICT sector	ICT sector	Total Economy	ICT sector	Total Economy	ICT sector	ICT sector
Australia	8.8	2.9	15.7	-	-	-	-	9.1	4.4
Brazil	-1.4	4.2	-	-	-	-	-	-	-
Canada	2.2	6.0	-3.1	-	-	-	-	-3.8	-4.3
China	13.0	0.0	13.2	-	-	-	-	7.3	10.1
EU28	6.5	4.7	4.4	4.9	2.0	7.2	2.6	4.8	4.7
EU27_2020	7.7	4.7	4.9	6.8	1.5	8.3	2.4	4.6	4.9
India	5.1	-2.5	11.9	-	-	-	-	10.2	18.8
Japan	2.0	2.0	4.1	-	1.2	-	0.6	4.6	5.6
Korea	6.6	-0.1	-1.0	-	-	-	-	5.0	5.2
Norway	3.7	1.5	8.6	-	-	-	-	6.6	7.8
Russia	-3.5	6.3	-12.6	-	-	-	-	2.1	-1.2
Switzerland	0.1	-0.1	-	-	-	-	-	-	-
Taiwan	7.2	3.9	12.1	-	-	-	-	1.7	2.3
United States	7.0	1.6	1.6	-18.9	-0.9	-16.4	-2.9	-4.2	-

Note: Monetary variables are expressed in real terms. 2015-2016 for Canada (VA and BERD) and 2012-2013 for India (BERD, RERD and PERD). ICT sector PERD for United States not included because of lack of homogeneous data. ICT sector for United States (GBARD and ICTGBARD) includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

Source: 2020 PREDICT Dataset

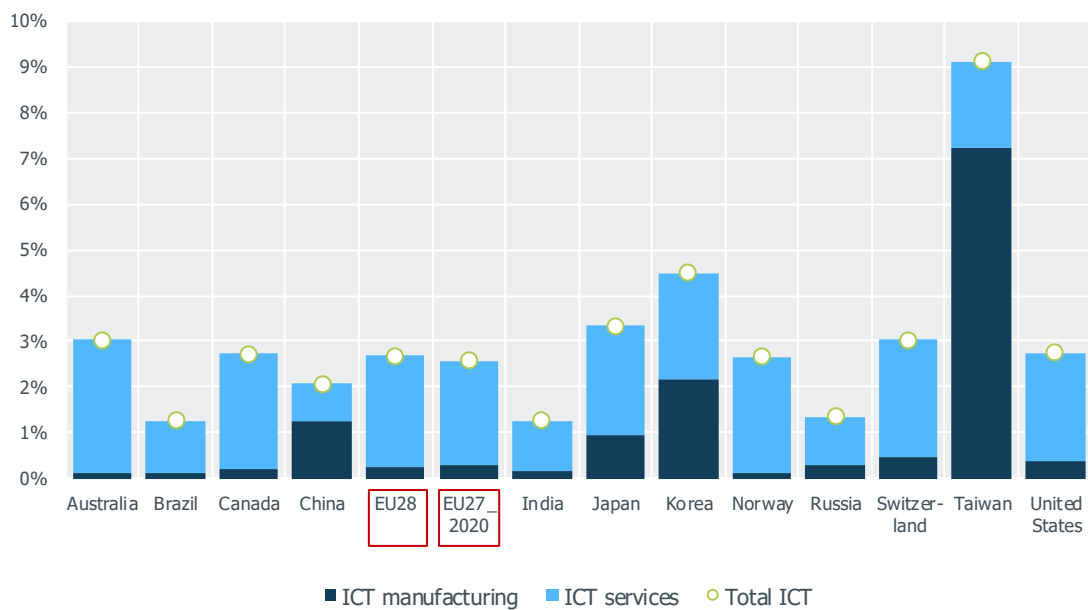
Figure 19: ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICTGBARD (2017)

a) ICT sector VA share of GDP



Note: 2016 for Canada.

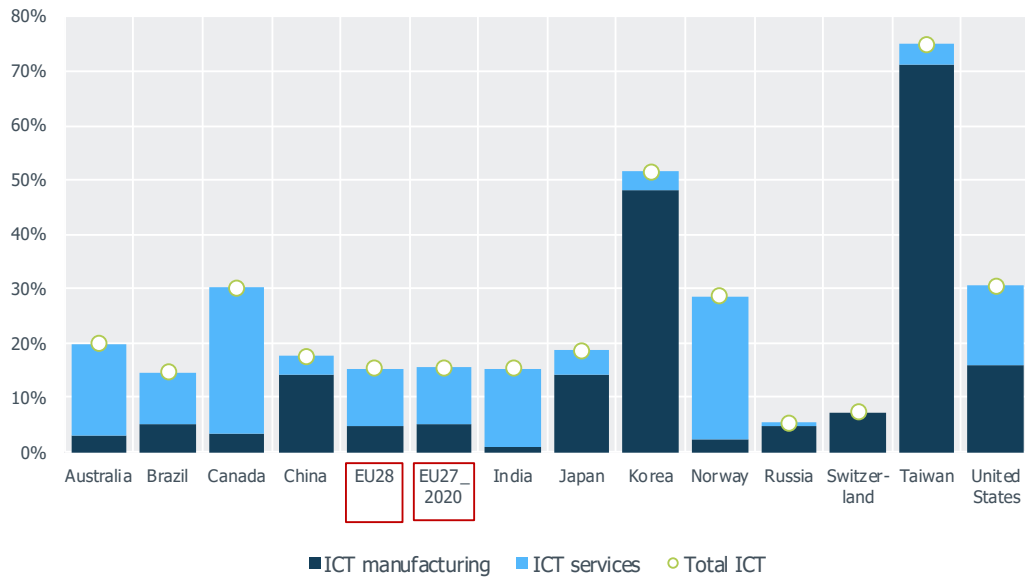
b) ICT sector employment share of total employment



Source: 2020 PREDICT Dataset.

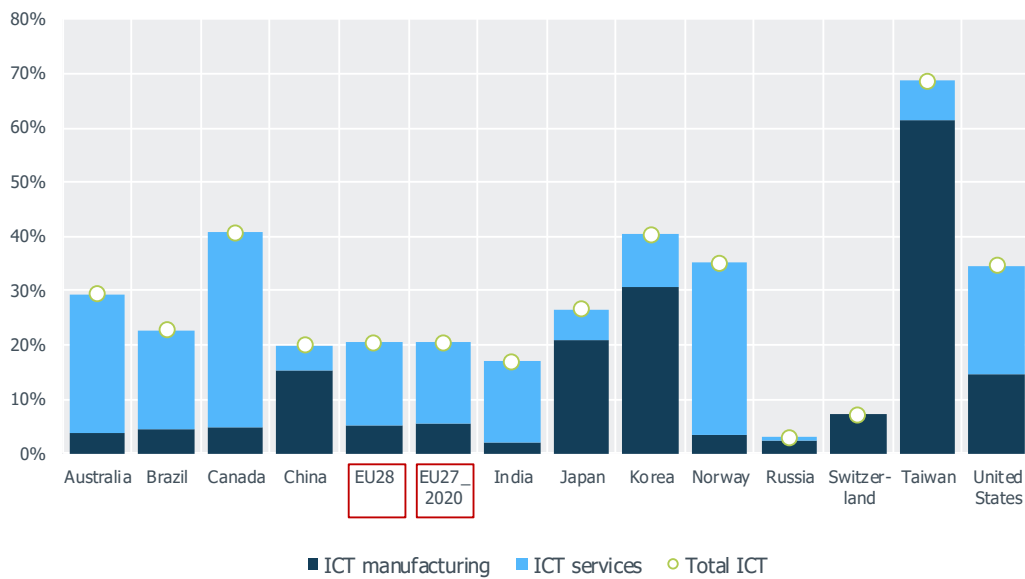
Figure 19 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICTGBARD (2017)

c) ICT sector BERD share of total BERD



Note: 2013 for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing.

d) ICT sector RERD share of total RERD

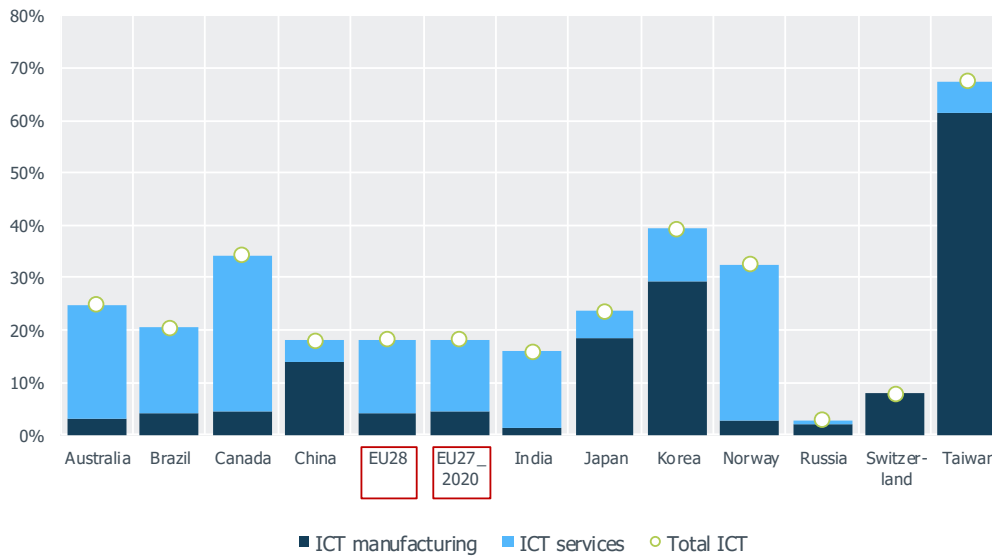


Note: 2013 for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

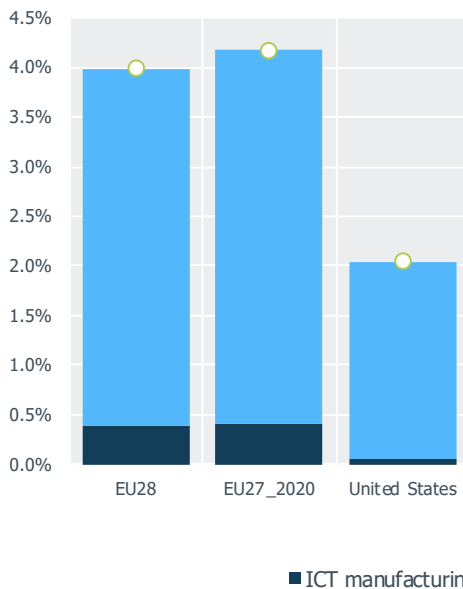
Figure 19 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICTGBARD (2017)

e) ICT sector PERD share of total PERD

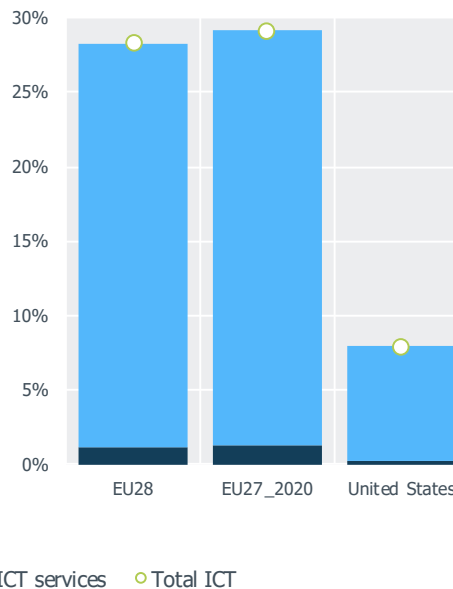


Note: 2013 for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing. ICT sector for United States not included because of lack of homogeneous data.

f) ICT sector GBARD share of total GBARD



g) ICT sector ICT GBARD share of total ICT GBARD



Note: 2018 for GBARD and ICT GBARD. ICT manufacturing for United States includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

Source: 2020 PREDICT Dataset.

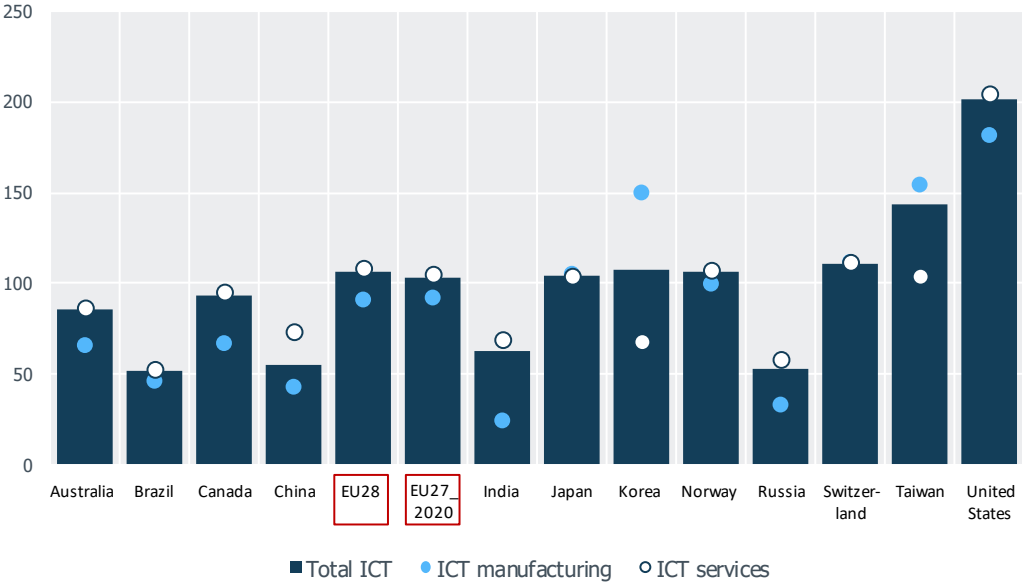
In 2017, three Asian countries: Taiwan (16.3%), South Korea (9.2%) and Japan (5.8%); and the US (5.9%) have the largest ICT sector measured as ICT VA share over total GDP, followed by India (5.1%) and China (4.8%) (Figure 18). All these countries had a larger share than the EU28 (4.1%). Taiwan (9.1%), South Korea (4.5%) and Japan (3.3%) also take the lead in terms of employment, followed by Australia (3.0%) and Switzerland (3.0%), all of which had larger shares than the US and the EU28 (both 2.7%). China (2.1%), Russia (1.4%), Brazil (1.3%) and India (1.3%) lagged behind. Taiwan, South Korea and Canada, followed by the US and Norway, are the countries with the largest share of BERD, R&D researchers and R&D personnel⁸ in the ICT

⁸ No data on R&D personnel available for the US.

sector over the total. The first two countries also stand out for the size of their ICT manufacturing sector. The EU28 is in an intermediate position among the countries included in the PREDICT database. It only surpasses the US in public funded R&D (GBARD) and ICT GBARD in the ICT sector.

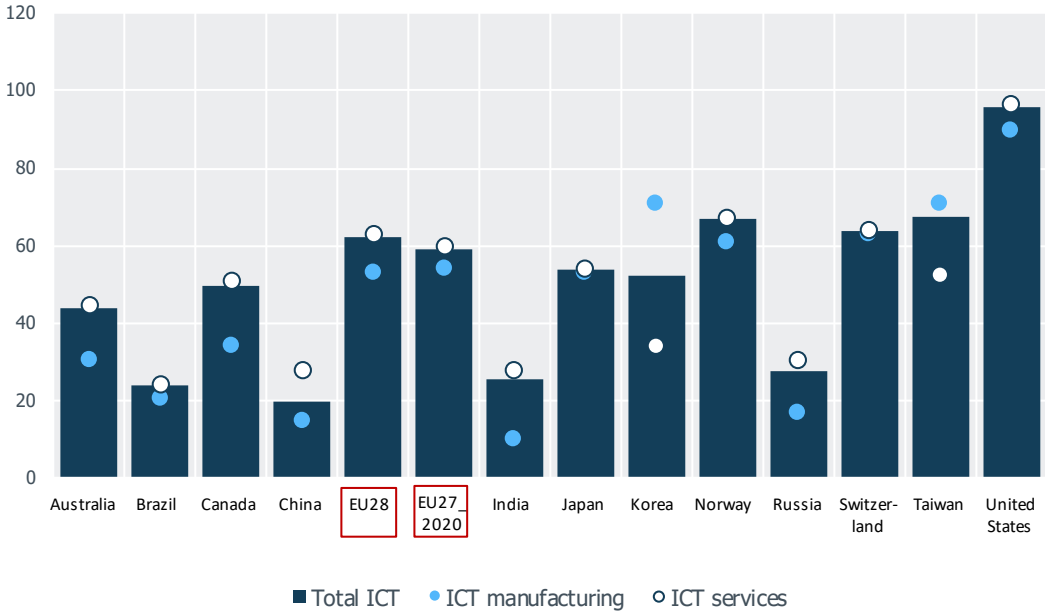
Figure 20: ICT sector, ICT manufacturing and ICT services in the international context: labour productivities (2017)

a) ICT sector productivity per person employed (Thousands of euros PPS 2015 per person)



Note: 2016 for Canada.

b) ICT sector productivity per hour worked (Euros PPS 2015 per hour worked)

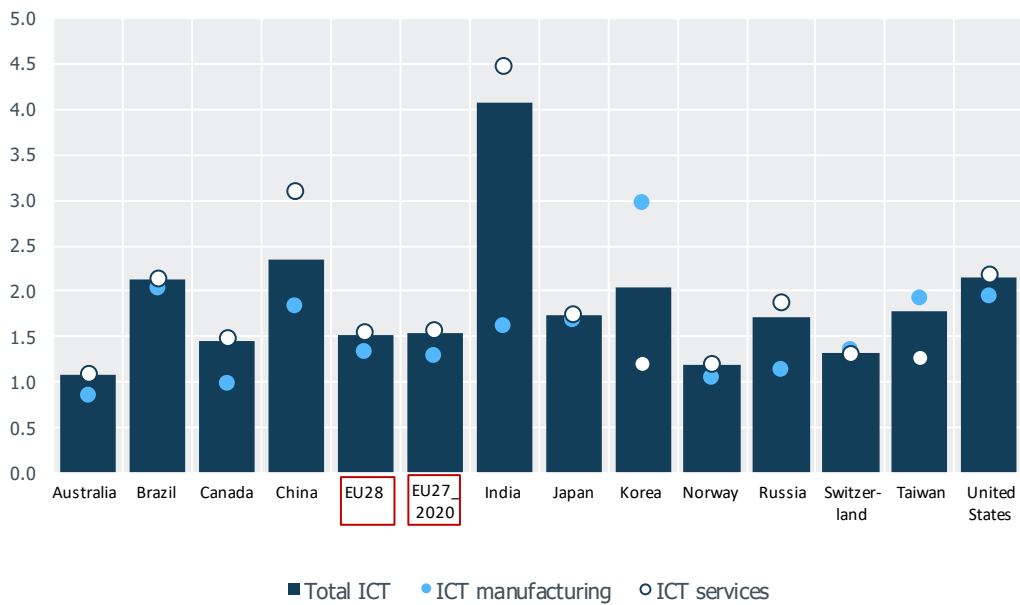


Note: 2016 for Canada.

Source: 2020 PREDICT Dataset.

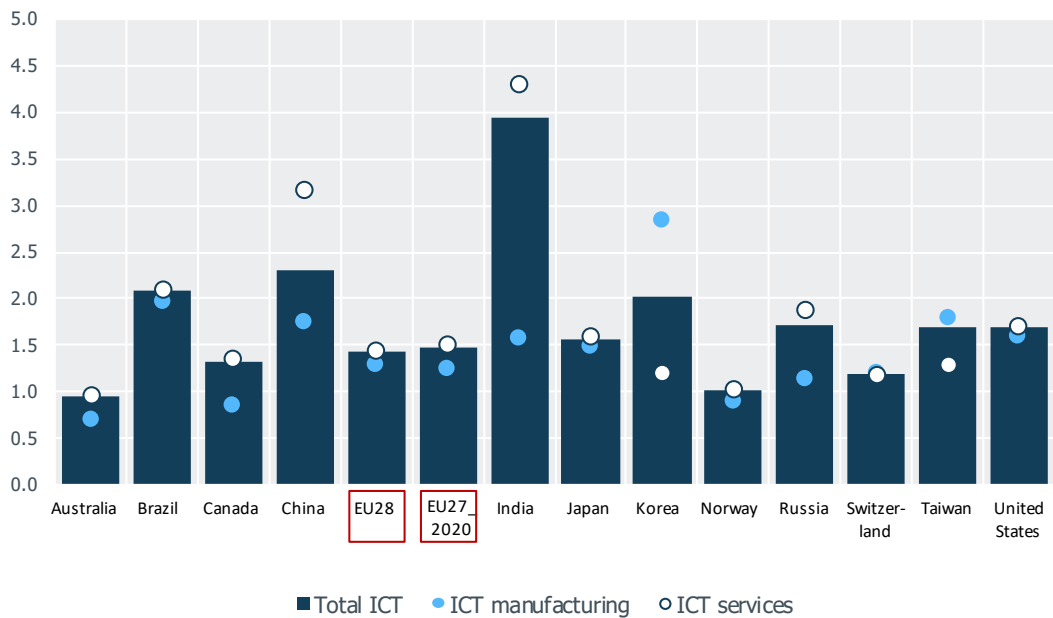
Figure 20 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: labour productivity (2017)

c) ICT sector productivity per person employed ratio over total economy productivity



Note: 2016 for Canada.

d) ICT sector productivity per hour worked ratio over total economy productivity



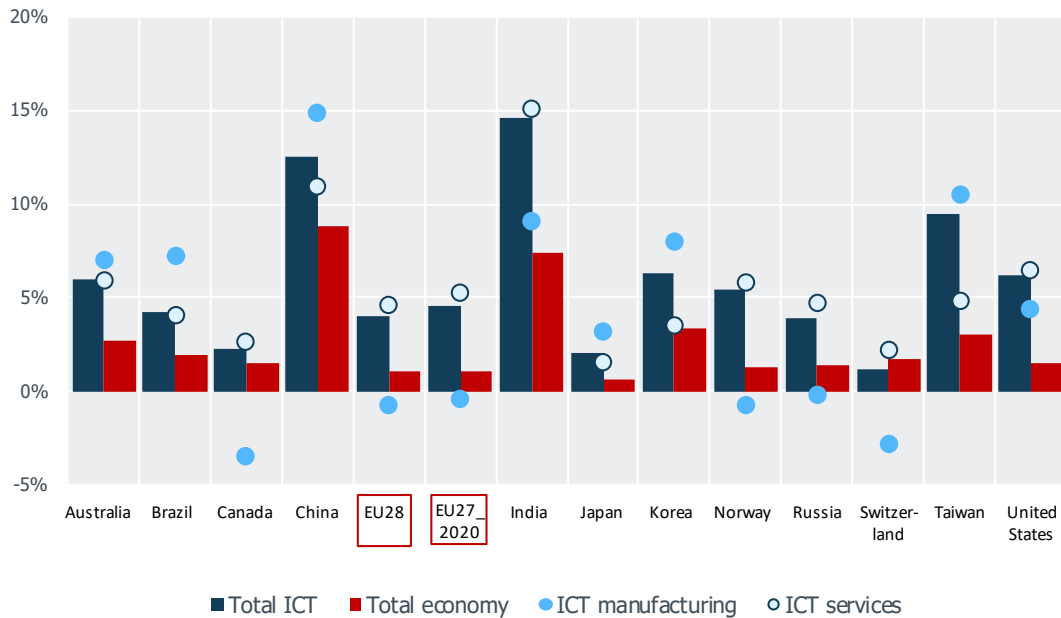
Note: 2016 for Canada.

Source: 2020 PREDICT Dataset.

The US is the country with the highest labour productivity in the ICT sector, both in terms of persons and per hour worked (Figure 19). Its leadership is especially noticeable in the ICT manufacturing sector, followed by Taiwan, South Korea (in terms of persons) and Norway (in terms of hours worked). The EU28 occupies the sixth position when productivity is defined by person employed and the fifth per hour worked. In the EU28, labour productivity is higher in the ICT services sector than in ICT manufacturing. In all countries considered, labour productivity in the ICT sector is similar or exceeds the total economy, both in terms of persons and hours worked. In India it is around 4 times higher, and in China and Brazil more than double. Productivity by hour worked in the ICT sector is about 1.5 higher than that of the whole economy in the EU28 and the US. In addition, in the two countries the gap is larger in ICT services than in ICT manufacturing.

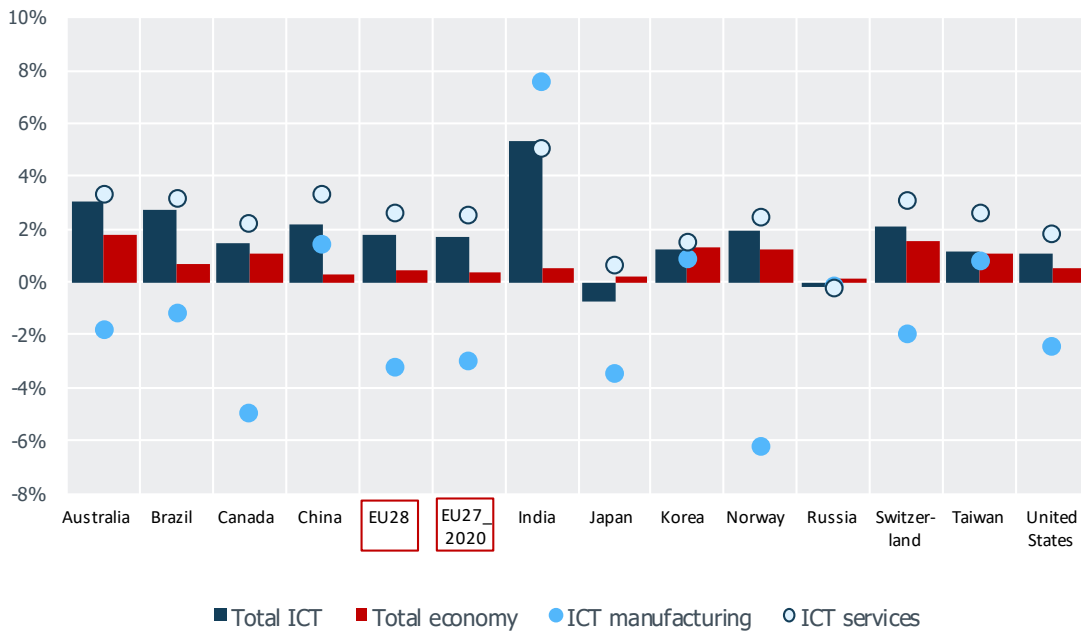
Figure 21: Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2017)

a) Value added



Note: 2006-2016 for Canada.

b) Employment

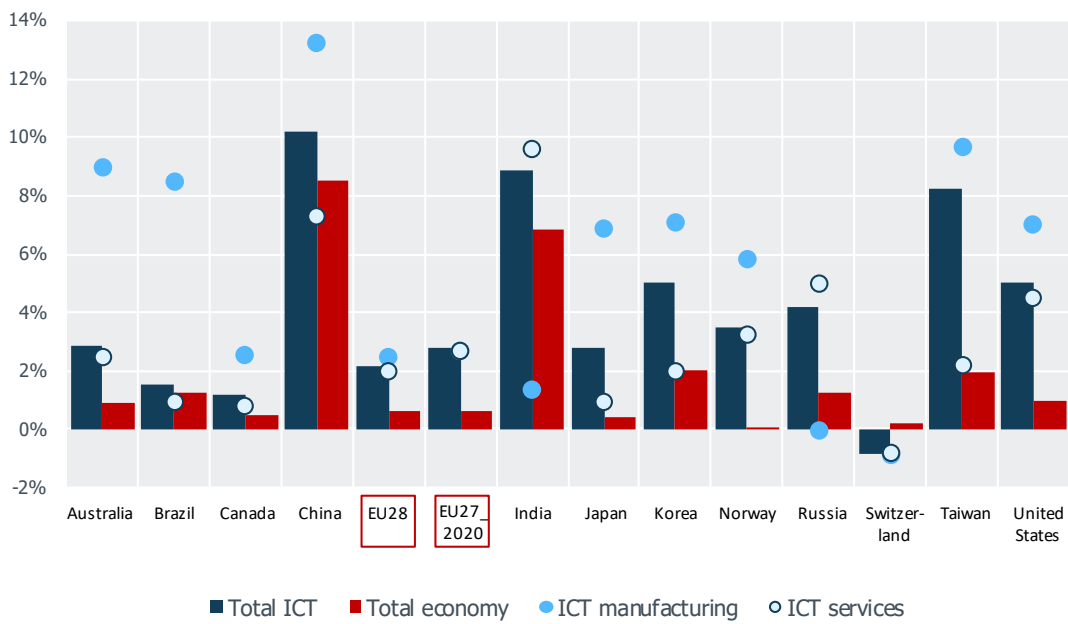


Note: Monetary variables are expressed in real terms.

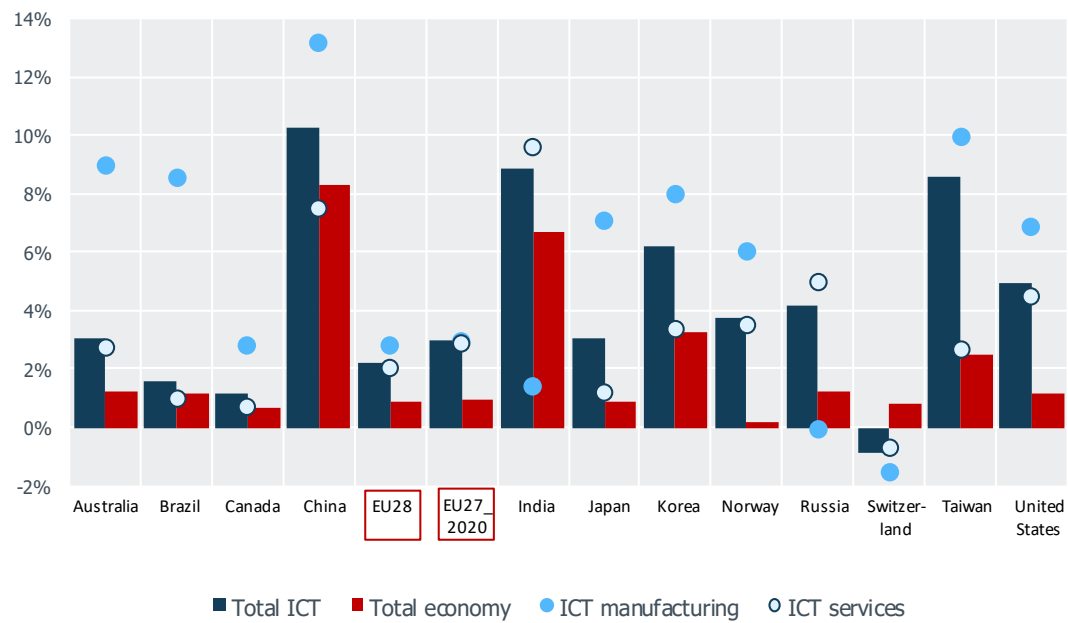
Source: 2020 PREDICT Dataset.

Figure 21 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2017)

c) Productivity per person employed



d) Productivity per hour worked

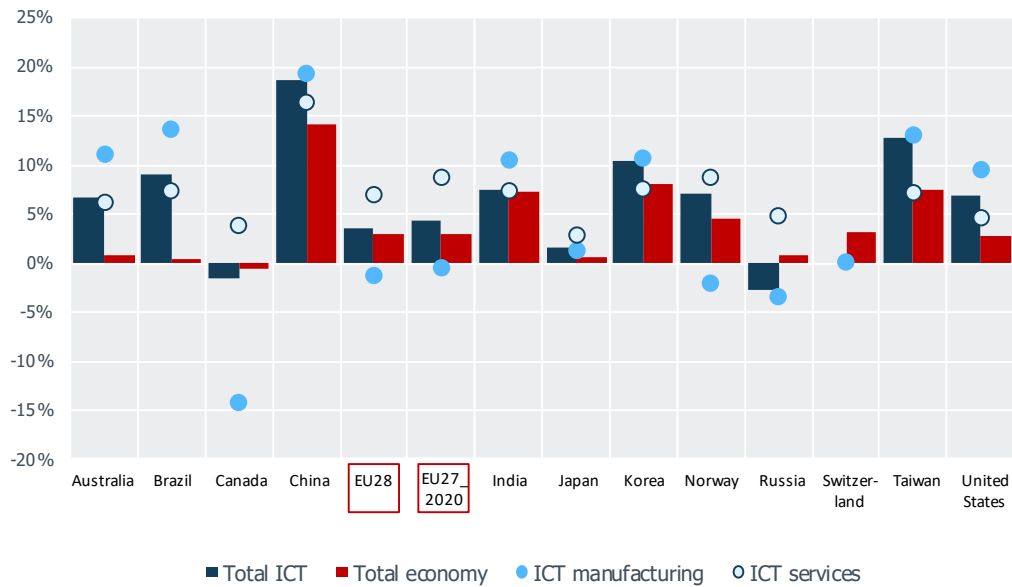


Note: Monetary variables are expressed in real terms. 2006-2016 for Canada.

Source: 2020 PREDICT Dataset.

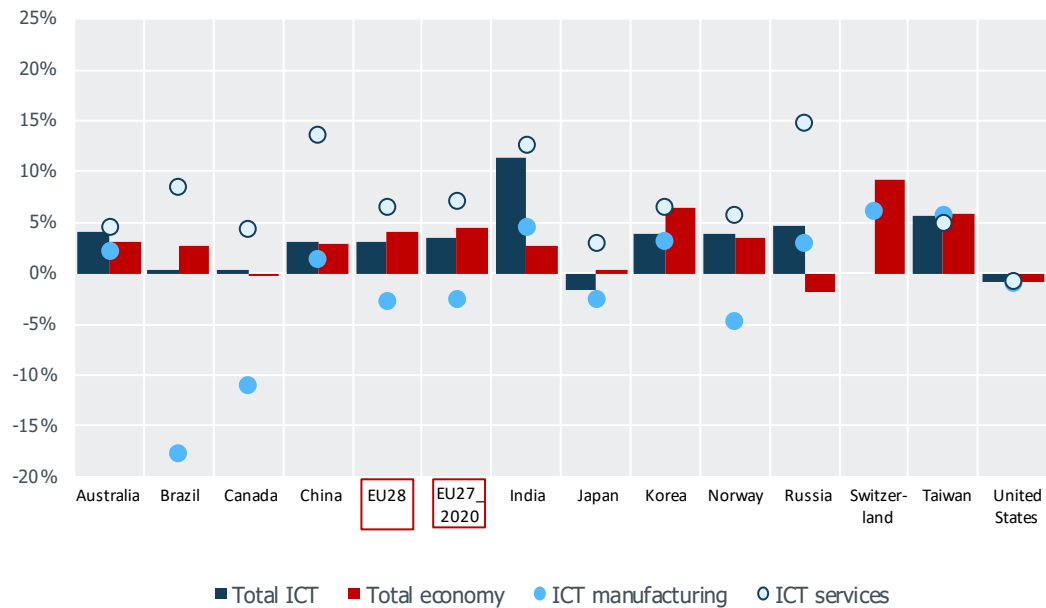
Figure 21 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2017)

e) BERD



Note: 2008-2014 for Brazil, 2006-2013 for India, 2008-2017 for Switzerland and 2006-2016 for Canada. ICT sector for Switzerland includes only ICT manufacturing.

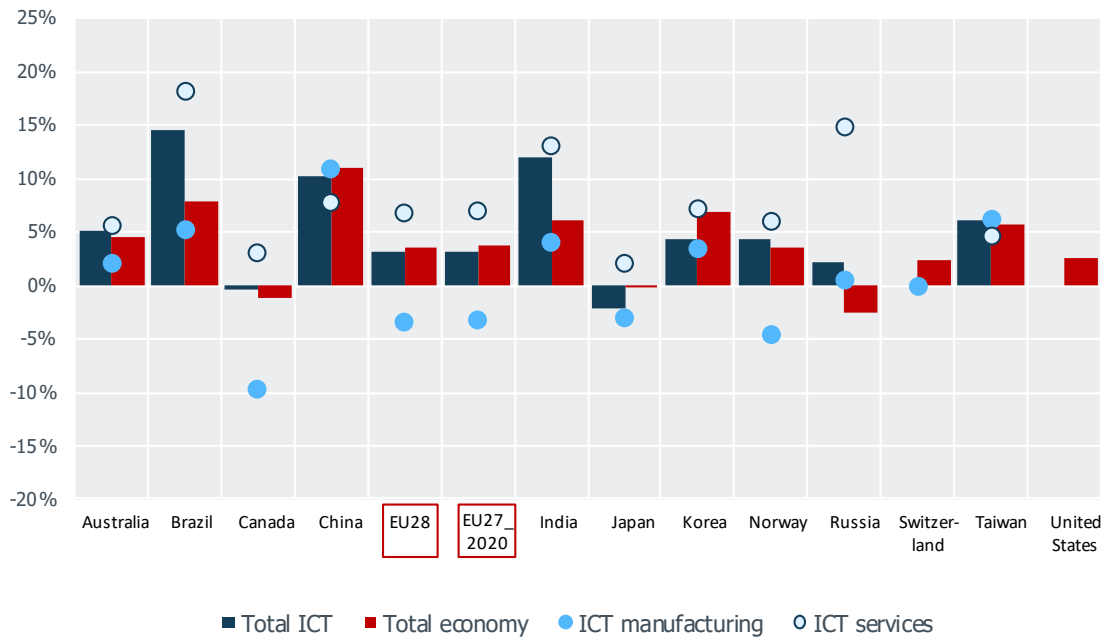
f) RERD



Note: Monetary variables are expressed in real terms. 2011-2014 for Brazil, 2006-2013 for India and 2008-2017 for Switzerland. ICT sector for Switzerland includes only ICT manufacturing. Source: 2020 PREDICT Dataset.

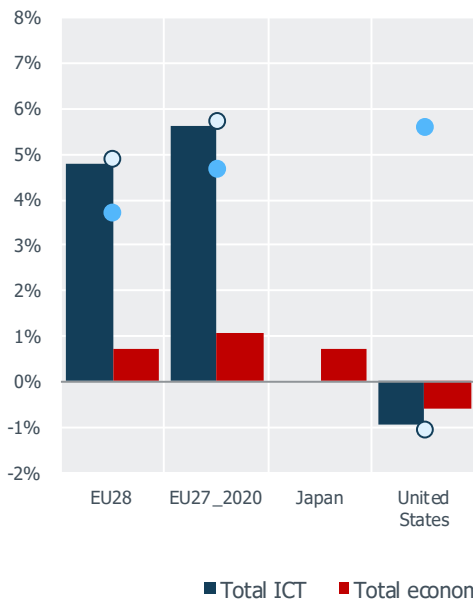
Figure 21(cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2017)

g) PERD

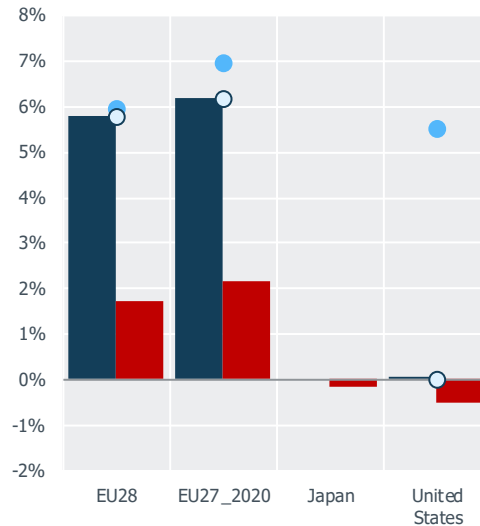


Note: Monetary variables are expressed in real terms. 2008-2014 for Brazil, 2006-2013 for India and 2008-2017 for Switzerland. ICT sector for Switzerland includes only ICT manufacturing

h) GBARD



i) ICT GBARD



Note: 2006-2018 for GBARD and ICT GBARD. ICT manufacturing for United States includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

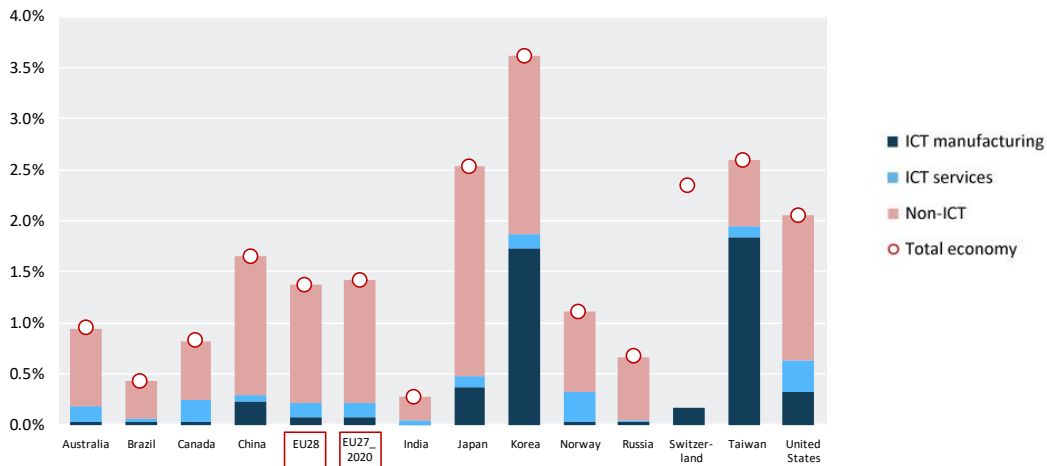
Source: Source: 2020 PREDICT Dataset

India and China presented the highest growth rates between 2006 and 2017 for VA, both in the ICT sector and the total economy (Figure 20). In India the ICT service sector was more dynamic, while in China it was ICT manufacturing. In the case of employment, India and Australia show the highest growth rates in the ICT sector, but only the latter leads the growth of total economy. In the EU28 the annual growth rate of VA in the ICT sector (4.0%) was quite lower than the US (6.2%), while employment grew at a higher rate in the EU

(1.8%) than in the US (1.1%). The highest annual growth in labour productivity per hour worked in the ICT sector is shown by China (10.2%), India (8.9%), Taiwan (8.6%), South Korea (6.2%) and US (5.0%), more than twice those of the EU28 (2.2%). In terms of BERD, China showed the most dynamic behaviour (18.7%). India (11.3%) leads in R&D researchers and Brazil (14.5%) in R&D personnel. Compared to those countries, the ICT sector in the EU28, and also in the US, was much less dynamic. However, the EU28 presented a higher growth rate in GBARD and ICT GBARD in the ICT sector than the US.

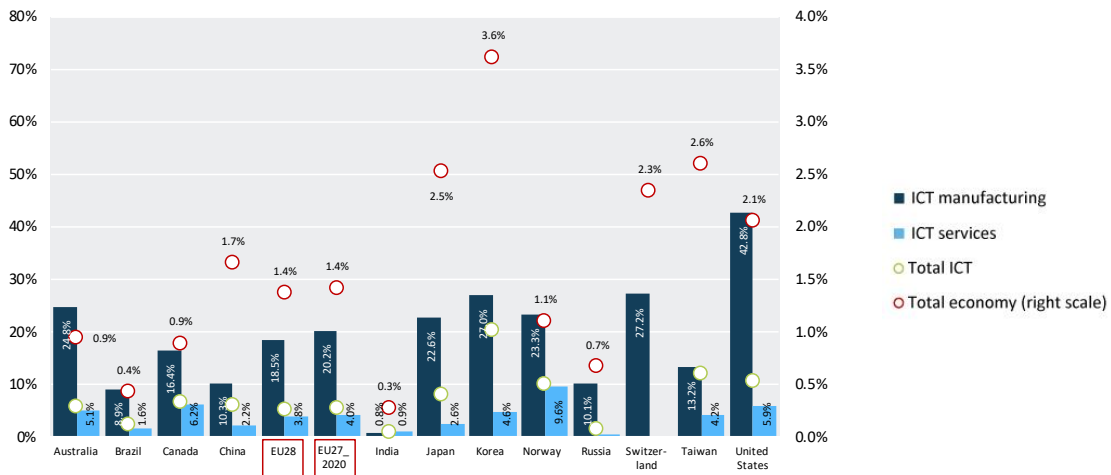
Figure 22: BERD intensity in the international context (2017)

a) BERD/GDP



Note: 2014 for Brazil and 2013 for India.

b) ICT sector BERD/ICT sector VA



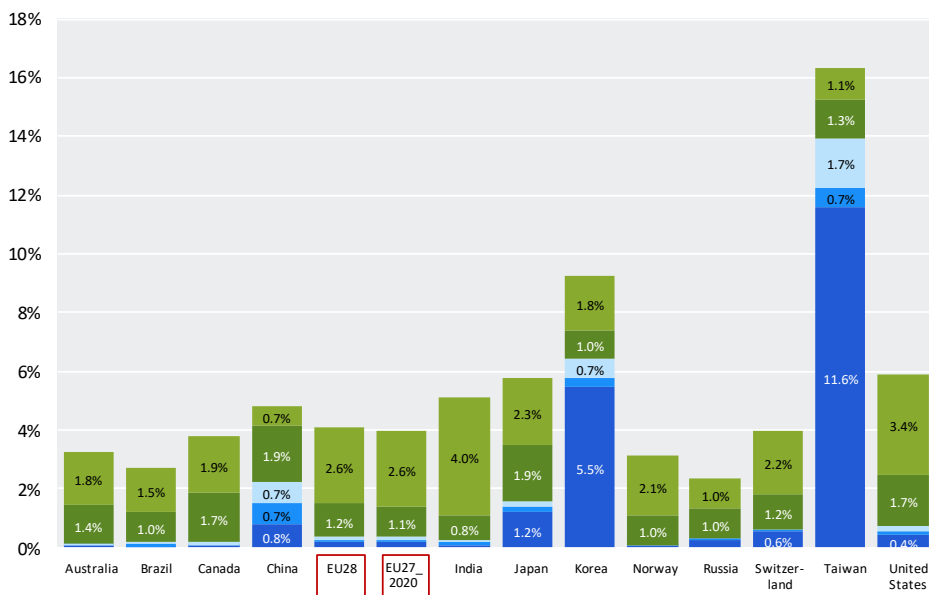
Note: 2014 for Brazil, 2013 for India and 2016 for Canada. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

South Korea (3.6%) has the highest BERD intensity (BERD/GDP) of all the countries considered (Figure 21), followed by Taiwan (2.6%), Japan (2.5%), Switzerland (2.3%) and the US (2.1%). In South Korea and Taiwan BERD intensity in the ICT manufacturing sectors is very high, while for the remaining countries the non-ICT sectors present the largest ratio. The BERD intensity level of EU28 (1.4%) is lower than the one of China (1.6%). BERD intensity in the ICT sector (measured as sector BERD/sector VA) is very high in South Korea, both for the total economy (3.6%) and for the ICT sector (20.2%). For ICT manufacturing, the highest intensity corresponds to the US (42.8%) followed by Switzerland (27.2%) and South Korea (27.0%). In the ICT service sector, Norway (9.6%) takes the lead followed by Canada (6.2%). The EU28 occupies the seventh position for the total economy (1.4%), ninth for the ICT sector (5.1) and seventh for ICT manufacturing (18.5%) and ICT services (3.8%).

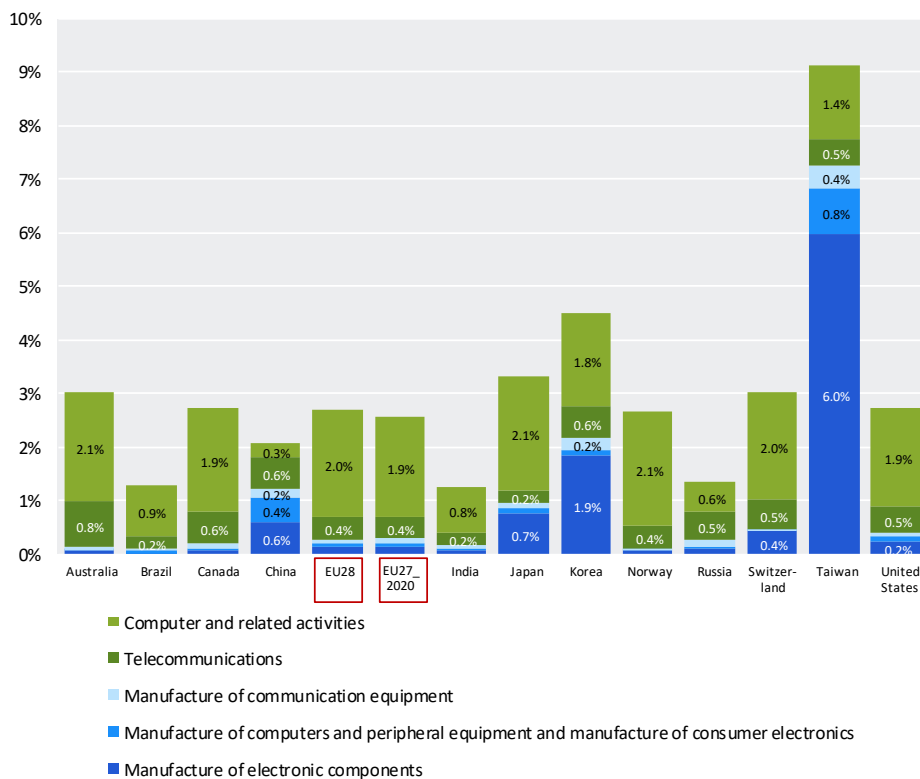
Figure 23: ICT sector by subsectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2017)

a) VA share of GDP



Note: 2016 for Canada.

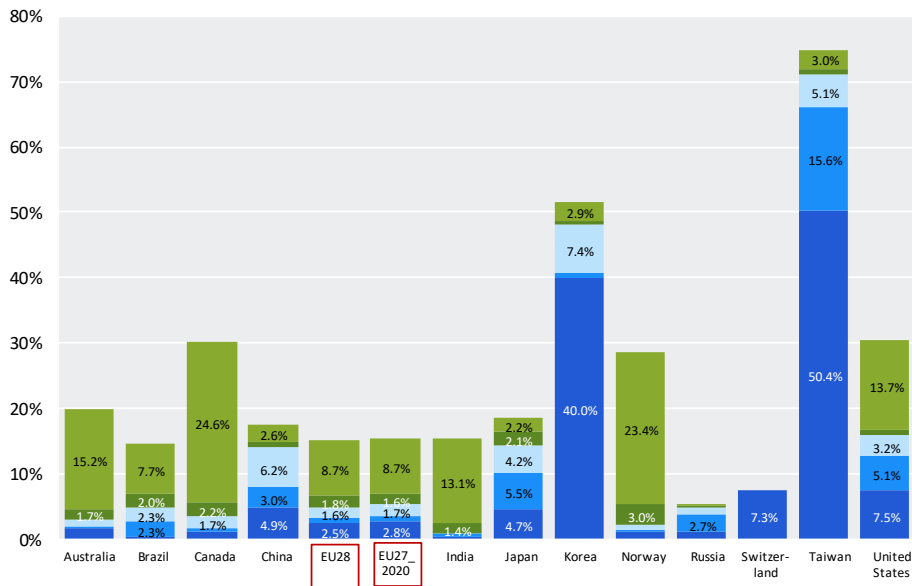
b) ICT sector employment share of total employment



Source: 2020 PREDICT Dataset

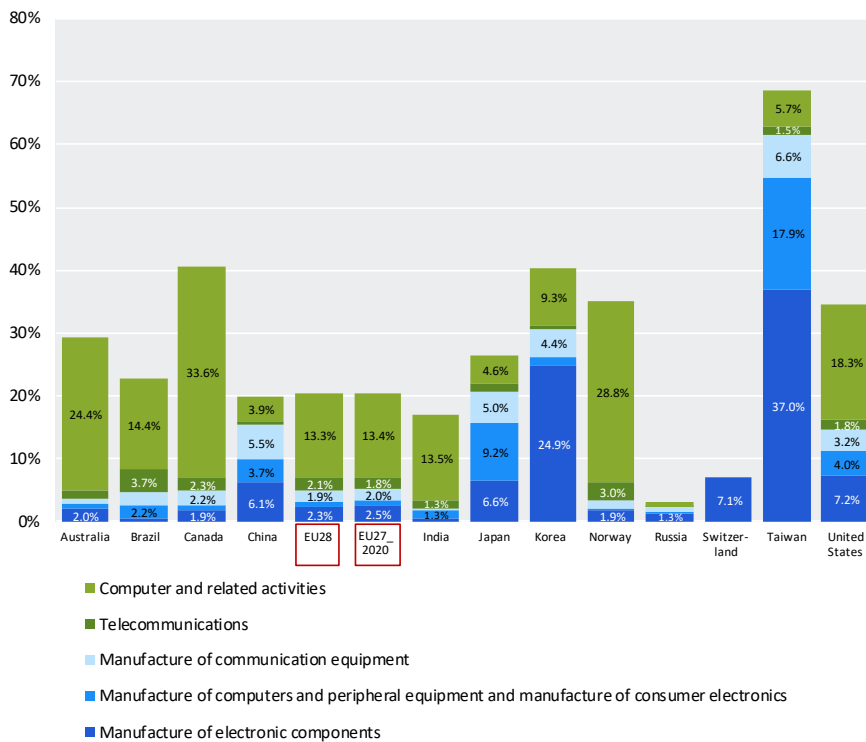
Figure 23 (cont.): ICT sector by subsectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2017)

c) ICT sector BERD share of total BERD



Note: 2013 for India and 2014 for Brazil.

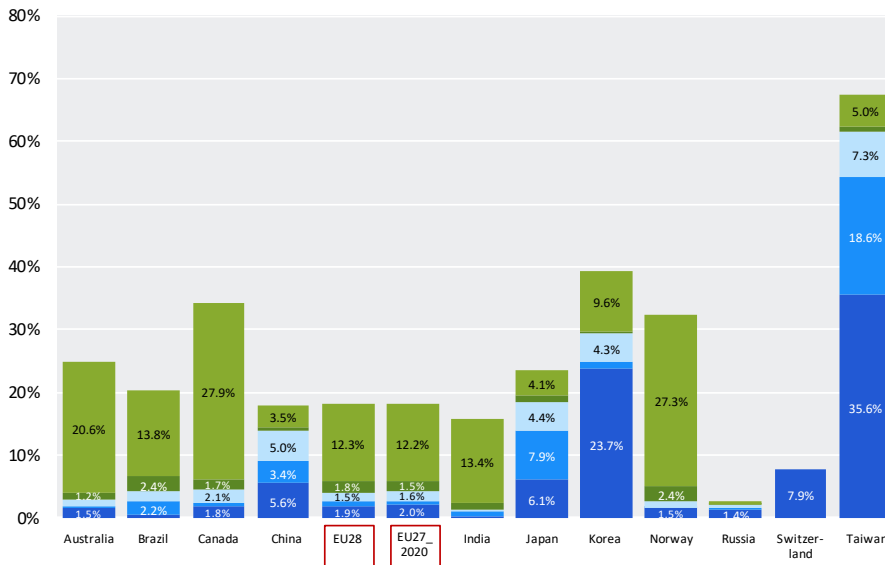
d) ICT sector RERD share of total RERD



Note: 2013 for India and 2014 for Brazil.

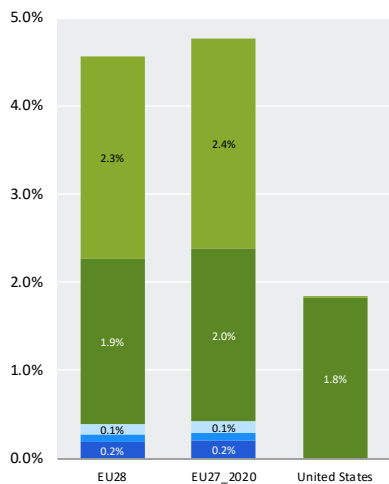
Figure 23 (cont.): ICT sector by subsectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2017)

e) ICT sector PERD share of total PERD

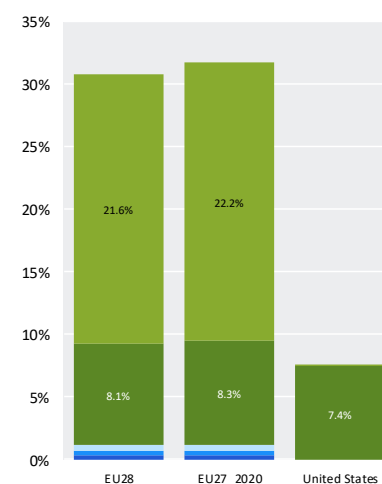


Note: 2013 for India and 2014 for Brazil. ICT sector for United States not included because of lack of homogeneous data.

f) ICT sector GBARD share of total GBARD



g) ICT sector ICT GBARD share of total ICT GBARD

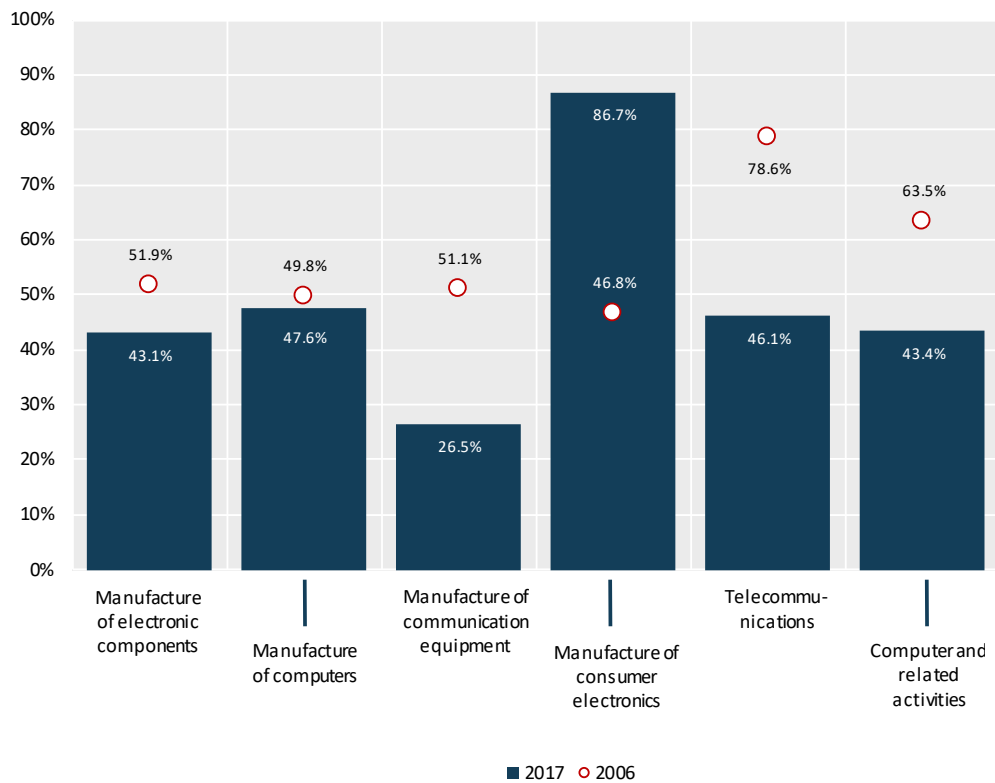


■ Computer and related activities
■ Telecommunications
■ Manufacture of communication equipment
■ Manufacture of computers and peripheral equipment and manufacture of consumer electronics
■ Manufacture of electronic components

Note: 2018 for GBARD and ICT GBARD.
Source: 2020 PREDICT Dataset.

ICT manufacturing sectors have a high share in the majority of the Asian countries in all the variables. In Taiwan (the country with the largest ICT sector in relative terms), the VA of the *Manufacturing of electronic components* sector amounts to 11.6% of total GDP (Figure 22), 6.0% of total employment, 50.4% of BERD, 37.0% of R&D researchers and 35.6% of R&D personnel. In China, the sector with the highest share in terms of VA is *Telecommunications* (1.9%), while in India it is *Computer and related activities* (4.0%). In the EU28 and the US, ICT services sectors (*Telecommunications* and *Computer and related activities*) have the largest shares in terms of all variables, especially in GBARD.

Figure 24: ICT subsector productivity per employed EU28 over United States (2006, 2017)

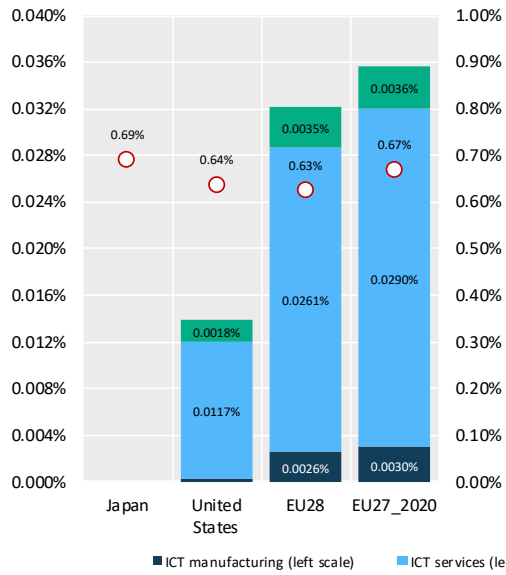


Source: 2020 PREDICT Dataset.

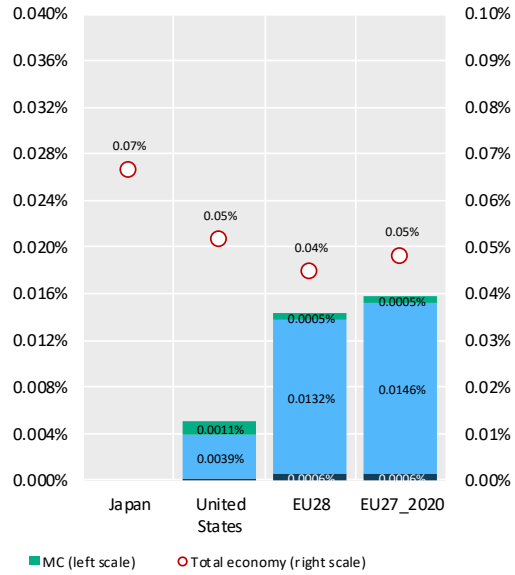
When comparing the EU28 and the US, the latter is the leader in many aspects, but especially in labour productivity (Figure 23). The US has a higher labour productivity per person employed than the EU28 in all ICT sub-sectors. *Manufacture of communication equipment* is the ICT sub-sector in which the gap is wider (EU28 only represents 26.5% of the total of the US), followed by *Manufacture of electronic components* (43.1%) and the two ICT services sub-sectors: *Computer and related activities* (43.4%) and *Telecommunications* (46.1%). In addition, the gap has widened since 2006 in five of the six sub-sectors considered, while only narrowing for *Manufacture of consumer electronics* (86.7%).

Figure 25: GBARD and ICT GBARD by non-EU economies (2018)

a) GBARD intensity (GBARD/GDP)



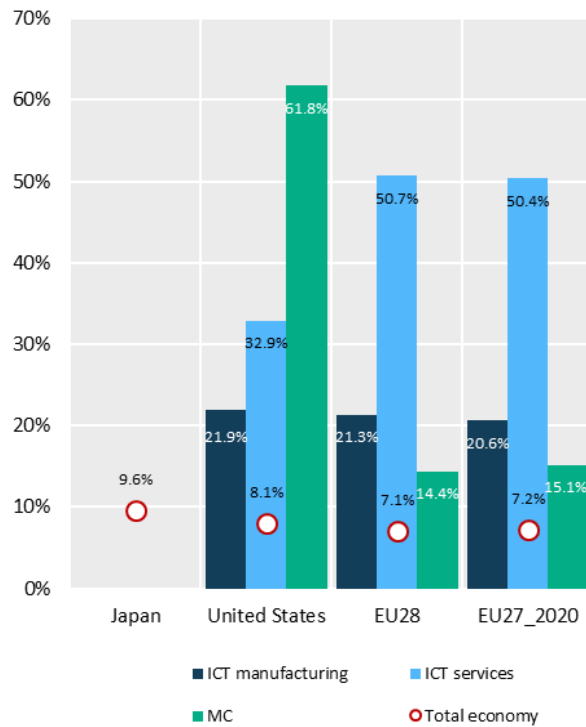
b) ICT GBARD intensity (ICT GBARD/GDP)



Note: Figures for Japan not fully homogeneous with EU28 and the United States (see methodology). ICT sector ICT GBARD for United States includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media). GDP nowcasted for 2018.

Source: 2020 PREDICT Dataset and Eurostat.

c) ICT GBARD/GBARD



Source: 2020 PREDICT Dataset

Public funding of R&D (GBARD) intensity (defined as GBARD/GDP) for the total economy is larger in Japan (0.69%) than in the US (0.64%) and the EU28 (0.63%). However, the EU28 presents higher values for the ICT sector, ICT manufacturing, ICT services and MC sectors (Figure 24). The same results apply to the ICT GBARD intensity. The only difference is that it is higher in the US than in the EU28 in the MC sector. The weight of ICT GBARD over total GBARD is especially high for the MC sector in the US (61.8%) as compared with the EU28 (14.4%). On the contrary, for the ICT services it is higher in the EU28 (50.7%) than in the US (32.9%), while the shares for the ICT manufacturing sector are similar.

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List of abbreviations

BERD	Business Expenditure on Research and Development
BRDIS	Business R&D and Innovation Survey
DG CONNECT	Directorate General for Communications Networks, Content and Technology
EU28	European Union 28 countries (2013-2020)
EU27_2020	European Union 27 countries (from 2020, without United Kingdom)
EUR	Euros
Eurostat	Statistical Office of the European Communities
FTE	Full-time equivalent
GBARD	Government budget allocations for Research and Development
GDP	Gross domestic product
GERD	Gross domestic Expenditure on Research and Development
ICT	Information and Communication Technologies
ISIC	International Standard Industry Classification
IVIE	Valencian Institute of Economic Research
MC	Media and Content sector
MS	Member State
NACE	Statistical classification of economic activities in the European Community
NMS	New Member States
OECD	Organisation for Economic Co-operation and Development
PERD	Business R&D personnel
PPS	Purchase Power Standard
PREDICT	Prospective Insights on R&D in ICT
RERD	Business R&D researchers
R&D	Research and Development
RS	Retail sale via mail order houses or via Internet
SIRD	Survey of Industrial Research and Development
SNA	System of National Accounts
US	United States
VA	Value added

List of definitions

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

BERD intensity: BERD/GDP.

Billions: Thousands of millions.

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

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

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

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

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

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

EU28: The former EU-28 aggregate covers the composition of the EU between 2013 and 2020, with 28 Member States (including United Kingdom).

EU27_2020: New code for European aggregate covering the EU with 27 Member States (without United Kingdom) from 2020.

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

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

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

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

ICT BERD intensity: ICT BERD/ICT VA.

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

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

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

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

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

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

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

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

MC sector: includes Publishing of books, periodicals and other publishing activities (581), Audiovisual and broadcasting activities (59-60) and Other information service activities (639). It corresponds to the definition given by OECD in 2007. See OECD definition: <http://www.oecd.org/sti/ieconomy/oecdguidetomeasuringtheinformationsociety2011.html>

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

Member States: Member States of the European Union up to 2012: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

New Member States (NMS): 2004 and 2007 European Union Eastern enlargements consisting of Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia. Finally Croatia acceded to the EU in July 2013.

Other economies: countries included for the non-EU comparison consisting of: Australia, Canada, China, Brazil, India, Japan, Korea, Norway, Russia, Switzerland, Taiwan and the United States.

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

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

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

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

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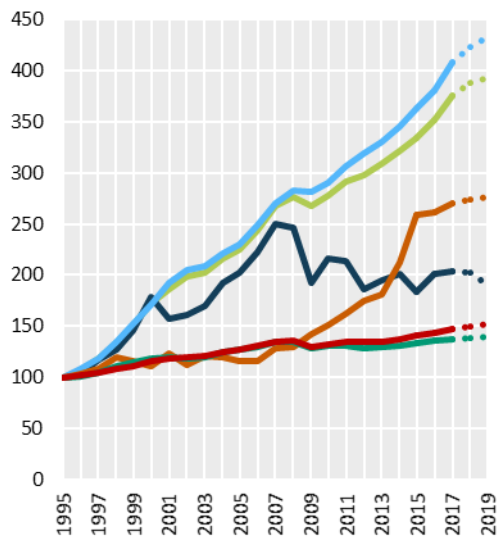
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ANNEX

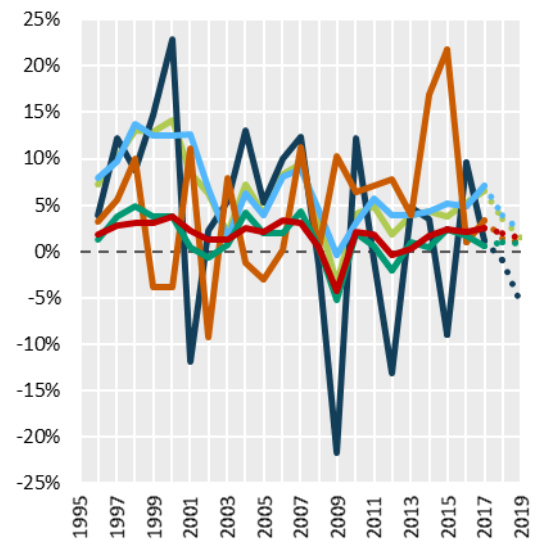
A.1 ICT sector and its R&D in the EU28

Figure A1: ICT sector VA in the EU28 (1995-2019)

a) Index 1995=100



b) Annual real growth rates



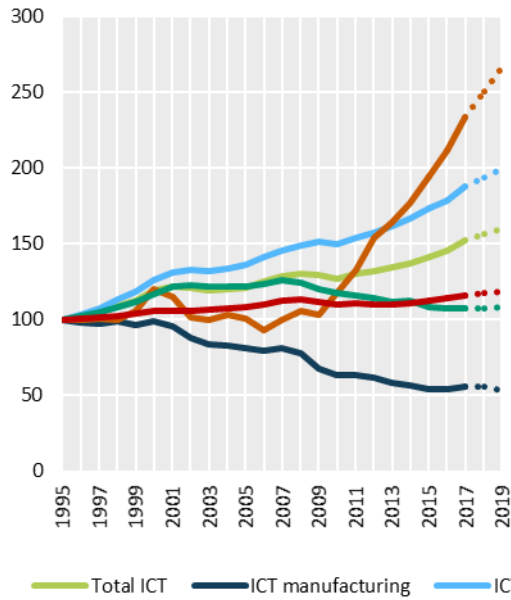
Legend: Total ICT (light green), ICT manufacturing (dark blue), ICT services (light blue), RS (orange), MC (green), GDP (red).

Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

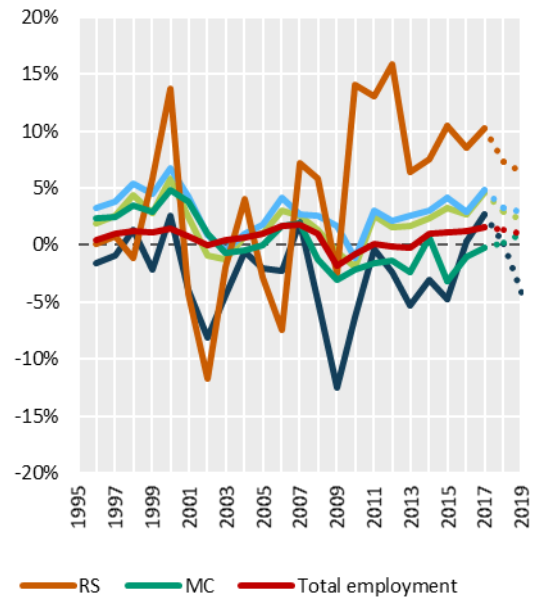
Source: 2020 PREDICT Dataset and Eurostat.

Figure A2: ICT sector employment in the EU28 (1995-2019)

a) Index 1995=100



b) Annual growth rates

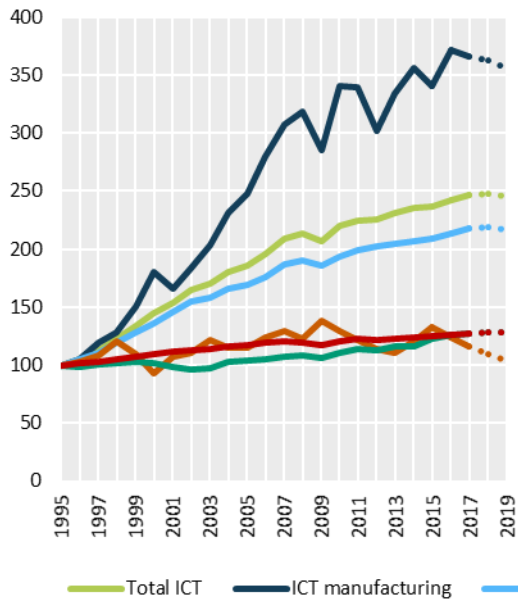


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

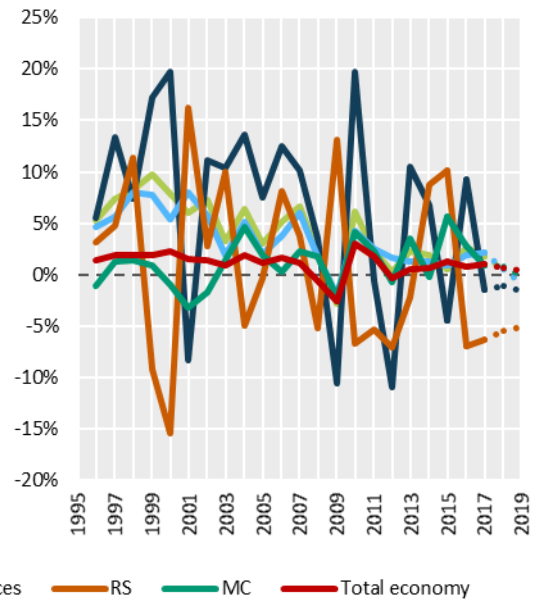
Source: 2020 PREDICT Dataset and Eurostat.

Figure A3: ICT sector productivity per person employed in the EU28 (1995-2019)

a) Index 1995=100



b) Annual real growth rates

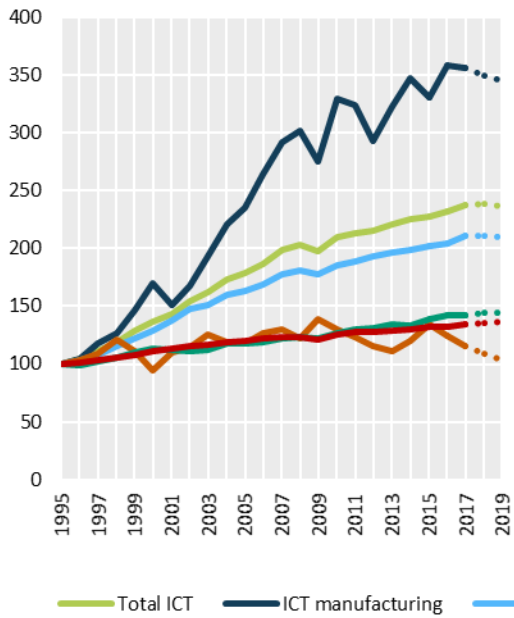


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

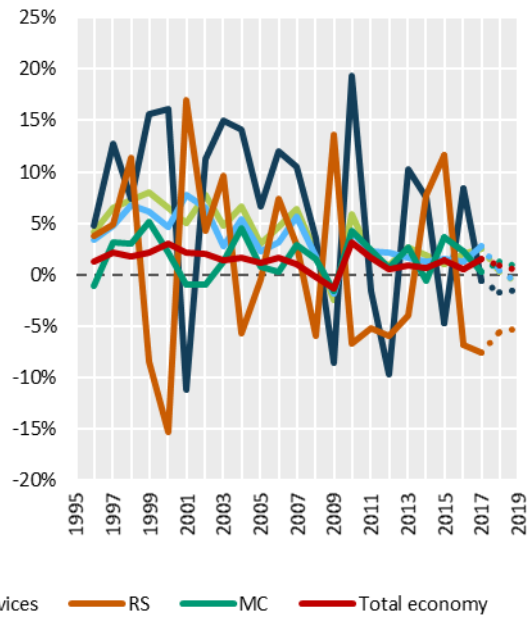
Source: 2020 PREDICT Dataset and Eurostat.

Figure A4: ICT sector productivity per hour worked in the EU28 (1995-2019)

a) Index 1995=100



b) Annual real growth rates

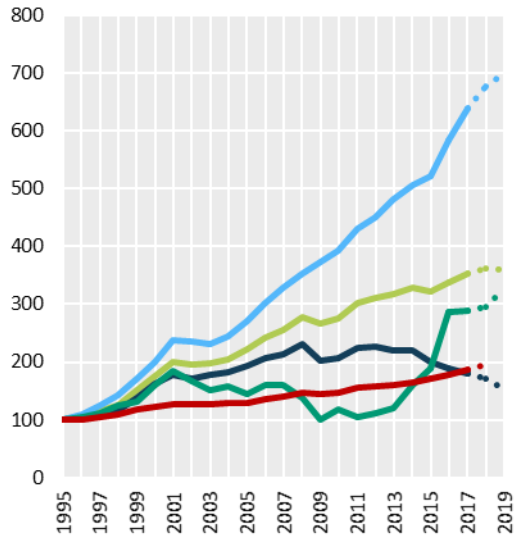


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

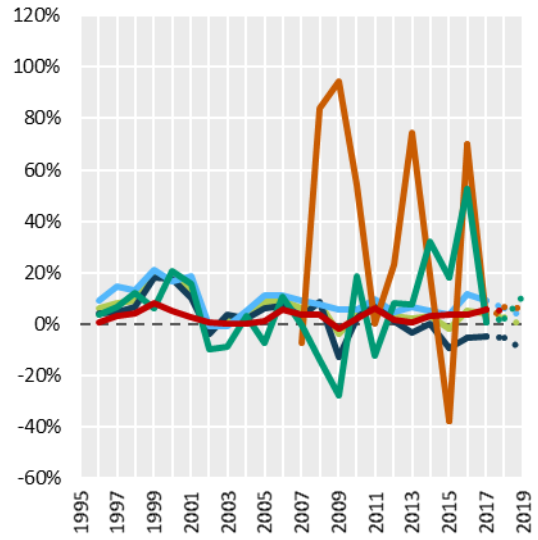
Source: 2020 PREDICT Dataset and Eurostat.

Figure A5: ICT sector BERD in the EU28 (1995-2019)

a) Index 1995=100



b) Annual real growth rates



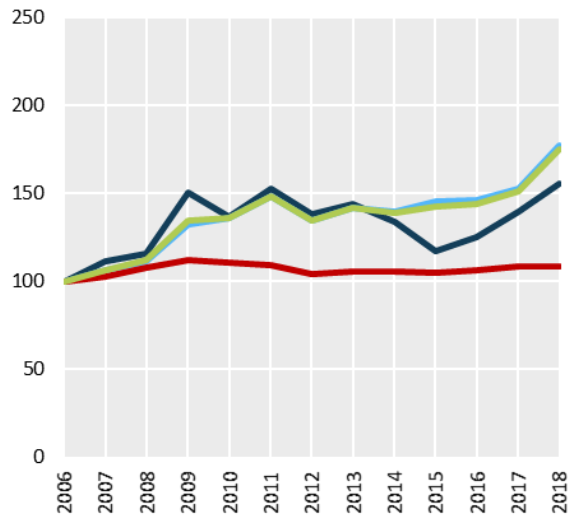
Legend: Total ICT (light green), ICT manufacturing (dark blue), ICT services (light blue), RS (orange), MC (teal), Total BERD (red)

Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

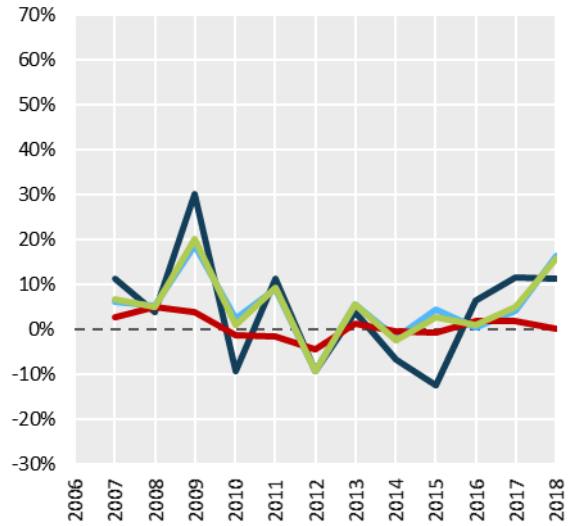
Source: 2020 PREDICT Dataset and Eurostat.

Figure A6: GBARD and ICT GBARD in the EU28 (2006-2018)

a) GBARD. Index 2006=100

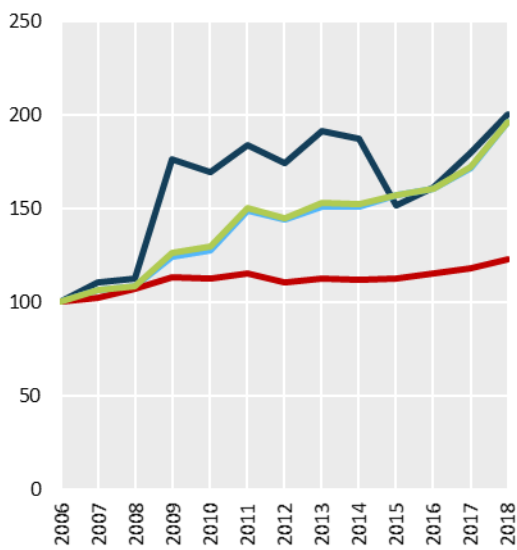


b) GBARD. Annual real growth rates

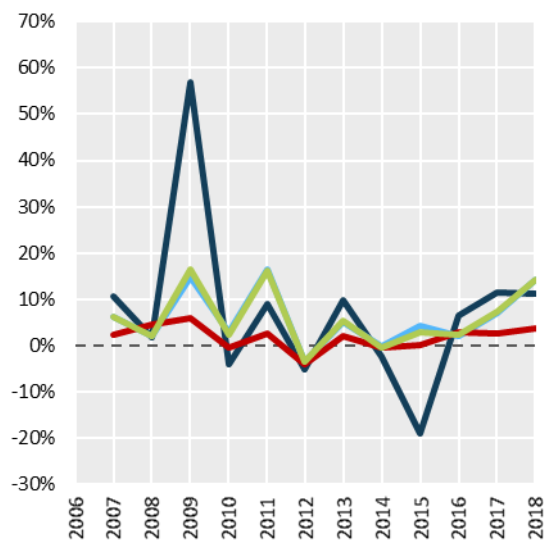


— ICT manufacturing — ICT services — Total GBARD — Total ICT

c) ICT GBARD. Index 2006=100



d) ICT GBARD. Annual real growth rates

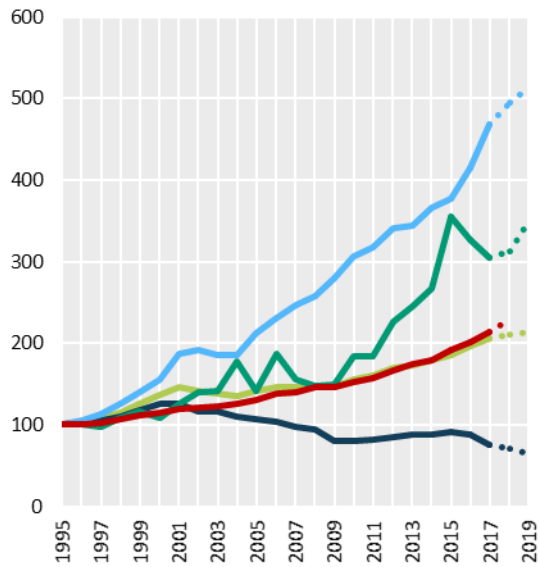


— ICT manufacturing — ICT services — Total ICT GBARD — Total ICT

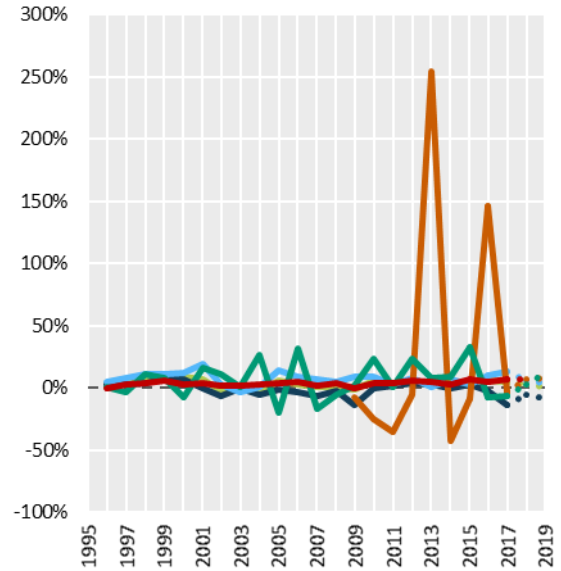
Source: 2020 PREDICT Dataset.

Figure A7: ICT sector RERD in the EU28 (1995-2019)

a) Index 1995=100



b) Annual growth rates



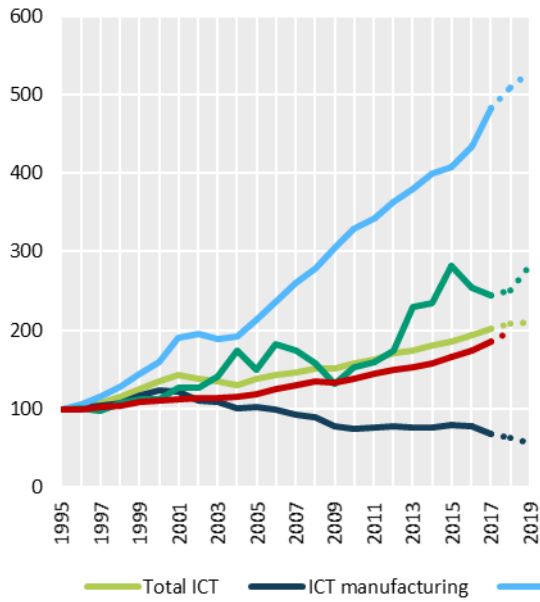
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total RERD

Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

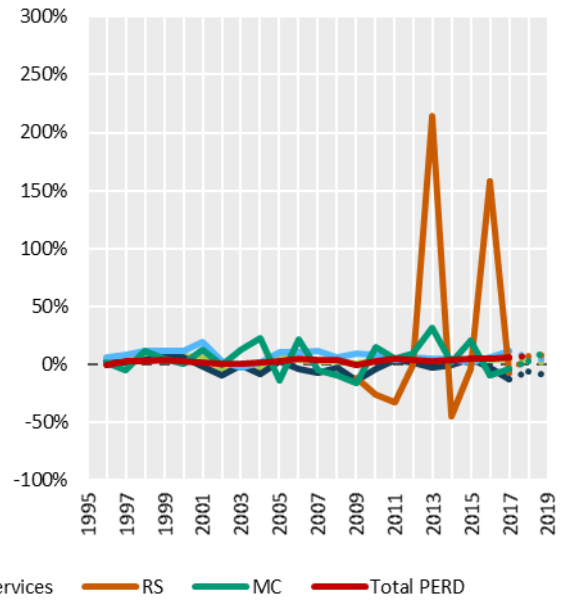
Source: 2020 PREDICT Dataset.

Figure A8: ICT sector PERD in the EU28 (1995-2019)

a) Index 1995=100



b) Annual growth rates

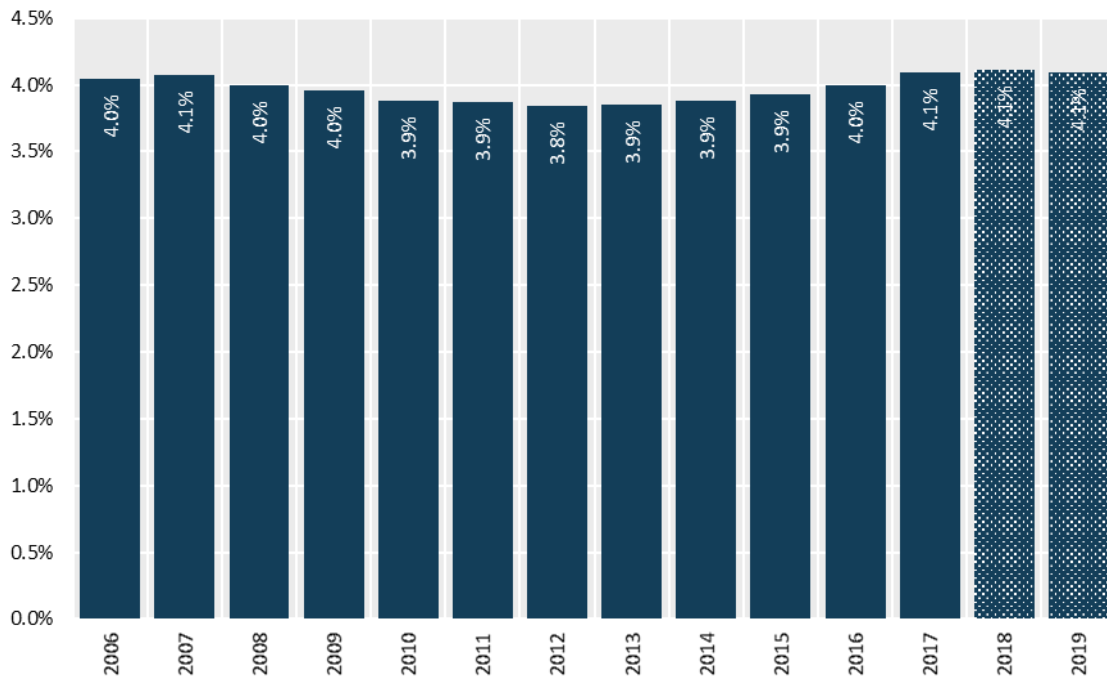


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset.

A.2 Analysis by sub-sectors in the EU28

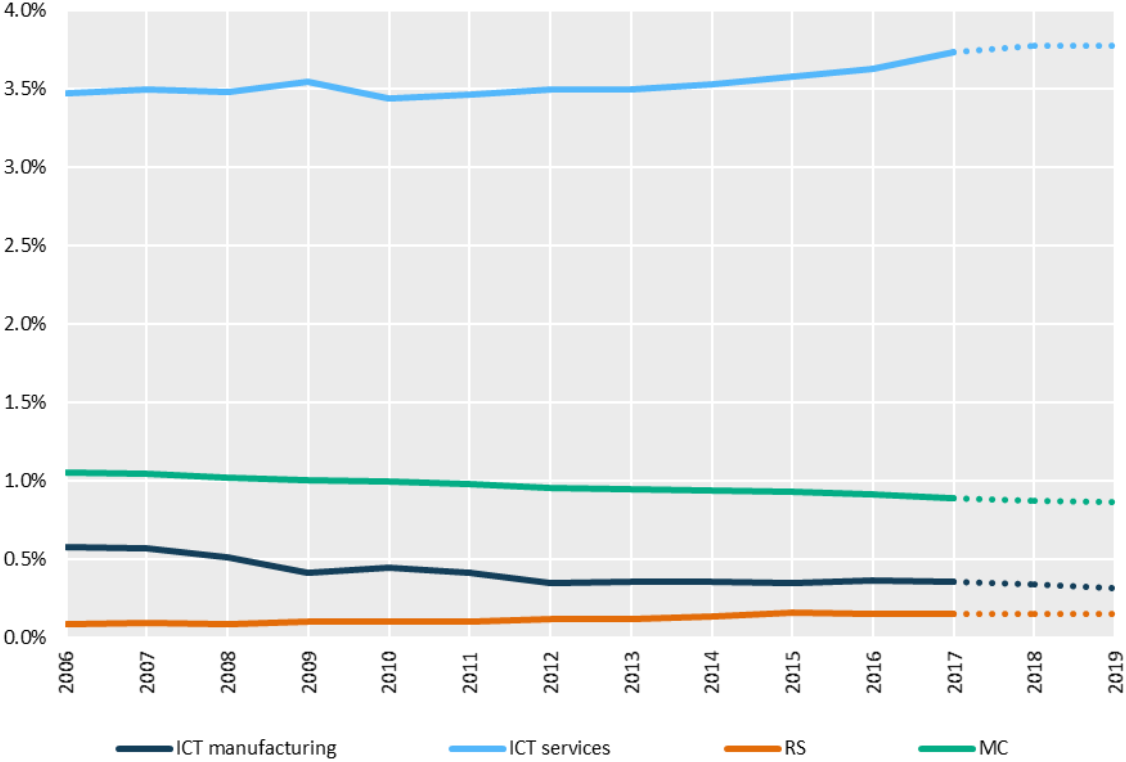
Figure A9: ICT sector VA share of GDP in the EU28 (2006-2019)



Note: Column patterns indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

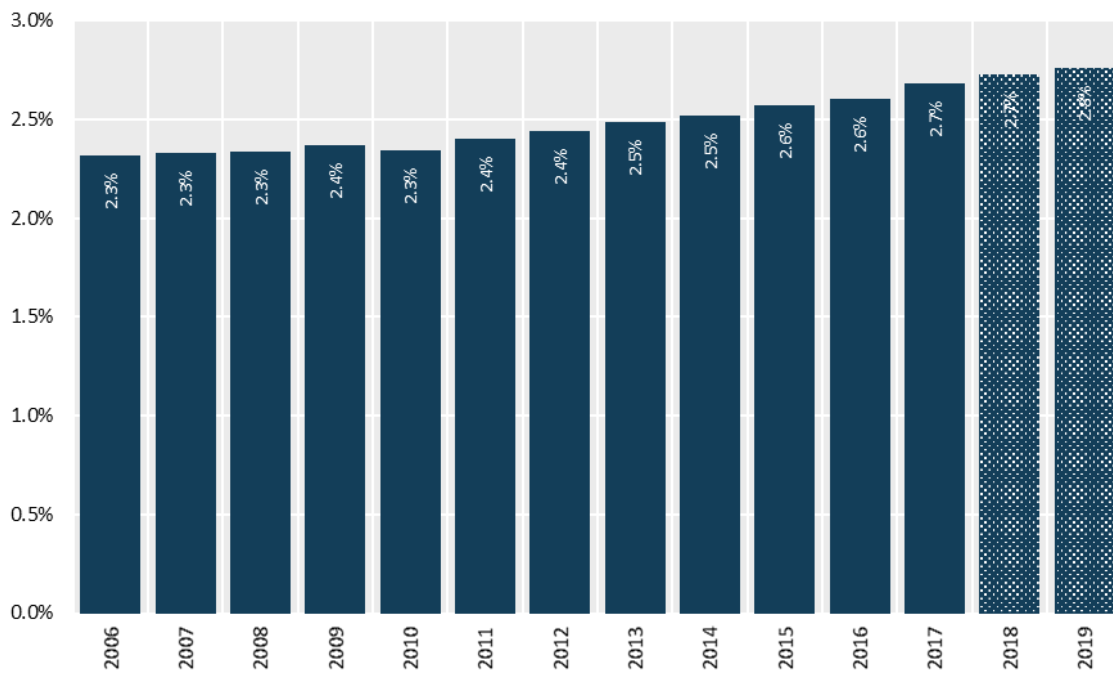
Figure A10: ICT manufacturing, ICT services, MC and RS sectors share of GDP in the EU28 (2006-2019)



Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

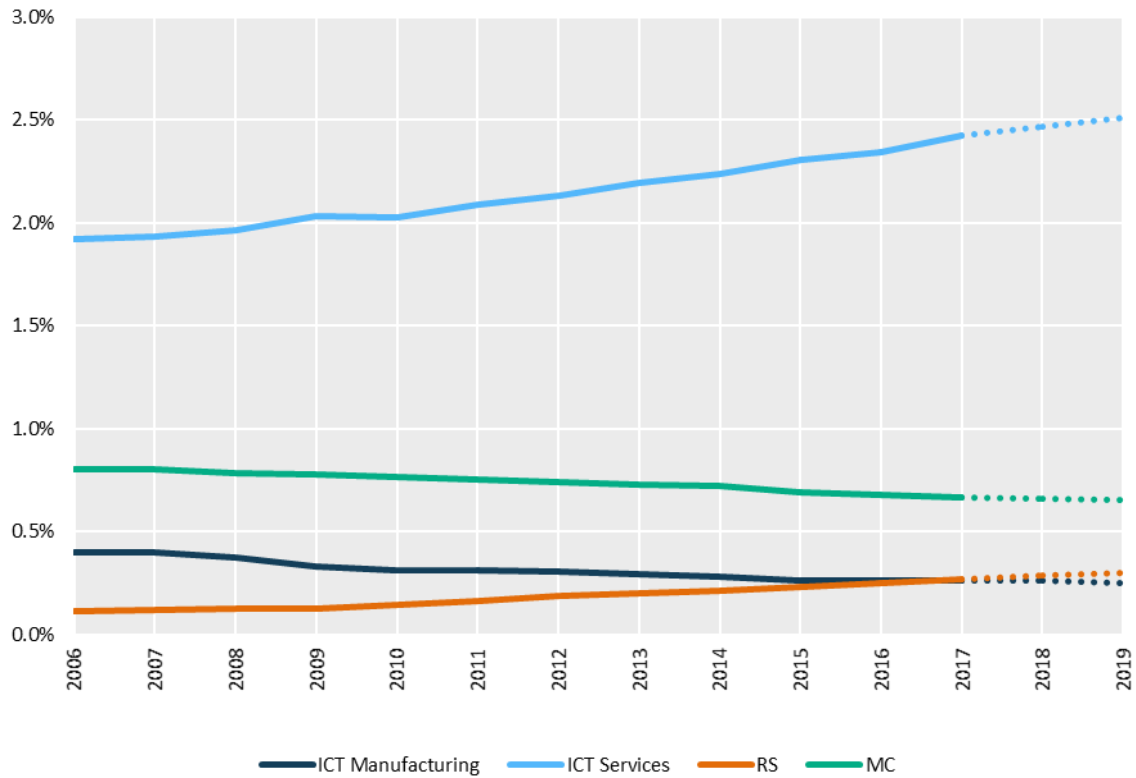
Figure A11: ICT sector employment share of total employment in the EU28 (2006-2019)



Note: Column patterns indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

Figure A12: ICT manufacturing, ICT services, MC and RS sectors share of the total employment in the EU28 (2006-2019)

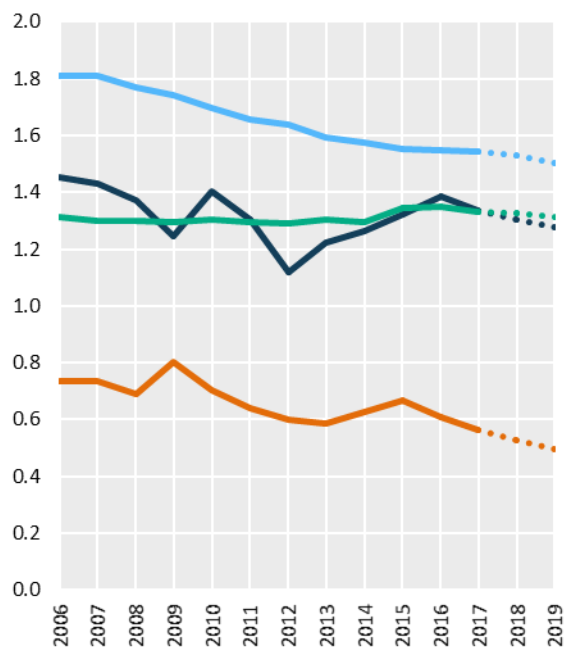


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

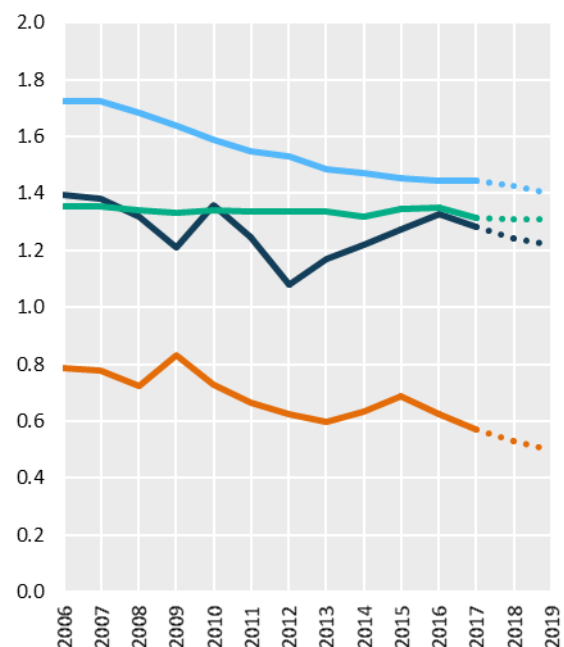
Source: 2020 PREDICT Dataset and Eurostat.

Figure A13: Productivity in ICT manufacturing, ICT services, MC and RS sectors as a ratio of total economy productivity in the EU28 (2006-2019)

a) Productivity per person employed



b) Productivity per hour worked

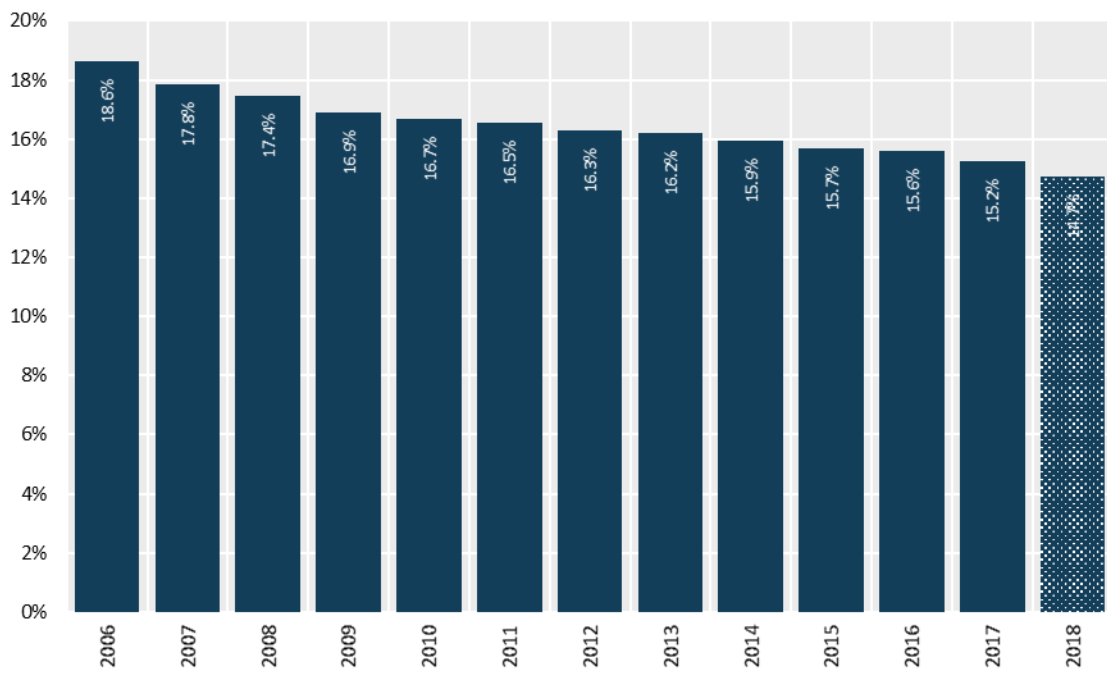


— ICT Manufacturing — ICT Services — RS — MC

Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

Figure A14: ICT sector BERD share of total BERD in the EU28 (2006-2018)



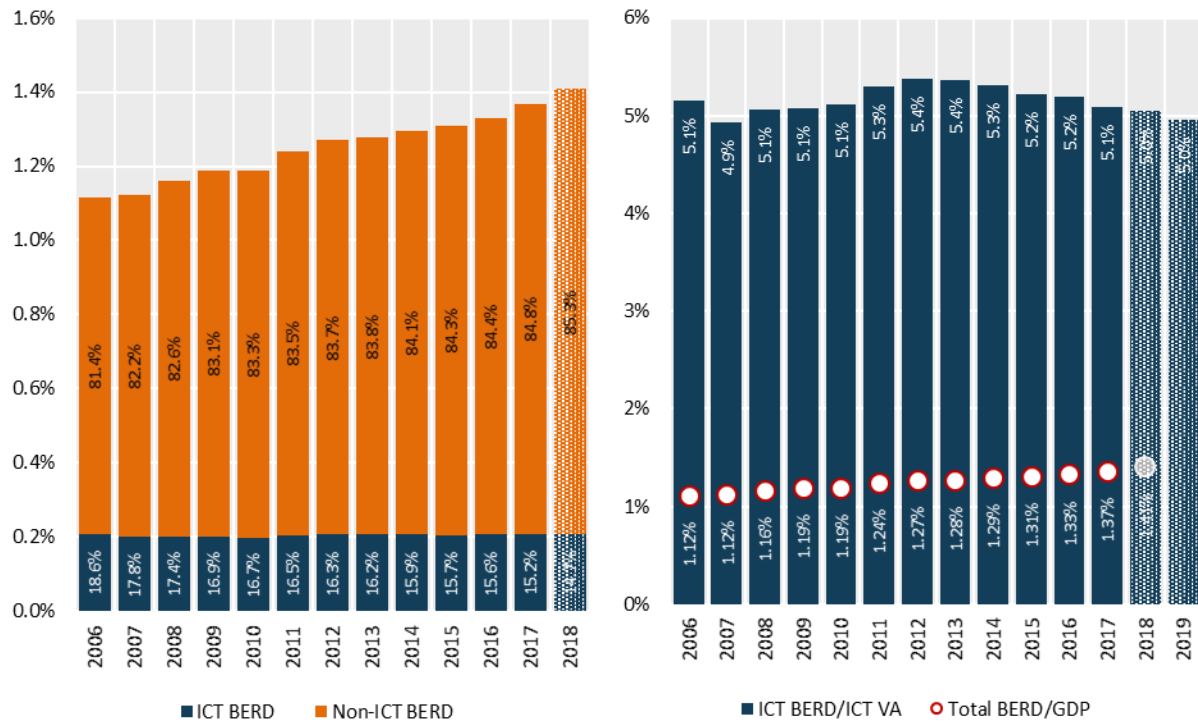
Note: Column patterns indicate nowcasted data.

Source: 2020 PREDICT Dataset.

Figure A15: ICT BERD intensity and total BERD intensity in the EU28 (2006-2019)

a) Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP)

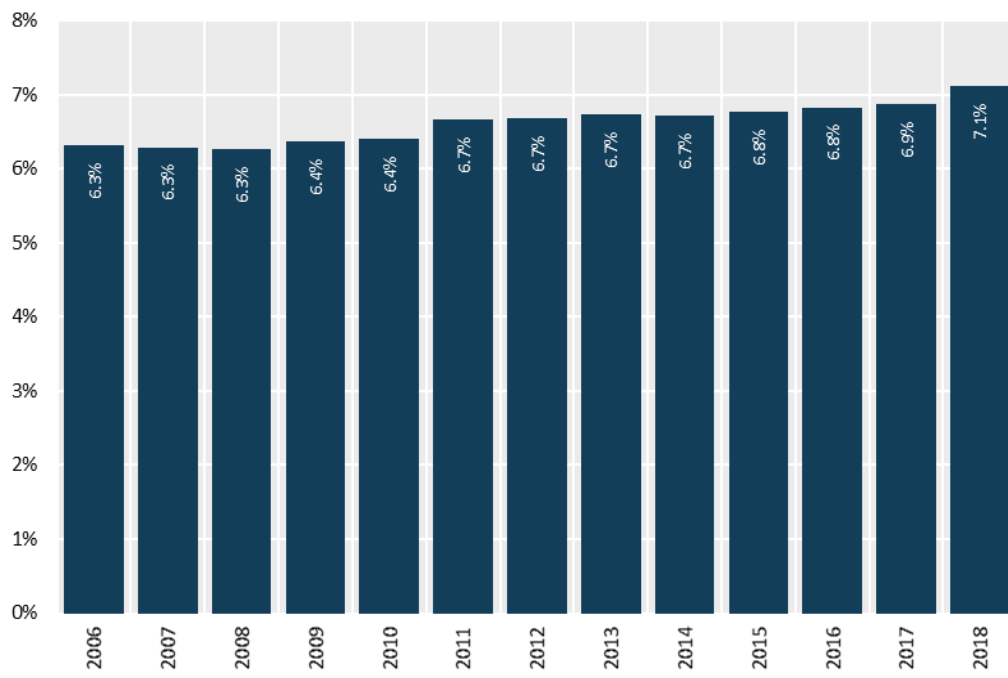
b) ICT BERD intensity and total BERD intensity



Note: Column and circle patterns indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

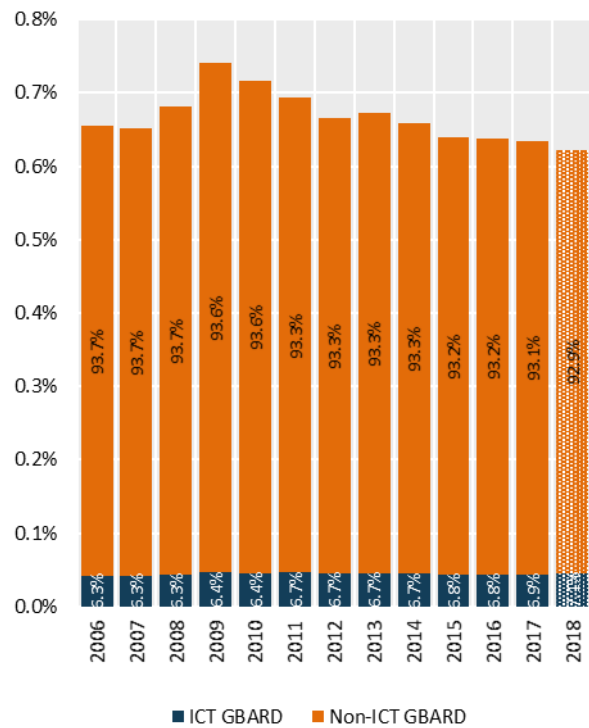
Figure A16: ICT GBARD share of total GBARD in the EU28 (2006-2018)



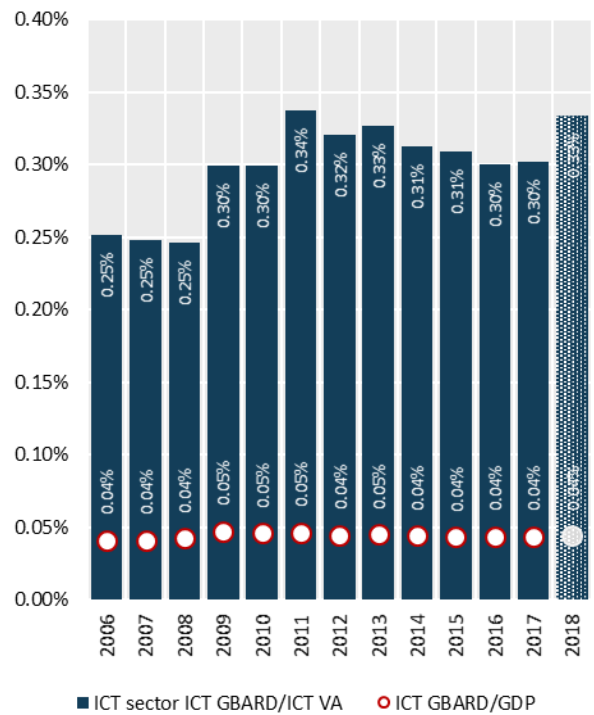
Source: 2020 PREDICT Dataset.

Figure A17: ICT GBARD intensity in ICT sector and total economy in the EU28 (2006-2018)

a) Contribution of ICT and non-ICT GBARD to total GBARD intensity



b) ICT GBARD intensity

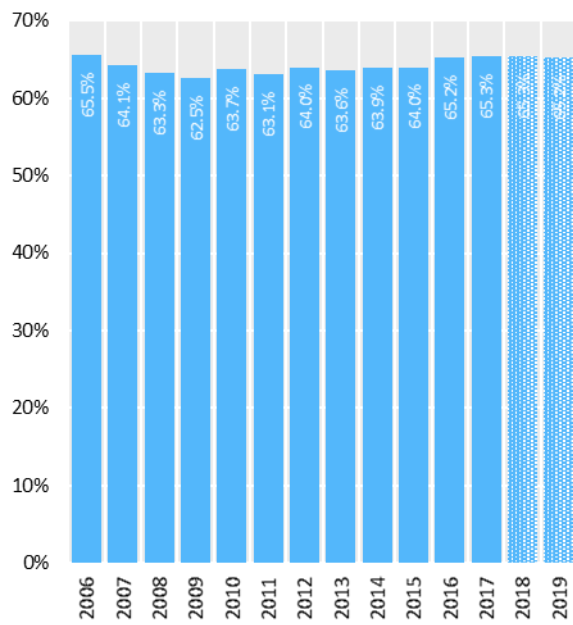


Note: Column and circle patterns indicate nowcasted data.

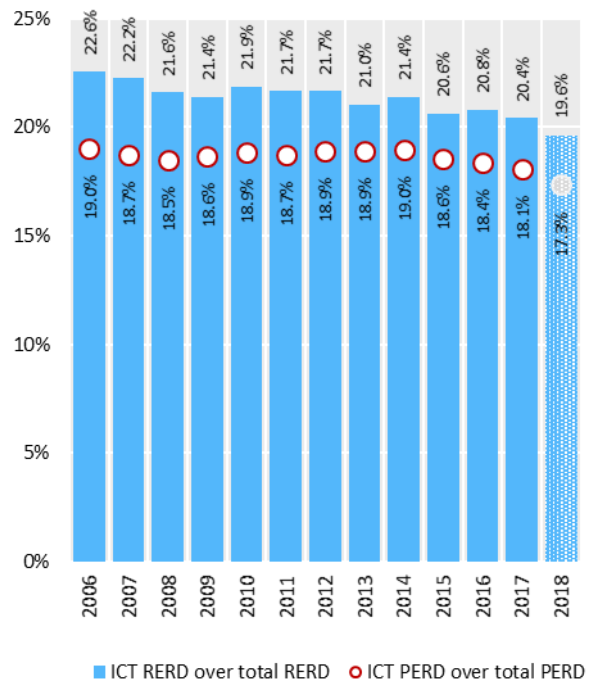
Source: 2020 PREDICT Dataset and Eurostat.

Figure A18: ICT sector RERD and ICT sector PERD in the EU28 (2006-2019)

a) ICT RERD over ICT PERD



b) ICT RERD over total RERD, and ICT PERD over total PERD

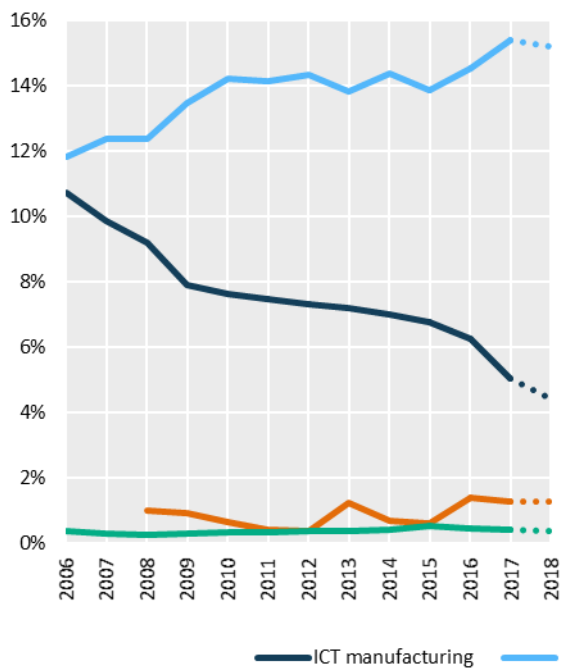


Note: Column and circle patterns indicate nowcasted data.

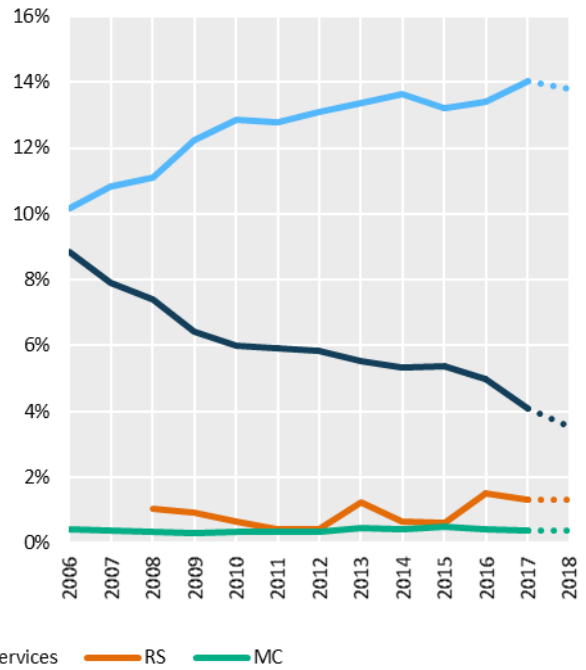
Source: 2020 PREDICT Dataset.

Figure A19: ICT manufacturing, ICT services, MC and RS sector share of total in the EU28 (2006-2018)

a) RERD



b) PERD



Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

Source: 2020 PREDICT Dataset and Eurostat.

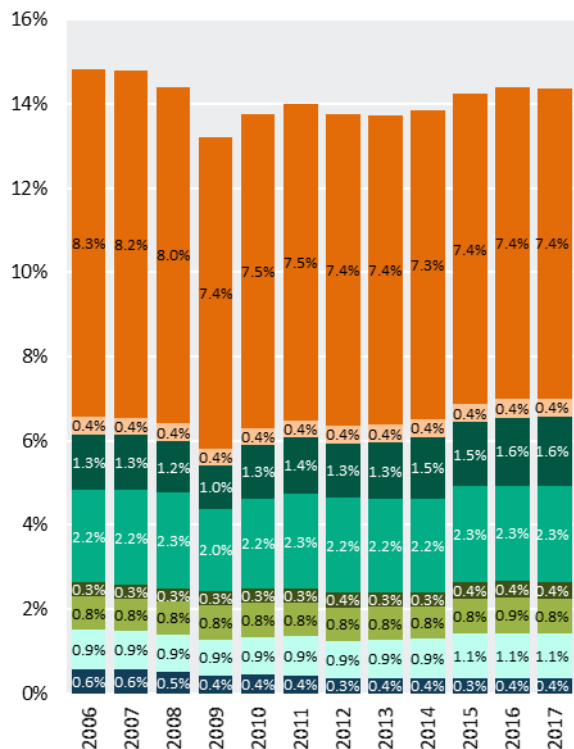
Figure A20: ICT sector VA share of GDP by sub-sector in the EU28 (2006, 2017)



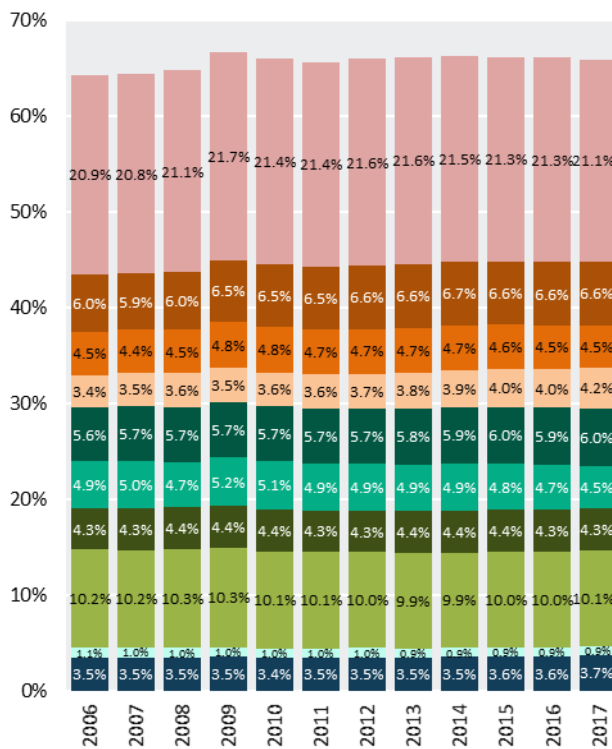
Source: 2020 PREDICT Dataset

Figure A21: ICT sector VA share of GDP and comparison with non-ICT economic activities in the EU28 (2006-2017)

a) Manufacturing



b) Services



- Rest of manufacturing industries
- Manufacture of other transport equipment
- Manufacture of motor vehicles, trailers and semi-trailers
- Manufacture of machinery and equipment
- Manufacture of computer, electronic and optical products
- Manufacture of pharmaceuticals products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries

- Rest of service industries
- Human health and social work activities
- Education
- Administration and support service activities
- Professional, scientific and technical activities
- Financial and insurance activities
- Transportation and storage
- Wholesale and retail trade
- Media and content sector
- ICT total services

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

Source: 2020 PREDICT Dataset.

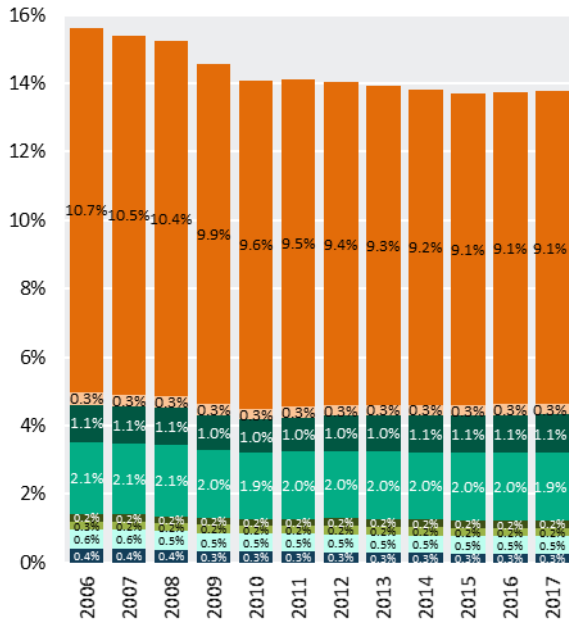
Figure A22: ICT sector employment share of total employment by sub-sector in the EU28 (2006, 2017)



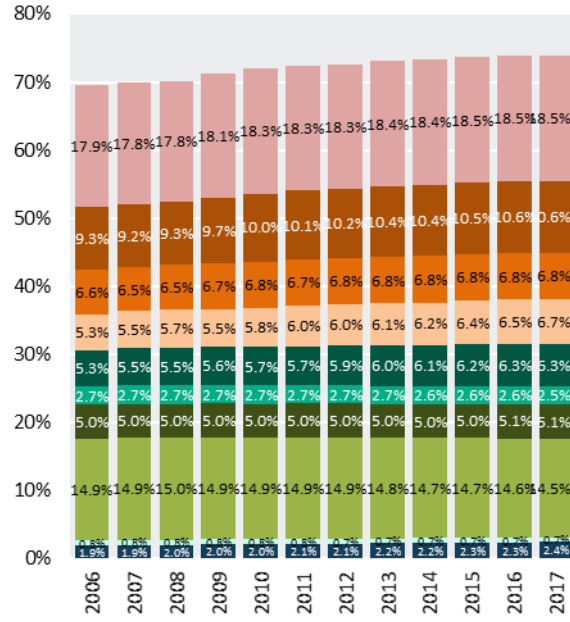
Source: 2020 PREDICT Dataset.

Figure A23: ICT sector employment share on total employment and comparison with non-ICT economic activities in the EU28 (2006-2017)

a) Manufacturing



b) Services



- Rest of manufacturing industries
- Manufacture of other transport equipment
- Manufacture of motor vehicles, trailers and semi-trailers
- Manufacture of machinery and equipment
- Manufacture of computer, electronic and optical products
- Manufacture of pharmaceuticals products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries

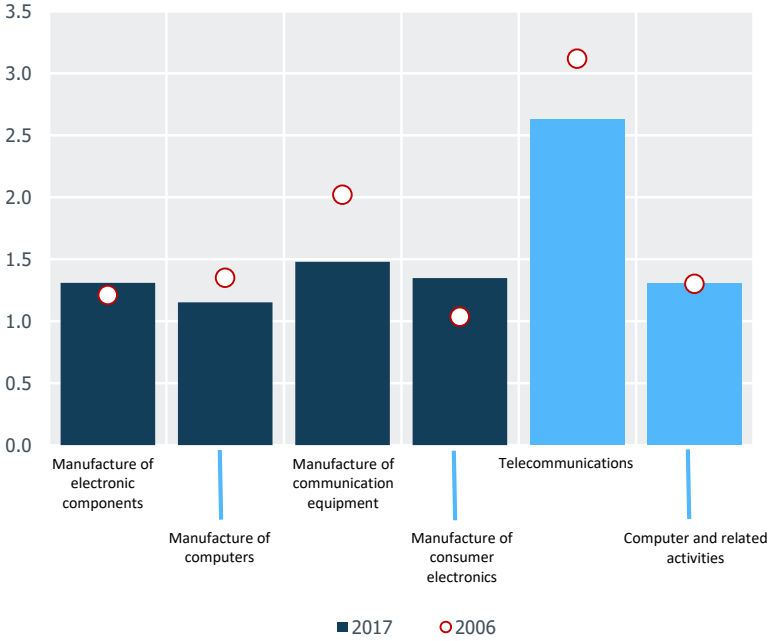
- Rest of service industries
- Human health and social work activities
- Education
- Administration and support service activities
- Professional, scientific and technical activities
- Financial and insurance activities
- Transportation and storage
- Wholesale and retail trade
- Media and content sector
- ICT total services

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

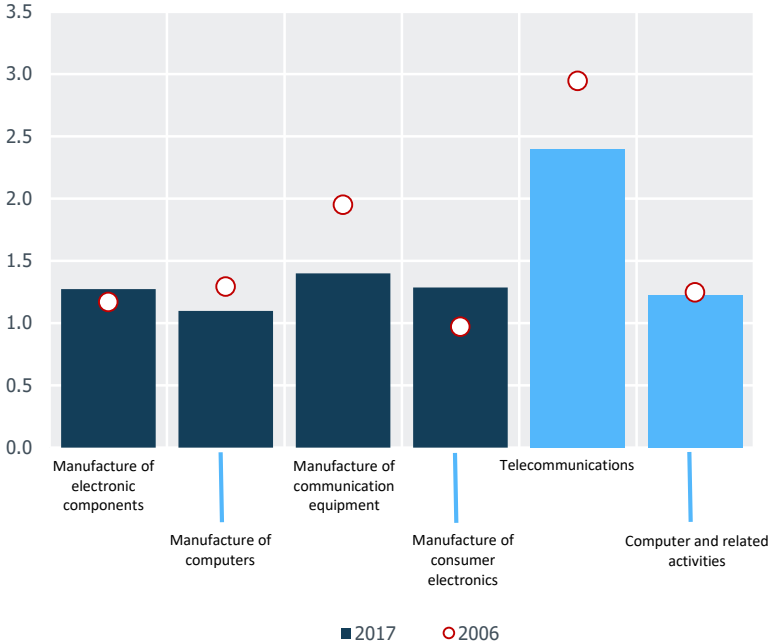
Source: 2020 PREDICT Dataset.

Figure A24: ICT sector productivity ratio over productivity in total economy by sub-sector in the EU28 (2006, 2017)

a) Labour productivity per person employed

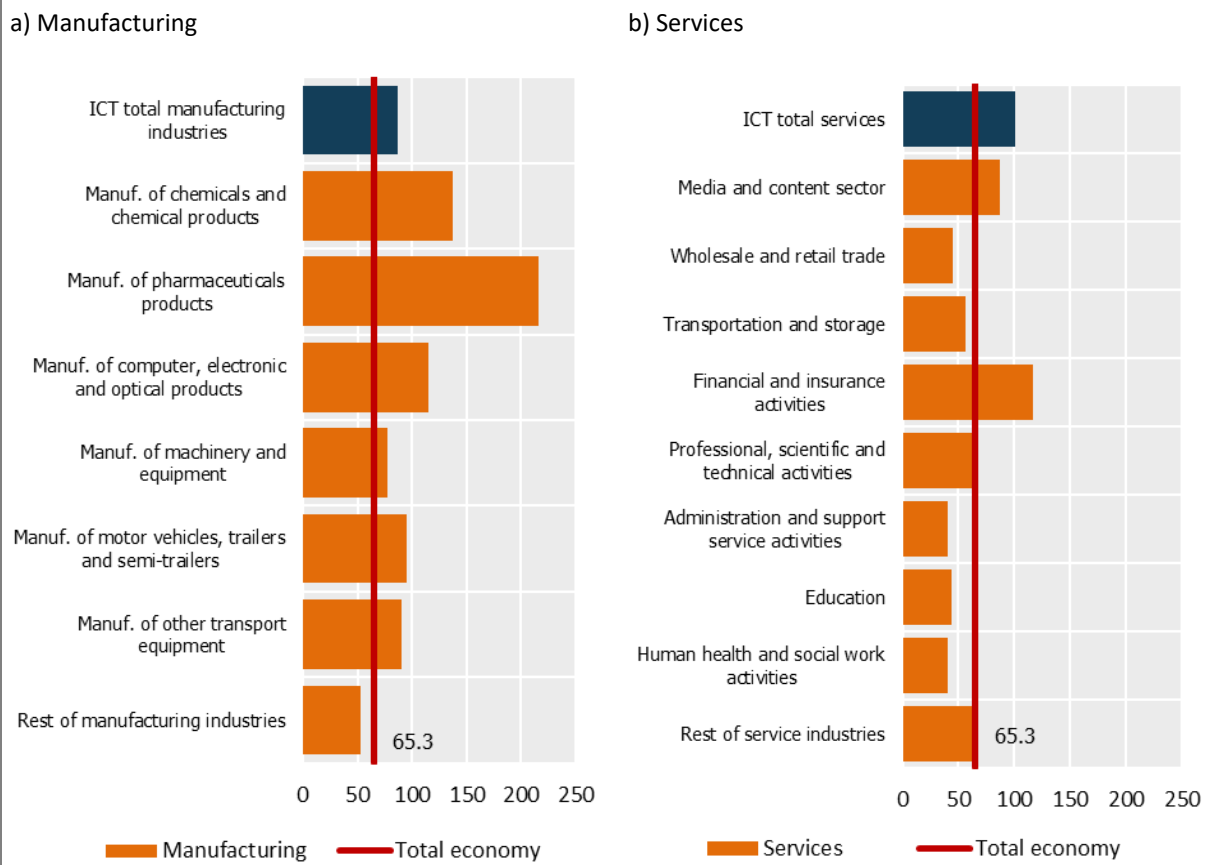


b) Labour productivity per hour worked



Source: 2020 PREDICT Dataset.

Figure A25: ICT sector productivity per person employed and comparison with non-ICT economic activities in the EU28 (thousand current EUR per person; 2017)



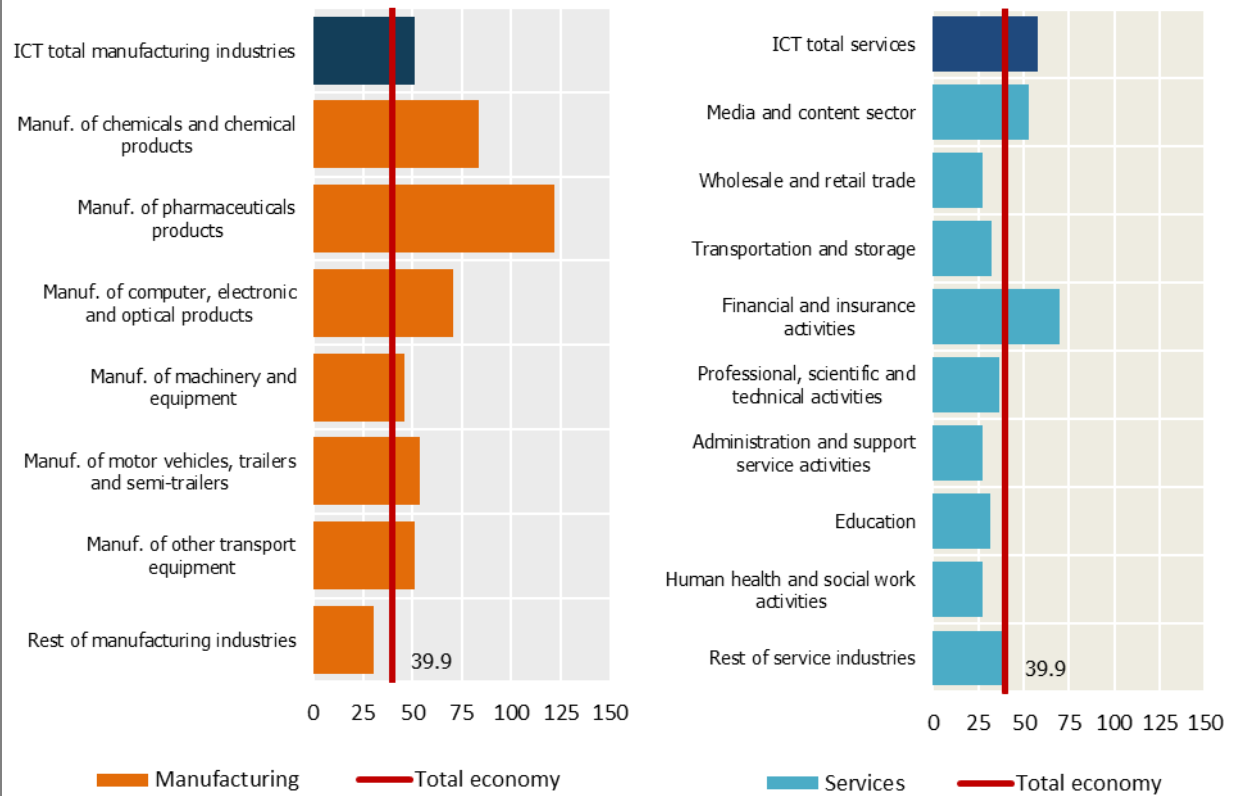
Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction not included neither in manufacturing nor in services industries.

Source: 2020 PREDICT Dataset.

Figure A26: ICT sector productivity per hour worked and comparison with non-ICT economic activities in the EU28 (current EUR per hour worked; 2017)

a) Manufacturing

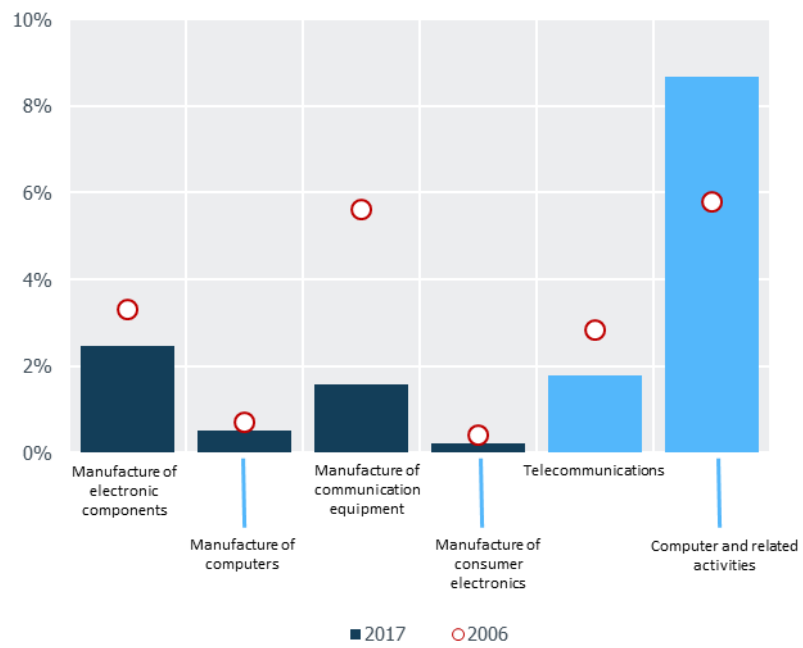
b) Services



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

Source: 2020 PREDICT Dataset.

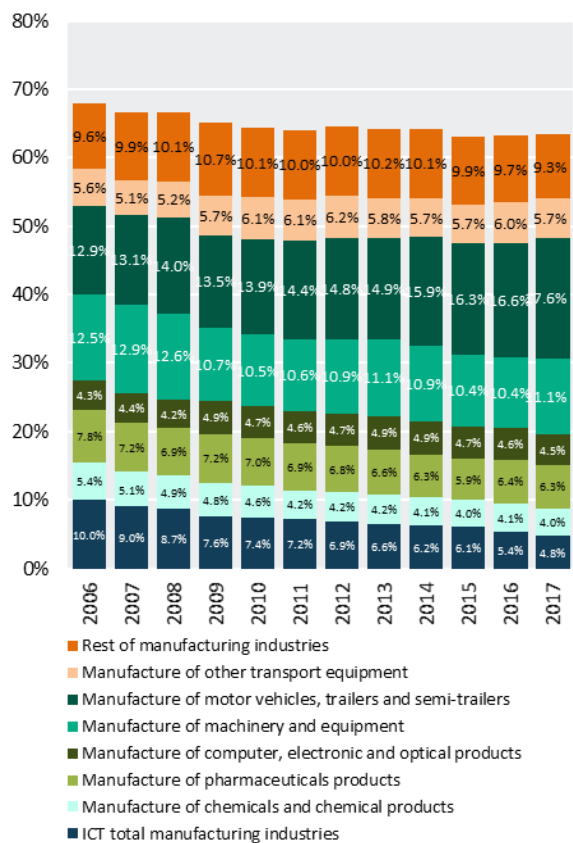
Figure A27: ICT sector BERD share of total BERD by sub-sector in the EU28 (2006, 2017)



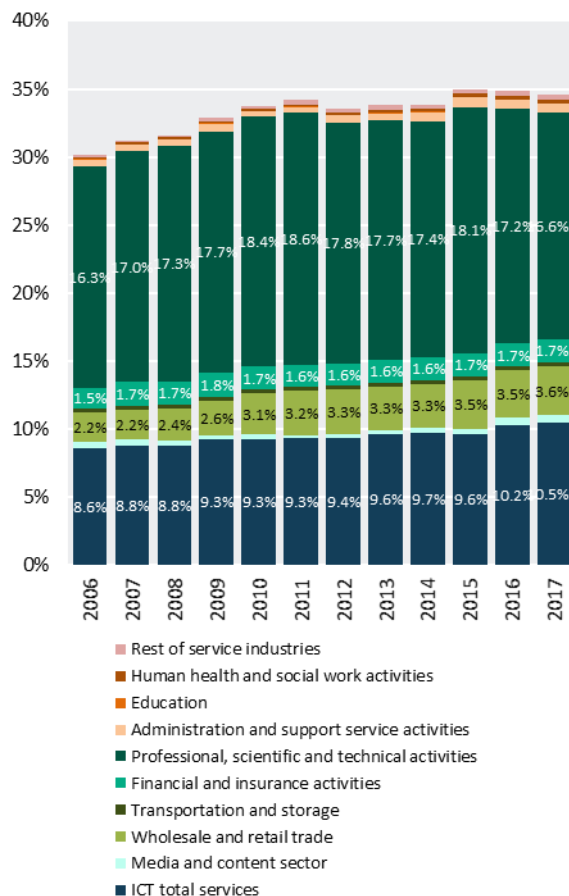
Source: 2020 PREDICT Dataset.

Figure A28: ICT sector BERD share of total BERD and comparison with non-ICT economic activities in the EU28 (2006-2017)

a) Manufacturing



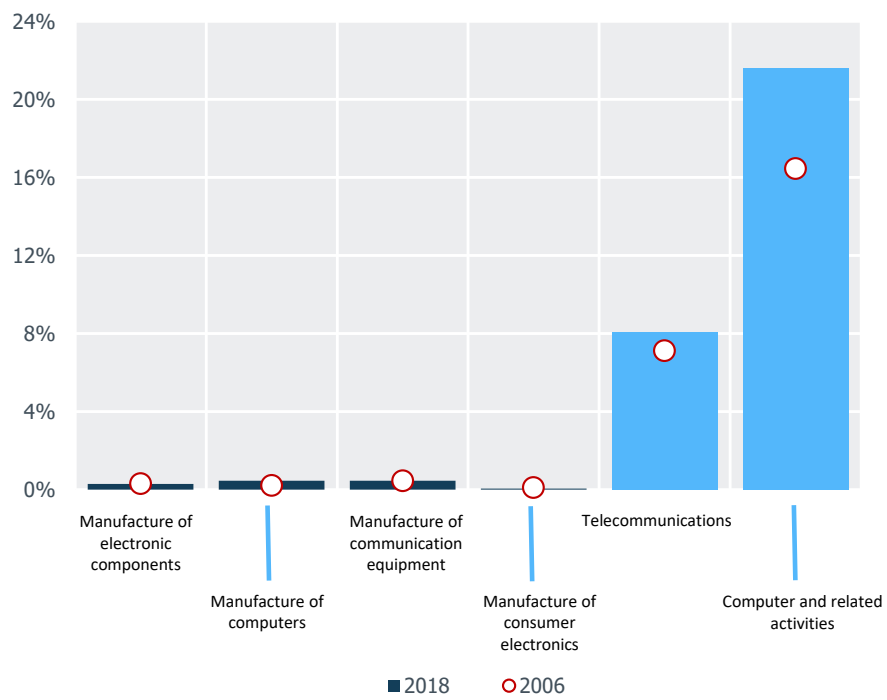
b) Services



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

Source: 2020 PREDICT Dataset.

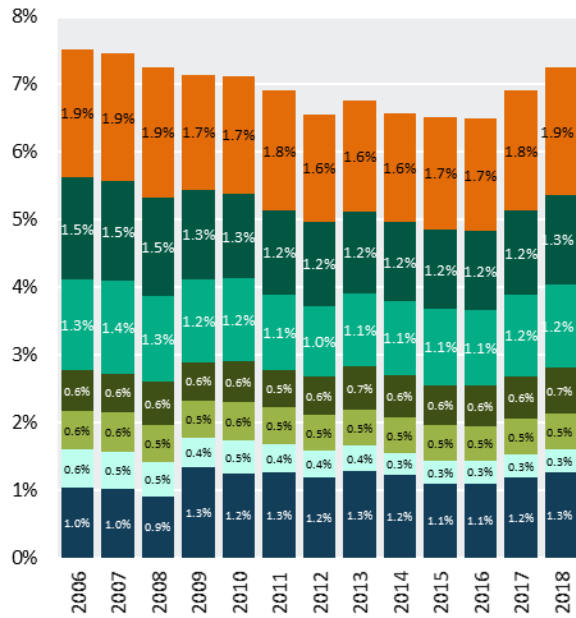
Figure A29: ICT GBARD share of total ICT GBARD by sub-sector in the EU28 (2006, 2018)



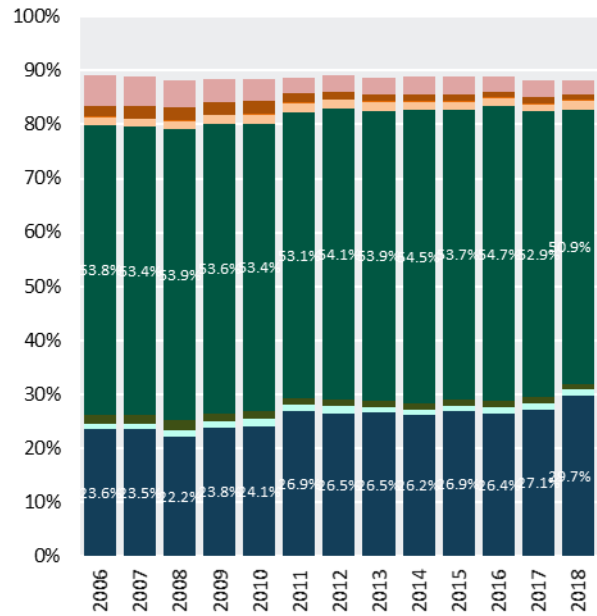
Source: 2020 PREDICT Dataset.

Figure A30: ICT sector ICT GBARD share on total ICT GBARD and comparison with non-ICT economic activities in the EU28 (2006-2018)

a) Manufacturing



b) Services



- Rest of manufacturing industries
- Manufacture of transport equipment
- Manufacture of machinery and equipment
- Manufacture of computer, electronic and optical products
- Manufacture of pharmaceuticals products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries

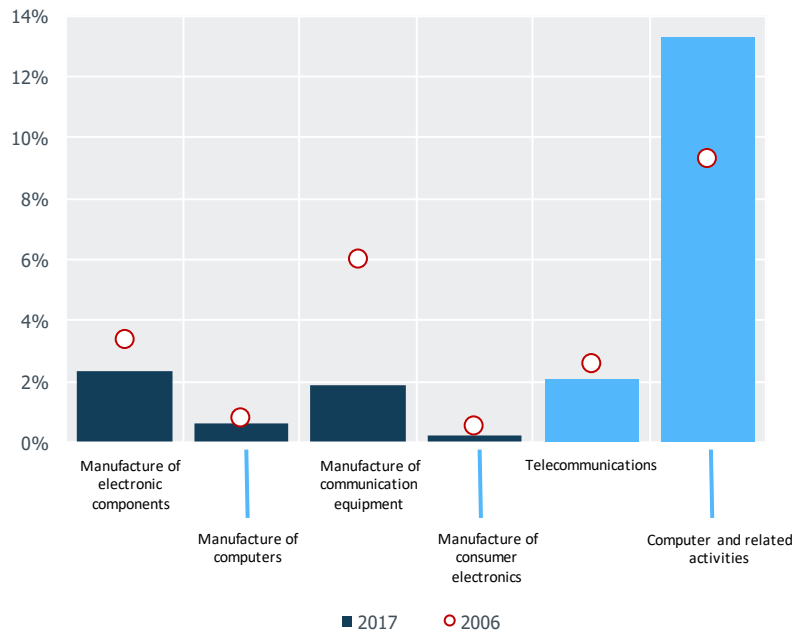
- Rest of service industries
- Human health and social work activities
- Education
- Administration and support service activities
- Professional, scientific and technical activities
- Transportation and storage
- Media and content sector
- ICT total services

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

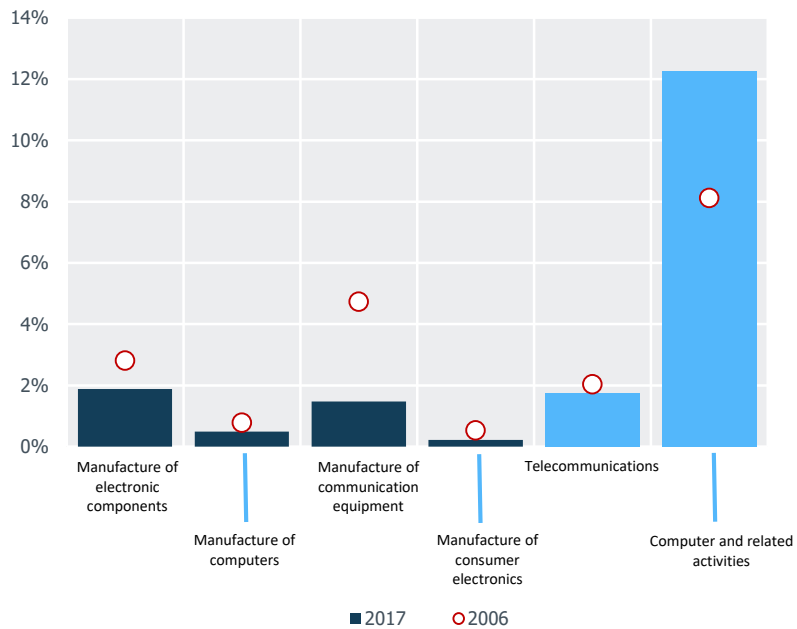
Source: 2020 PREDICT Dataset.

Figure A31: ICT sector share of total by sub-sector, RERD and PERD in the EU28 (2006, 2017)

a) RERD



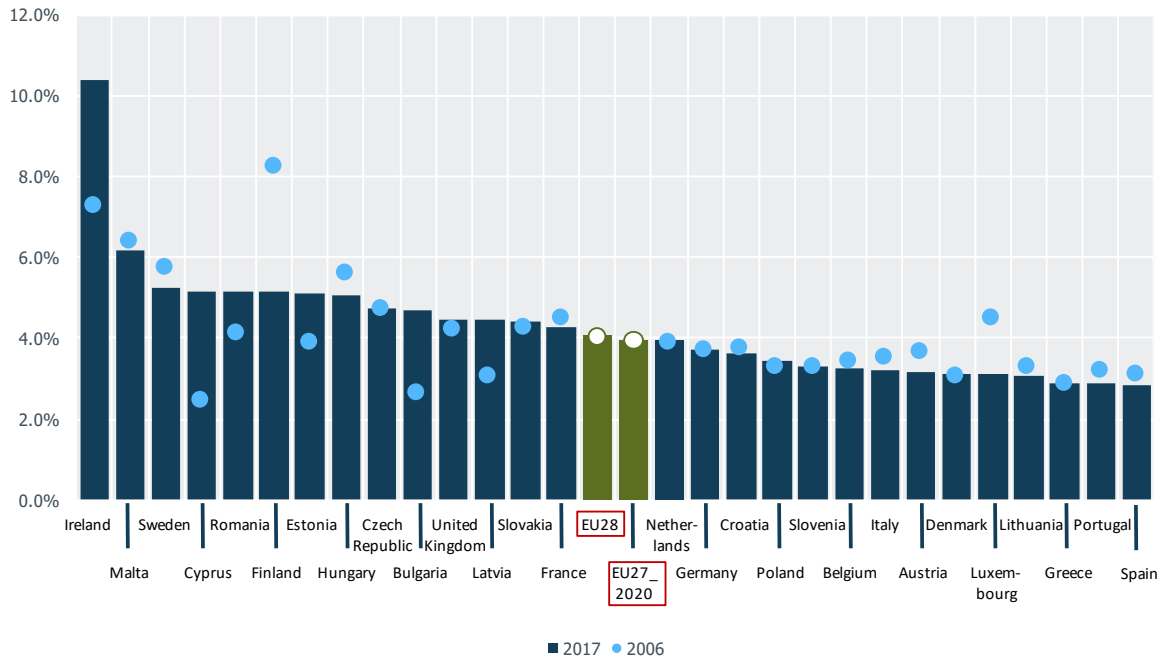
b) PERD



Source: 2020 PREDICT Dataset.

A.3 Analysis by Member State

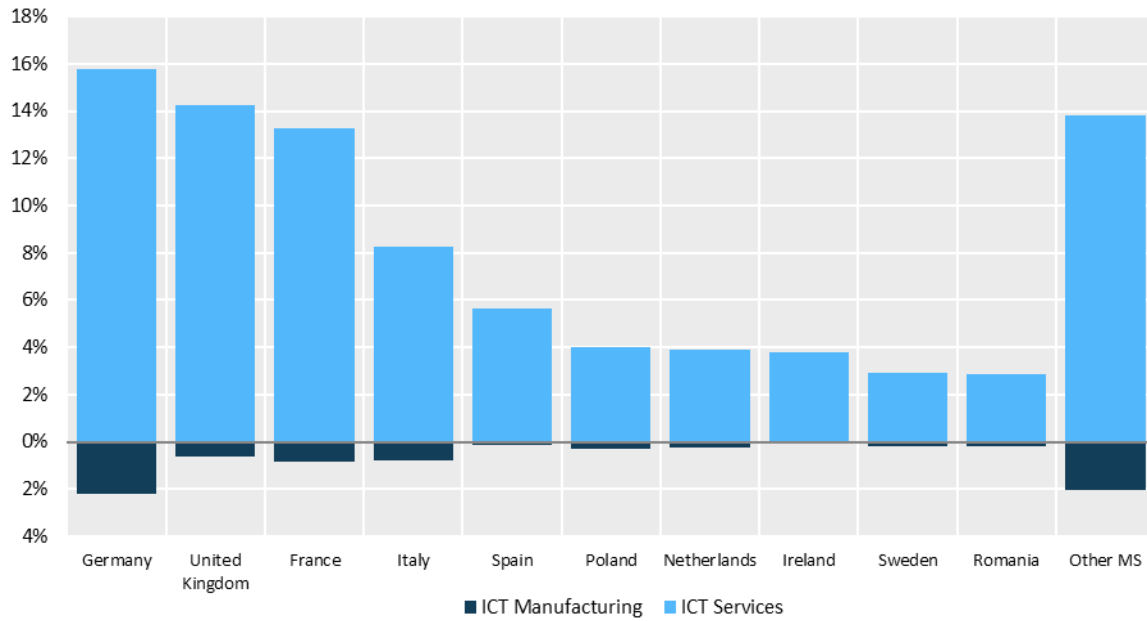
Figure A32: ICT sector VA share of GDP. EU28 Member States (2006, 2017)



Note: 2014 for Ireland.

Source: 2020 PREDICT Dataset.

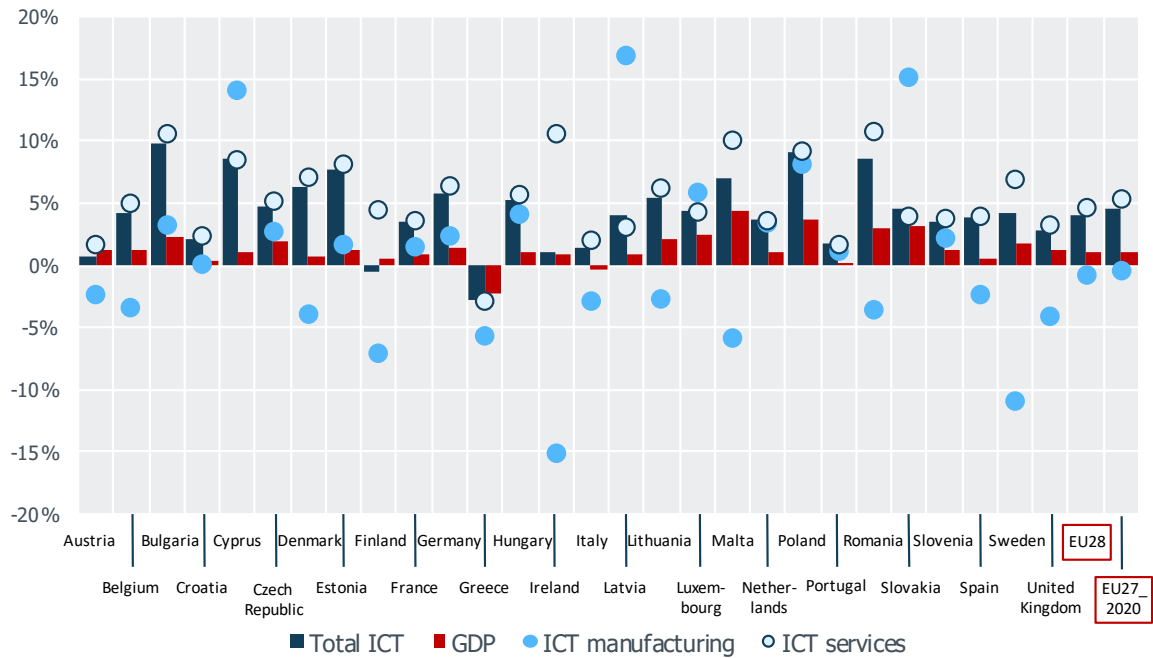
Figure A33: ICT manufacturing and ICT services VA in the ten largest EU28 Member States' contributors (percentages, 2017)



Note: ICT manufacturing is not available for Ireland in 2017 due to confidentiality reasons. In 2014, this sector accounts for around 0.4% of total ICT sector VA.

Source: 2020 PREDICT Dataset.

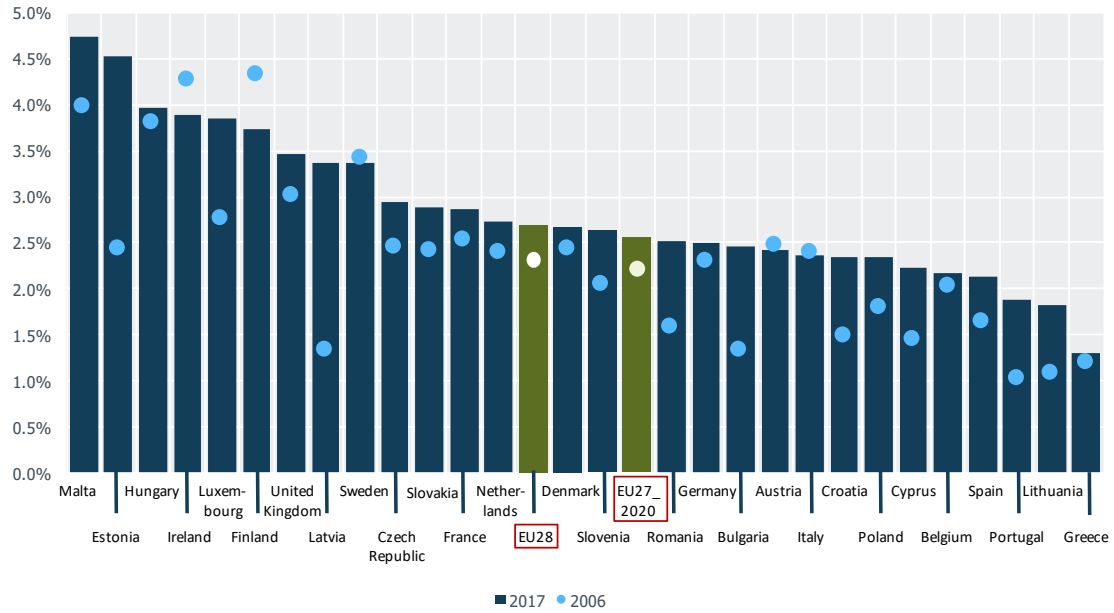
Figure A34: Mean annual real growth rate of VA in ICT sector, ICT manufacturing, ICT services and GDP by EU28 Member State (2006-2017)



Note: 2006-2014 for Ireland.

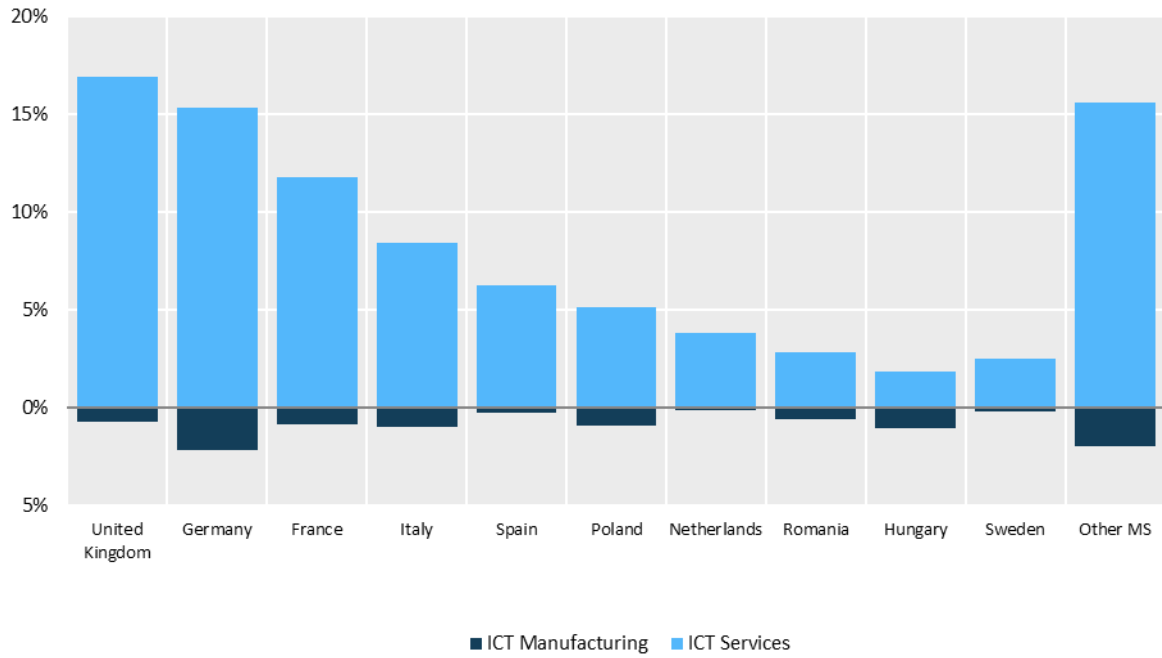
Source: 2020 PREDICT Dataset.

Figure A35: ICT sector employment share of total employment by EU28 Member State (2006, 2017)



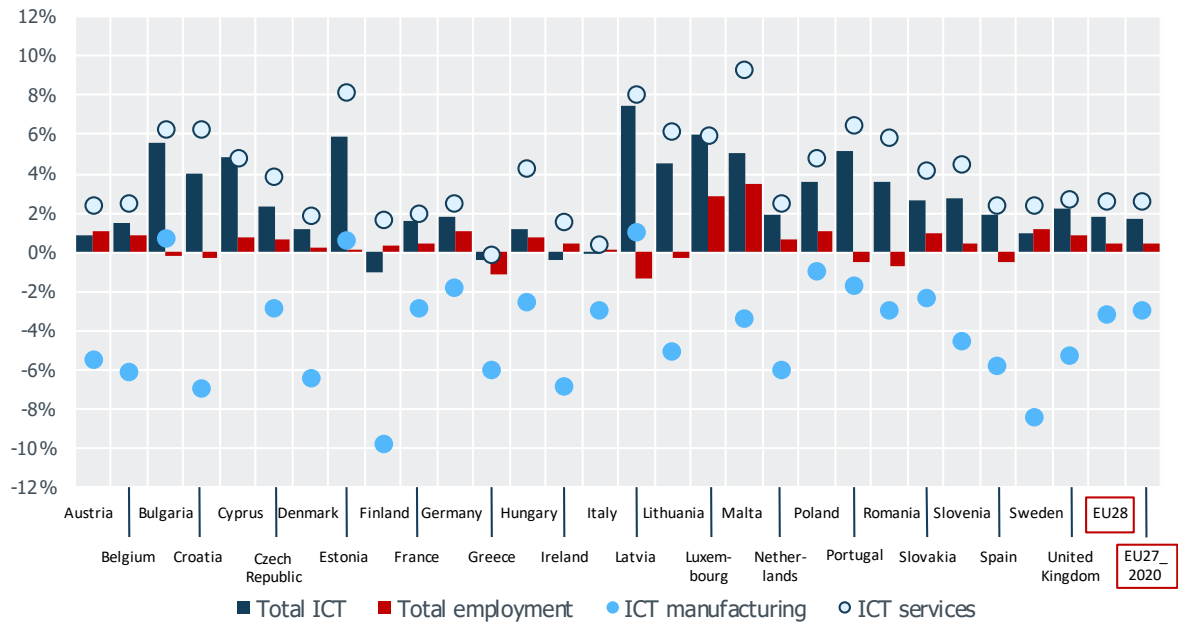
Source: 2020 PREDICT Dataset.

Figure A36: ICT manufacturing and ICT services employment in the ten largest EU28 Member States' contributors (percentages, 2017)



Source: 2020 PREDICT Dataset.

Figure A37: Mean annual growth rate of employment in ICT sector, ICT manufacturing, ICT services and total employment by EU28 Member State (2006-2017)



Source: 2020 PREDICT Dataset.

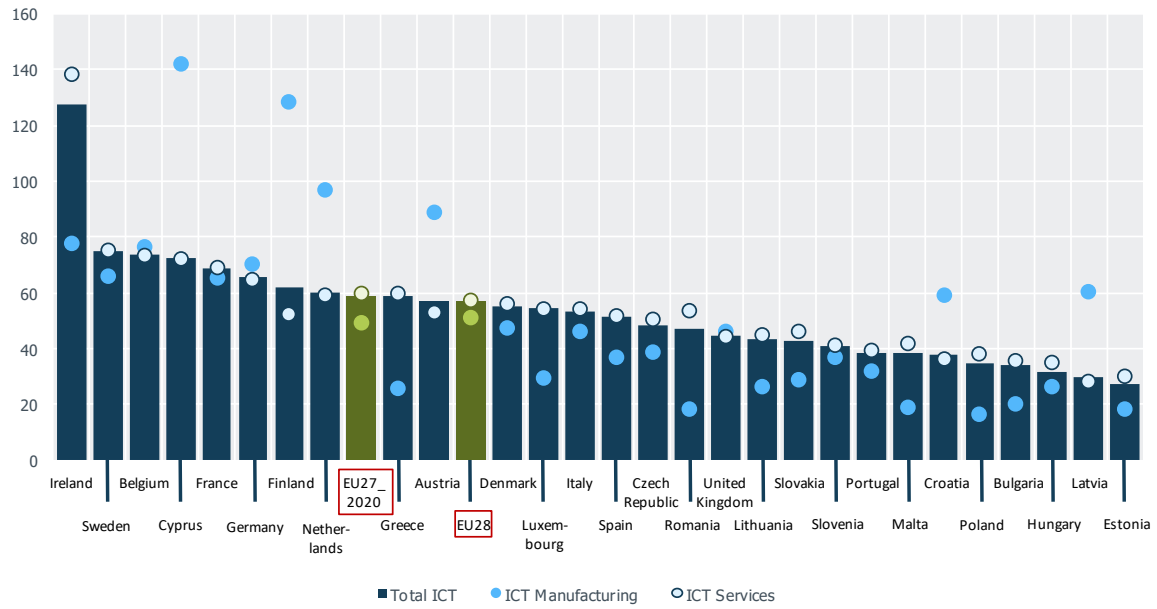
Figure A38: ICT sector productivity per person employed by EU28 Member State (thousands of EUR PPS per person, 2017)



Note: 2014 for Ireland.

Source: 2020 PREDICT Dataset.

Figure A39: ICT sector productivity per person employed by EU28 Member State (current EUR PPS per hour, 2017)

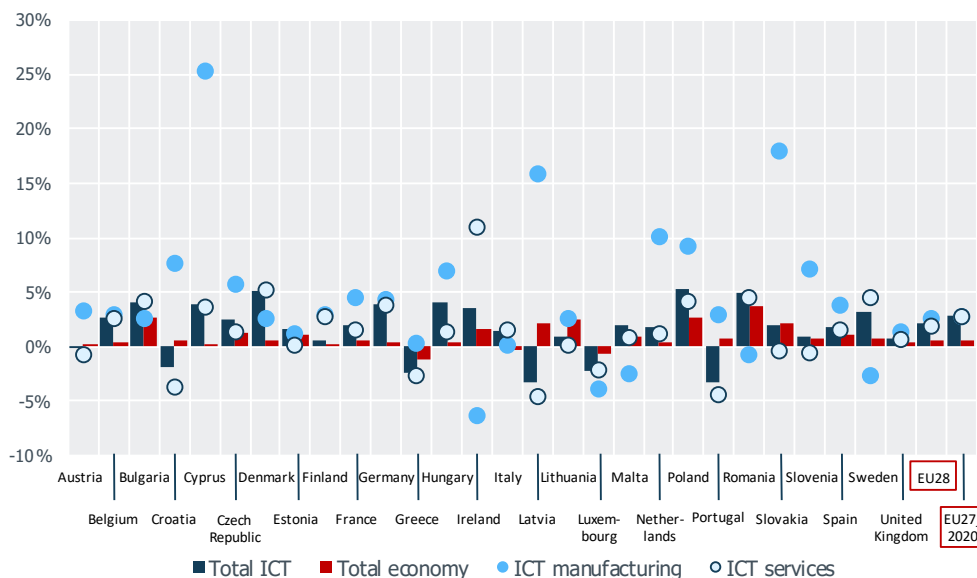


Note: 2014 for Ireland.

Source: 2020 PREDICT Dataset.

Figure A40: Mean annual real growth rate of labour productivity in ICT sector, ICT manufacturing, ICT services and total economy by EU28 Member State (2006-2017)

a) Productivity per person employed



Note: 2006-2014 for Ireland

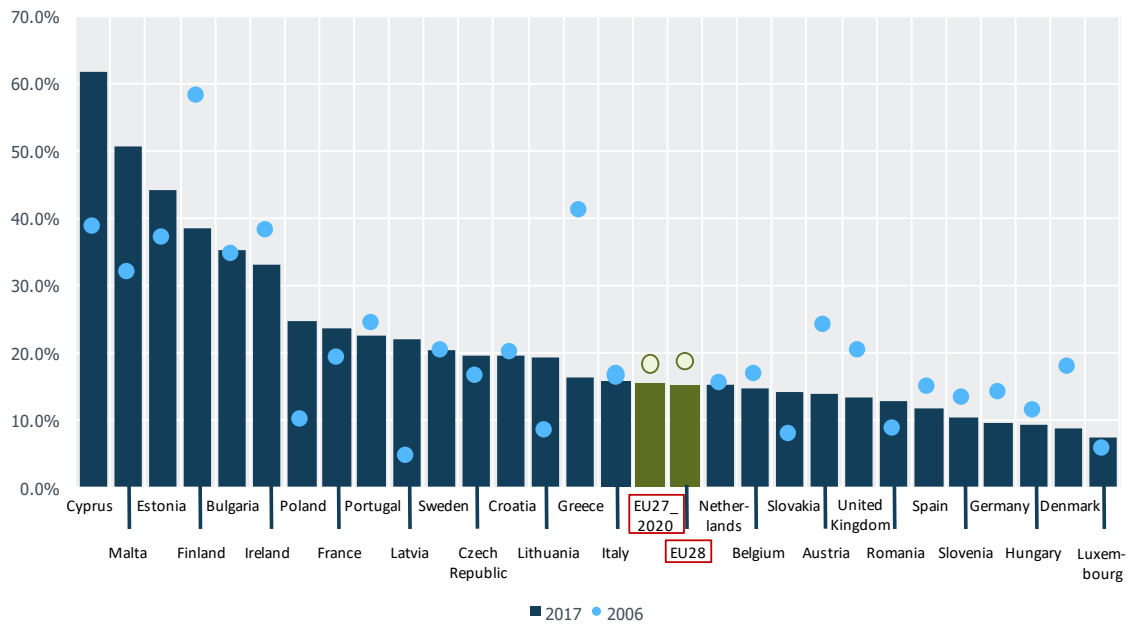
b) Productivity per hour worked



Note: 2006-2014 for Ireland.

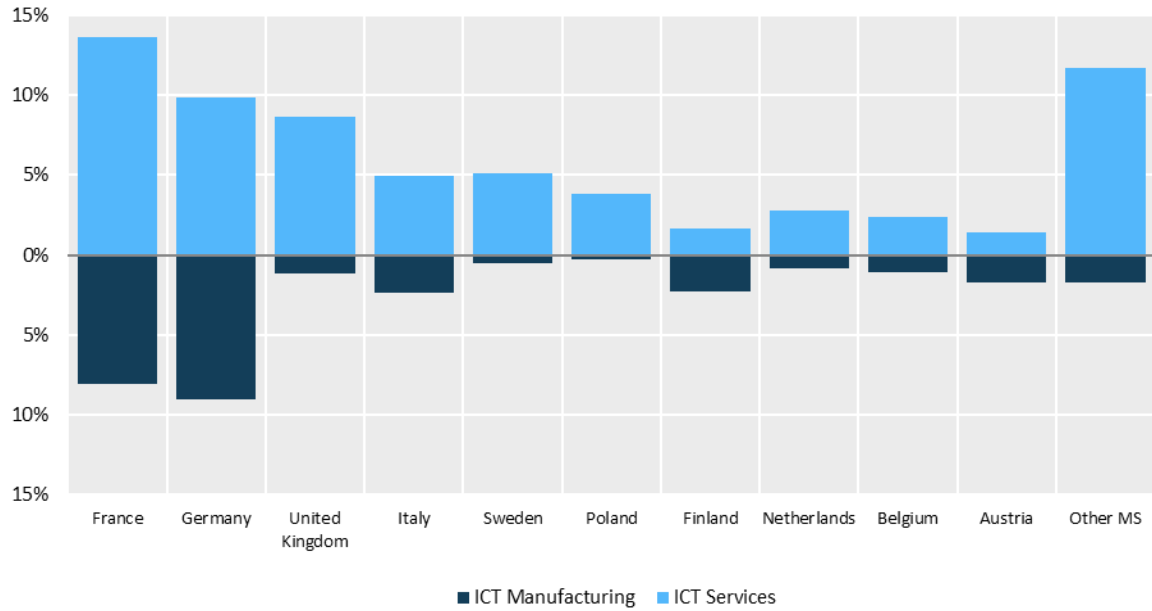
Source: 2020 PREDICT Dataset.

Figure A41: ICT sector BERD share of total BERD by EU28 Member State (2006, 2017)



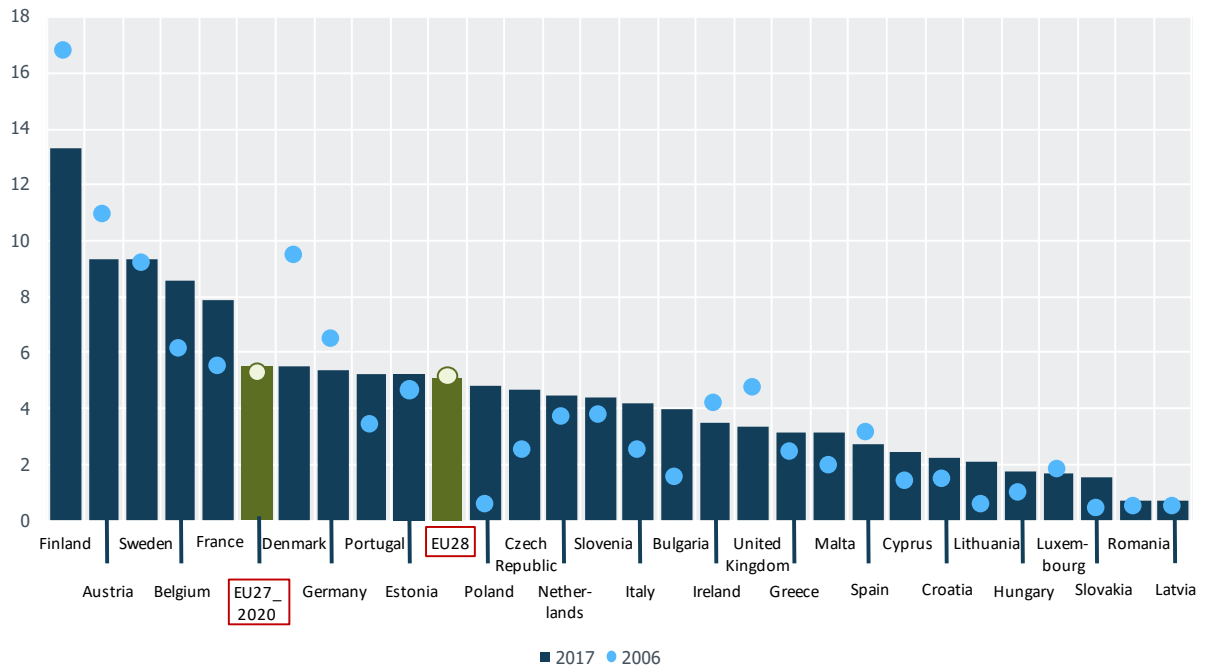
Source: 2020 PREDICT Dataset.

Figure A42: ICT manufacturing and ICT services BERD in the ten largest EU28 Member States' contributors (percentages, 2017)



Source: 2020 PREDICT Dataset.

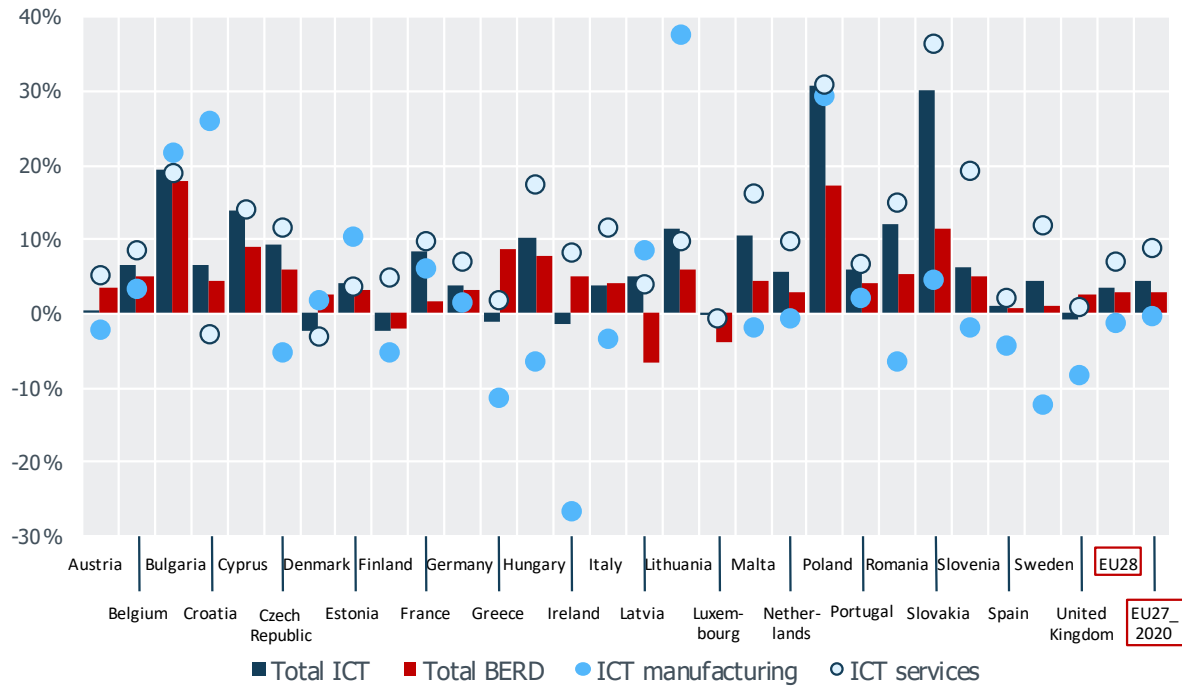
Figure A43: ICT sector BERD intensity (ICT sector BERD/ICT sector VA) by EU28 Member State (2006, 2017)



Note: 2014 for Ireland.

Source: 2020 PREDICT Dataset.

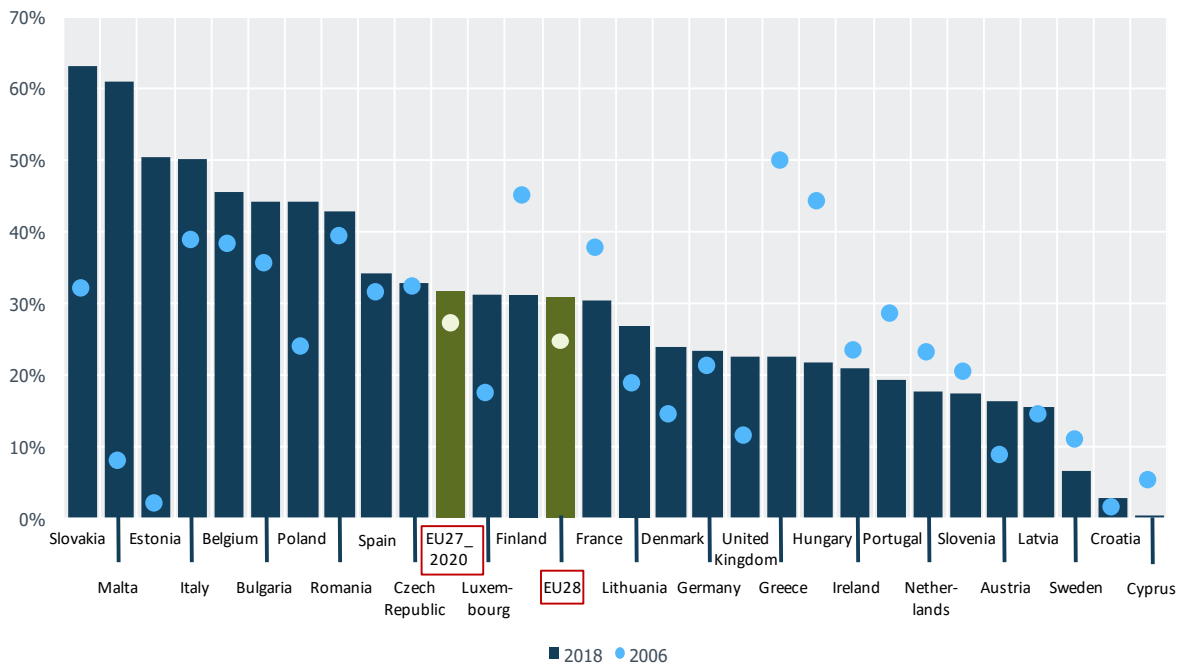
Figure A44: Mean annual real growth rate of BERD in ICT sector, ICT manufacturing, ICT services and total BERD by EU28 Member State (2006-2017)



Note: 2006-2014 for Ireland.

Source: 2020 PREDICT Dataset.

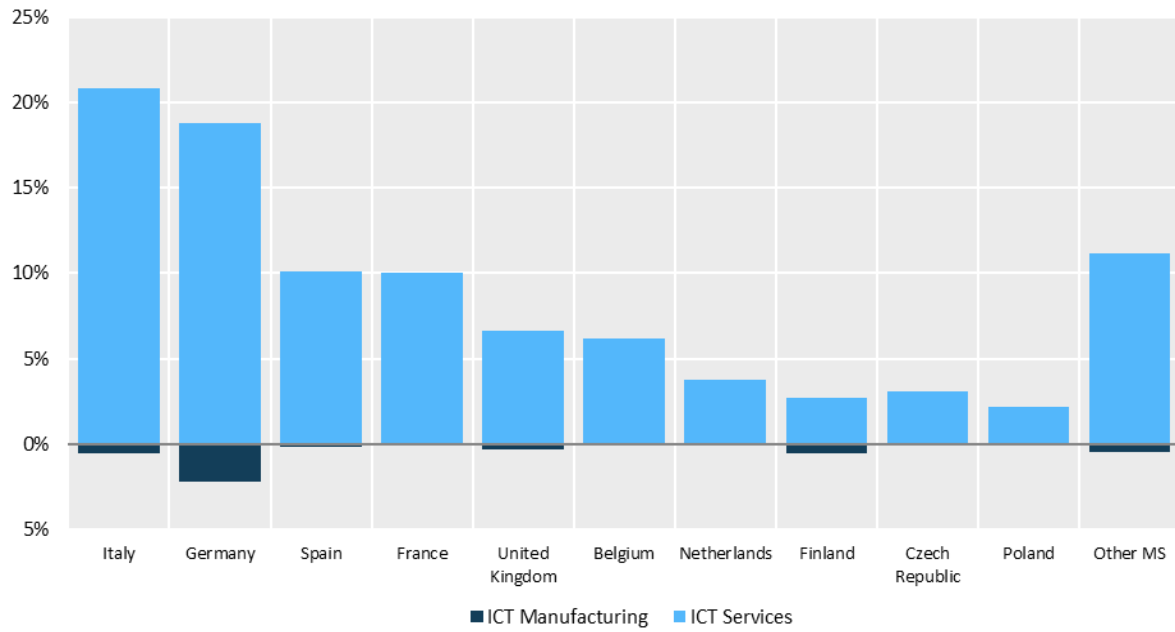
Figure A45: ICT sector ICT GBARD share of total ICT GBARD by EU28 Member State (2006, 2018)



Note: 2008 is the first year available for Croatia.

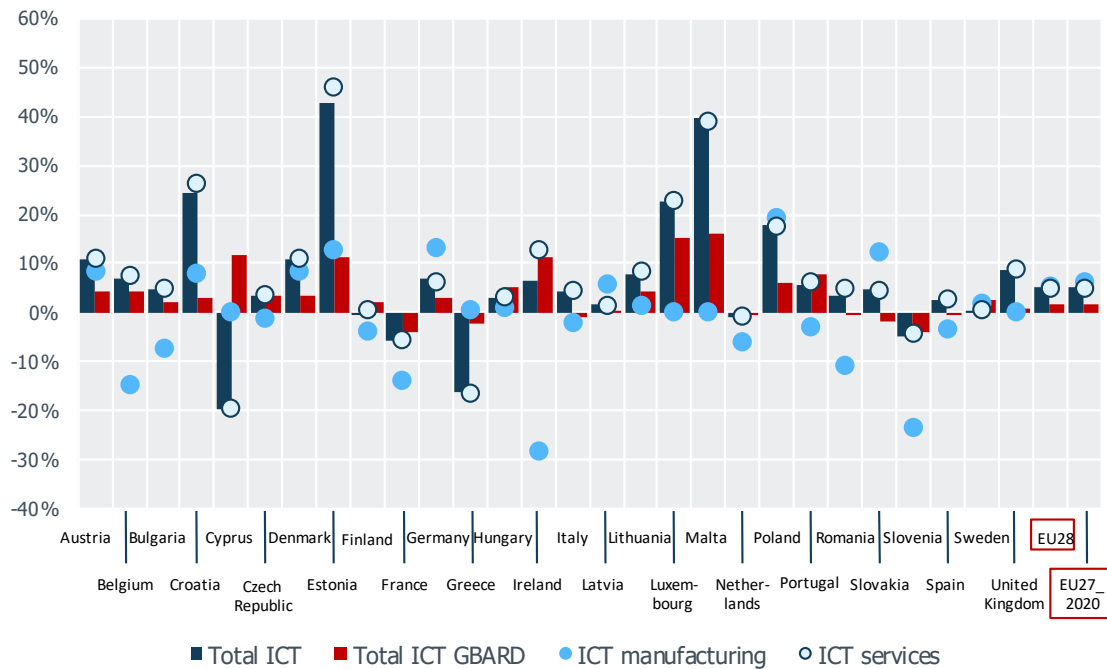
Source: 2020 PREDICT Dataset.

Figure A46: ICT manufacturing and ICT services ICT GBARD in the ten largest Member States' contributors (percentages, 2018)



Source: 2020 PREDICT Dataset.

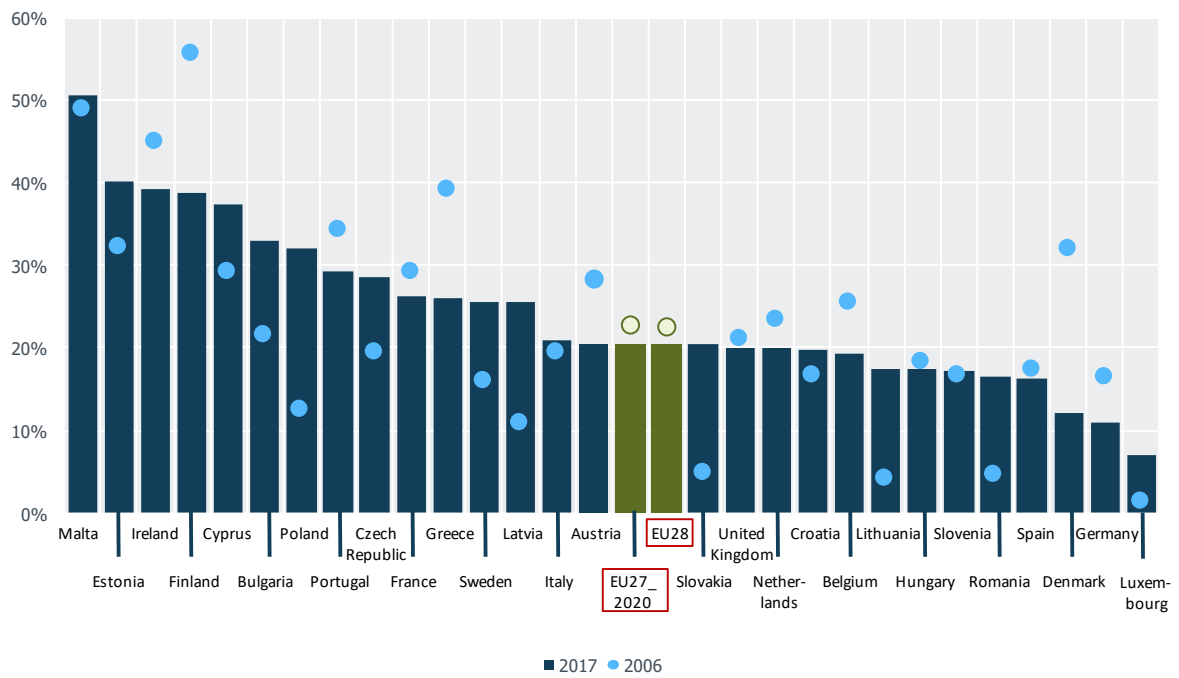
Figure A47: Mean annual real growth rate of ICT GBARD in ICT sector, ICT manufacturing, ICT services and total economy by EU28 Member State (2006-2017)



Note: 2006-2014 for Ireland and 2008-2016 for Croatia.

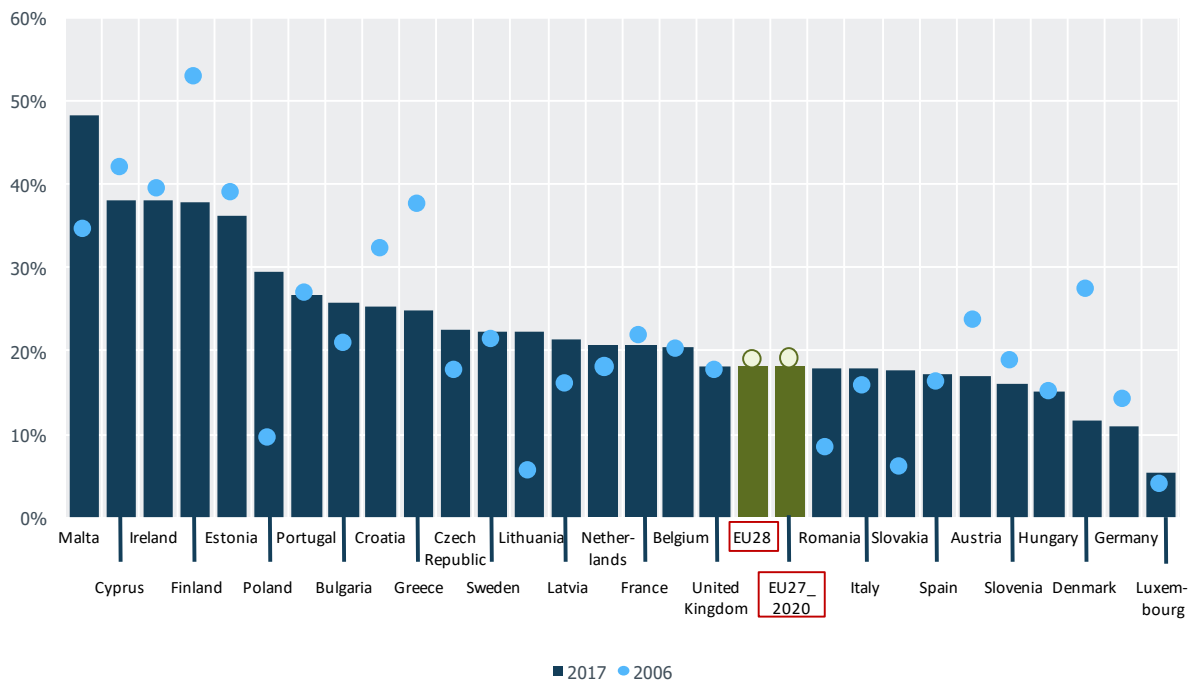
Source: 2020 PREDICT Dataset.

Figure A48: ICT sector RERD share of total RERD by EU28 Member State (2006, 2017)



Source: 2020 PREDICT Dataset.

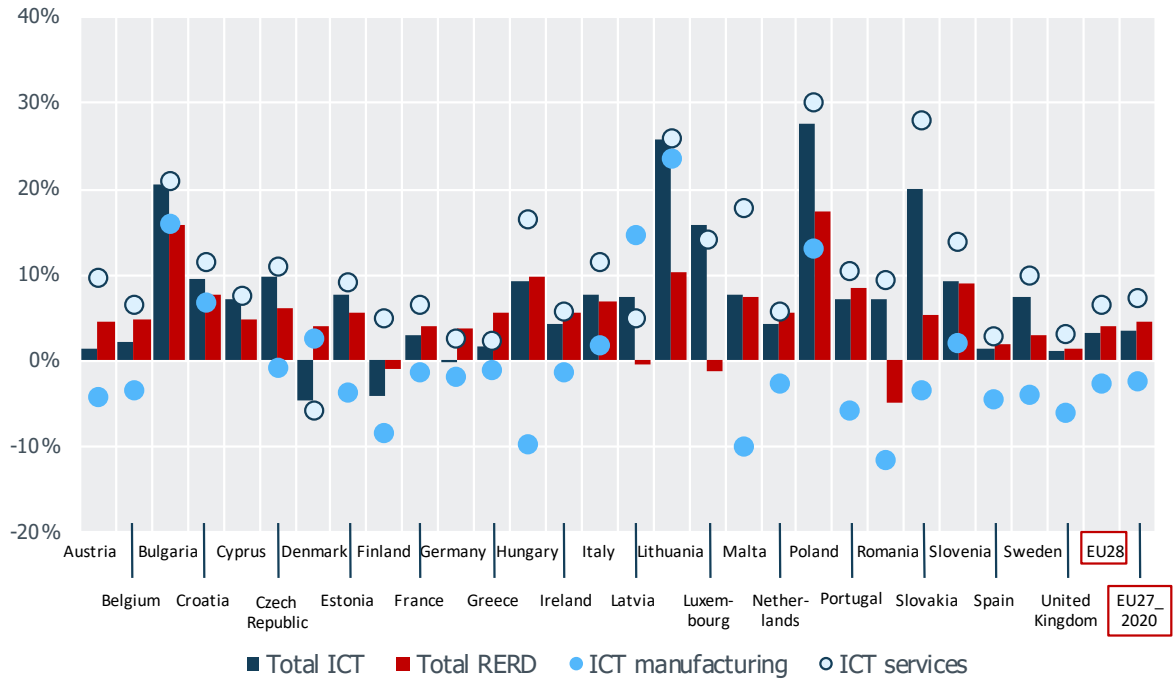
Figure A49: ICT sector PERD share of total PERD by EU28 Member State (2006, 2017)



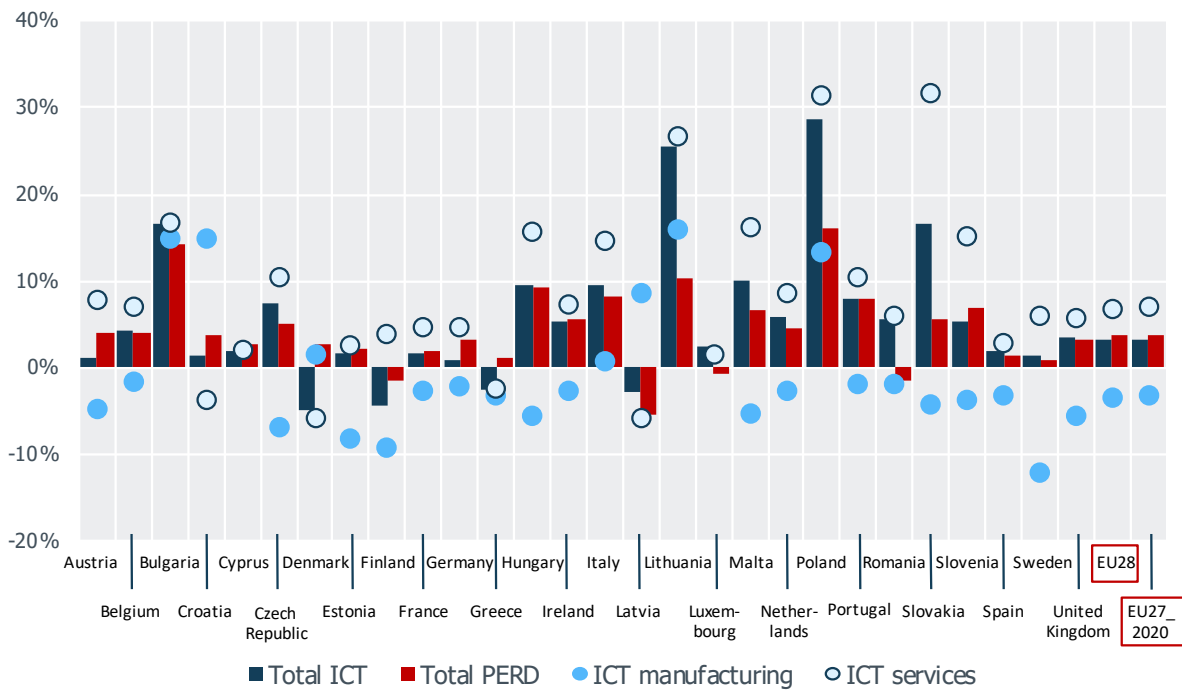
Source: 2020 PREDICT Dataset.

Figure A50: Mean annual growth rate of RERD and PERD in ICT sector, ICT manufacturing, ICT services and total economy by EU28 Member State (2006-2017)

a) RERD



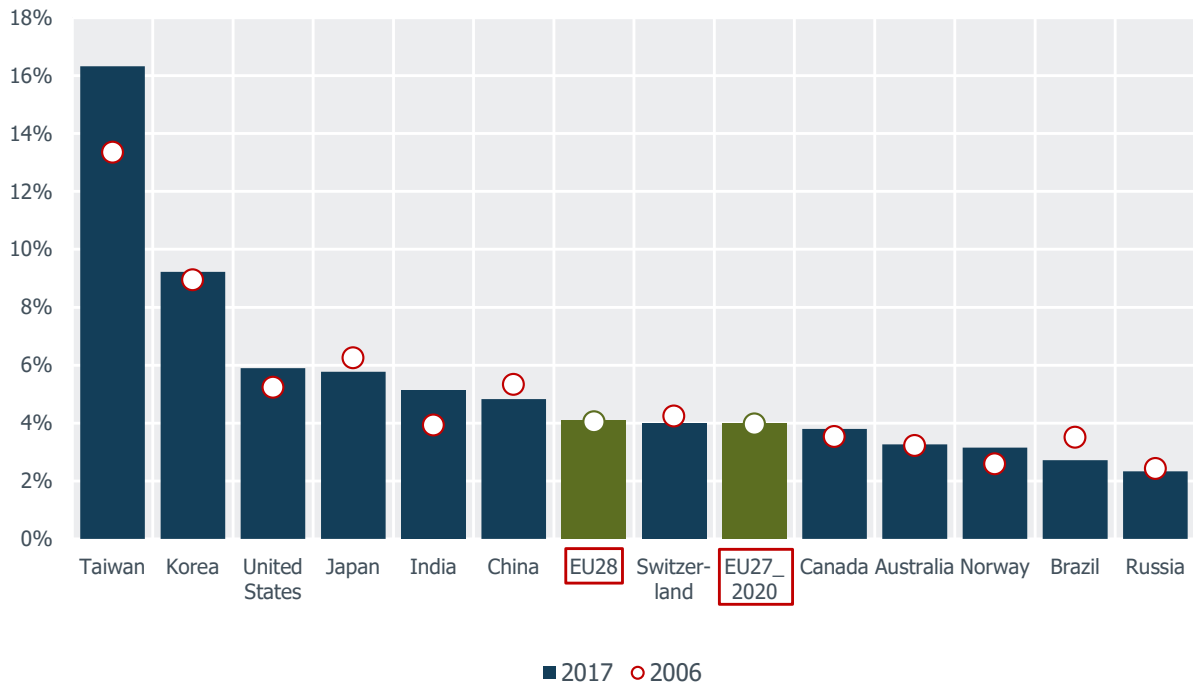
b) PERD



Source: 2020 PREDICT Dataset.

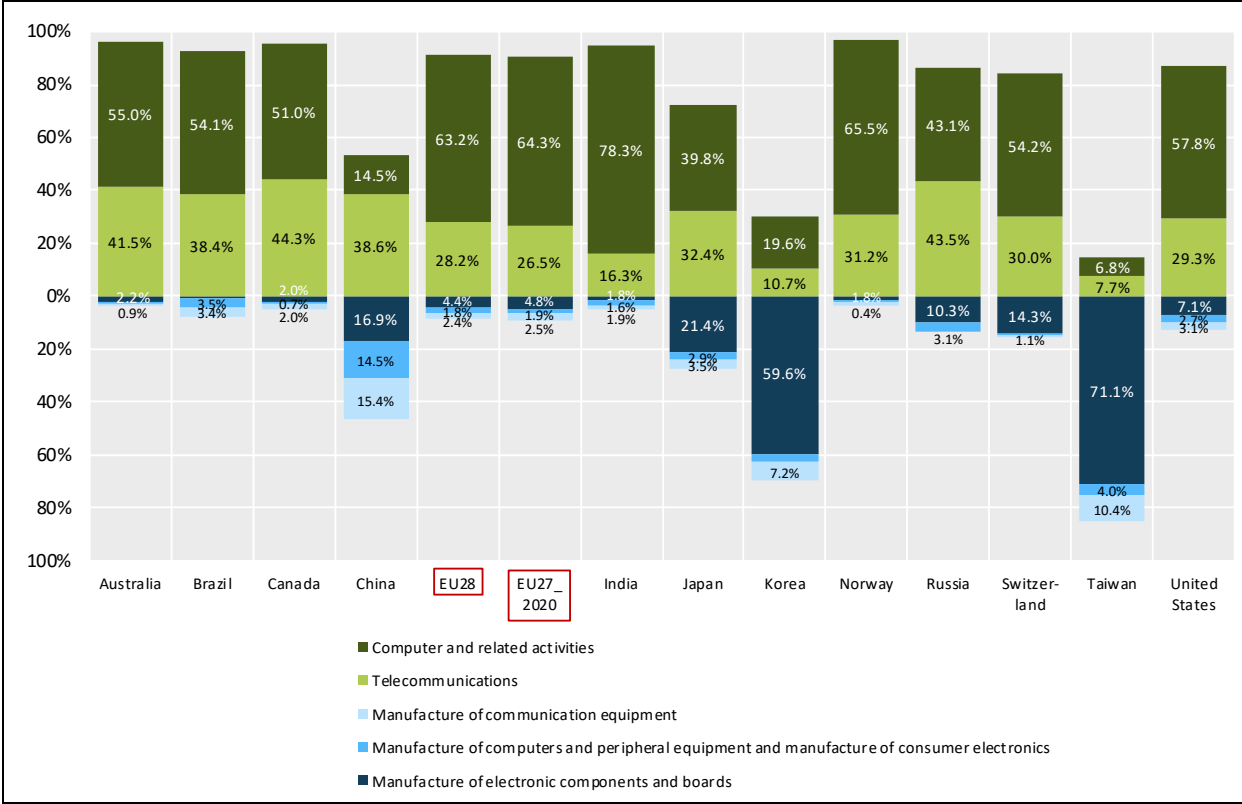
A.4 Comparison with other economies

Figure A51: ICT sector VA share of GDP in the EU28 and other non-EU28 economies (2006, 2017)



Source: 2020 PREDICT Dataset.

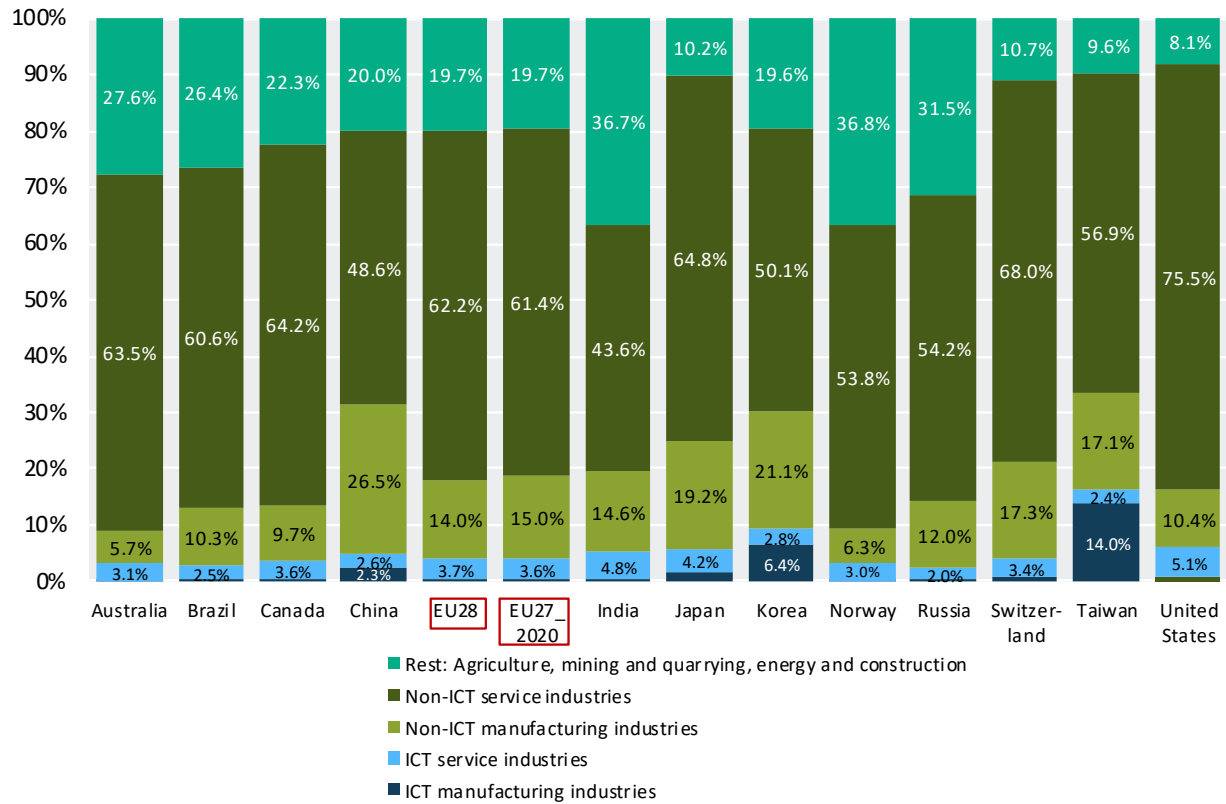
Figure A52: ICT sector VA by sub-sectors in the EU28 and other non-EU28 economies (2017)



Note: 2016 for Canada.

Source: 2020 PREDICT Dataset.

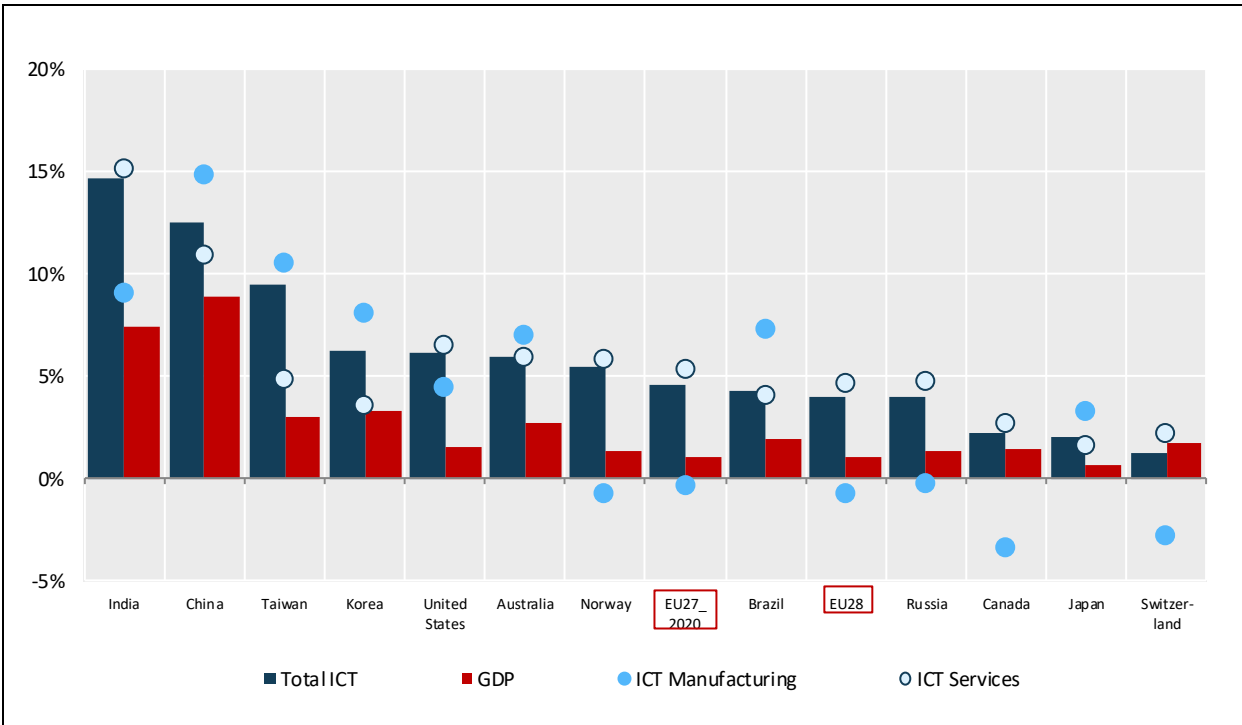
Figure A53: ICT sector VA share of GDP and comparison with non-ICT economic activities. EU28 and other non-EU28 economies (2017)



Note: 2016 for Canada. Non-ICT service industries include total Trade.

Source: 2020 PREDICT Dataset.

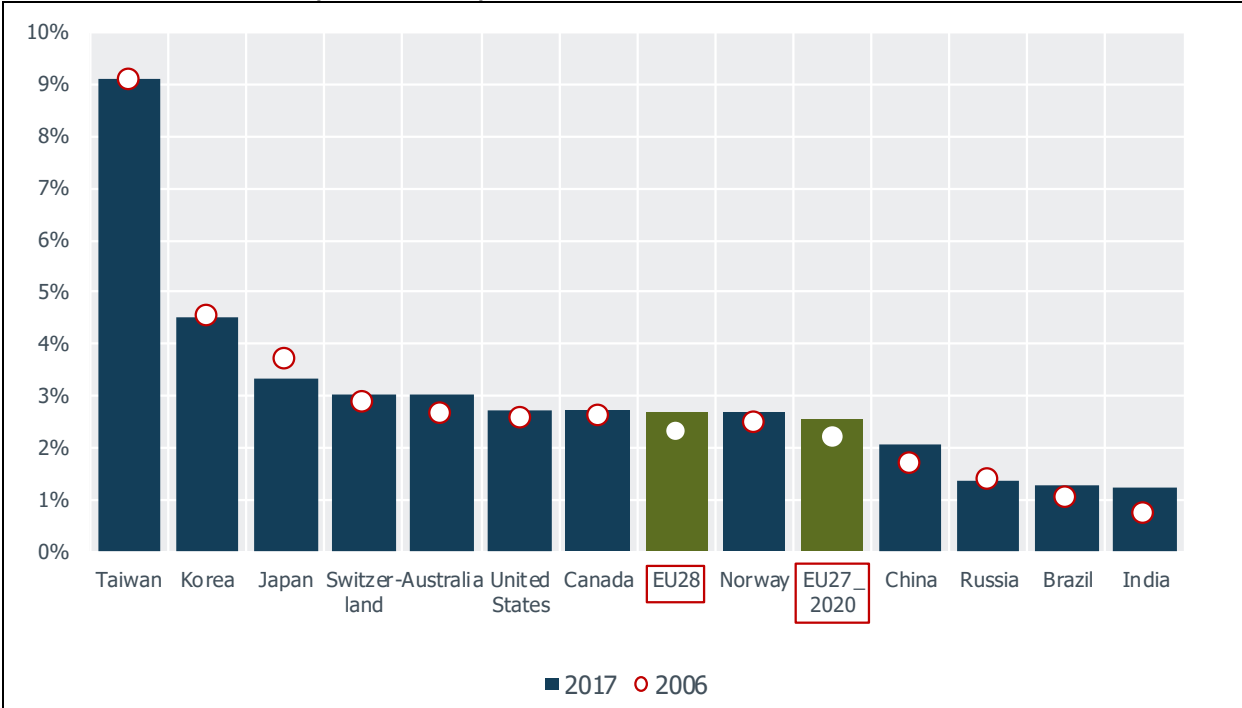
Figure A54: Mean annual real growth rate of ICT sector VA in the EU28 and other non-EU28 economies (2006-2017)



Note: 2006-2016 for Canada.

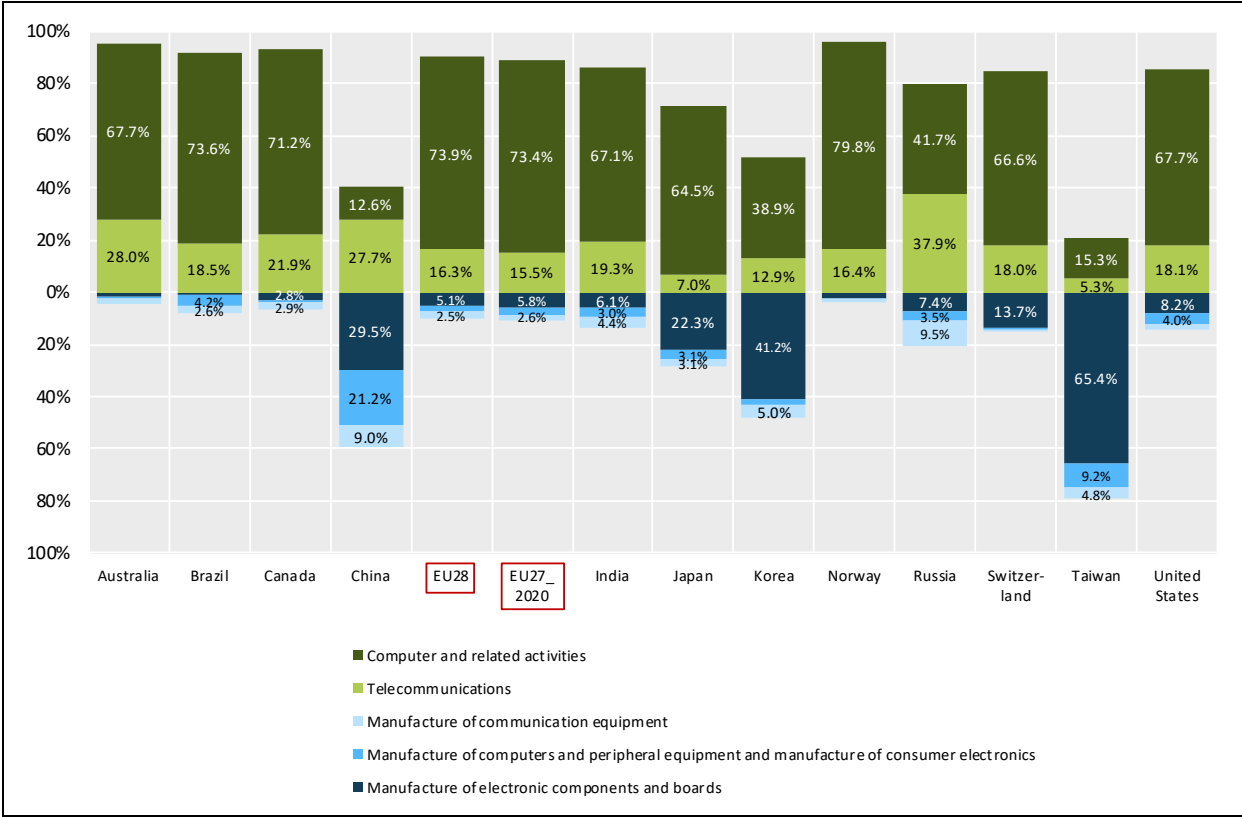
Source: 2020 PREDICT Dataset.

Figure A55: ICT sector employment share of total employment in the EU28 and other non-EU28 economies (2006, 2017)



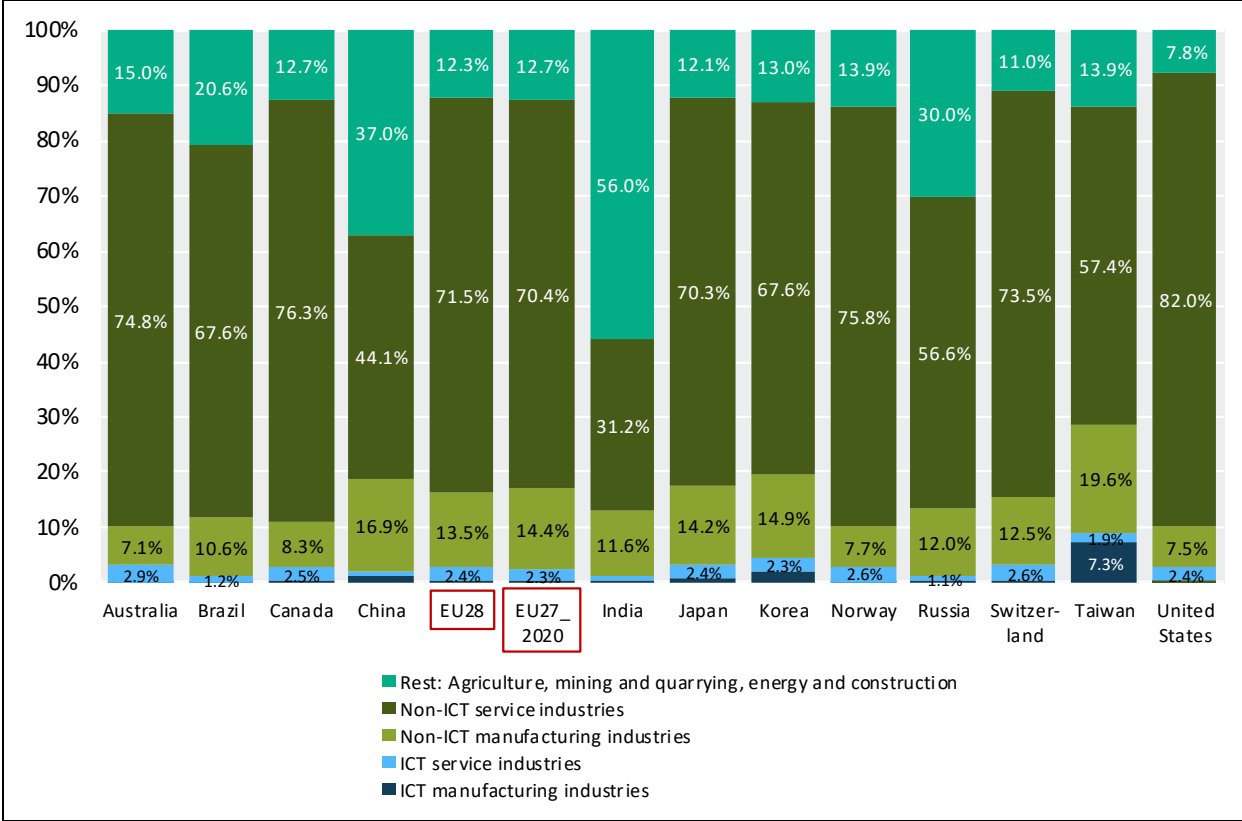
Source: 2020 PREDICT Dataset.

Figure A56: ICT sector employment by sub-sectors in the EU28 and other non-EU28 economies (2017)



Source: 2020 PREDICT Dataset.

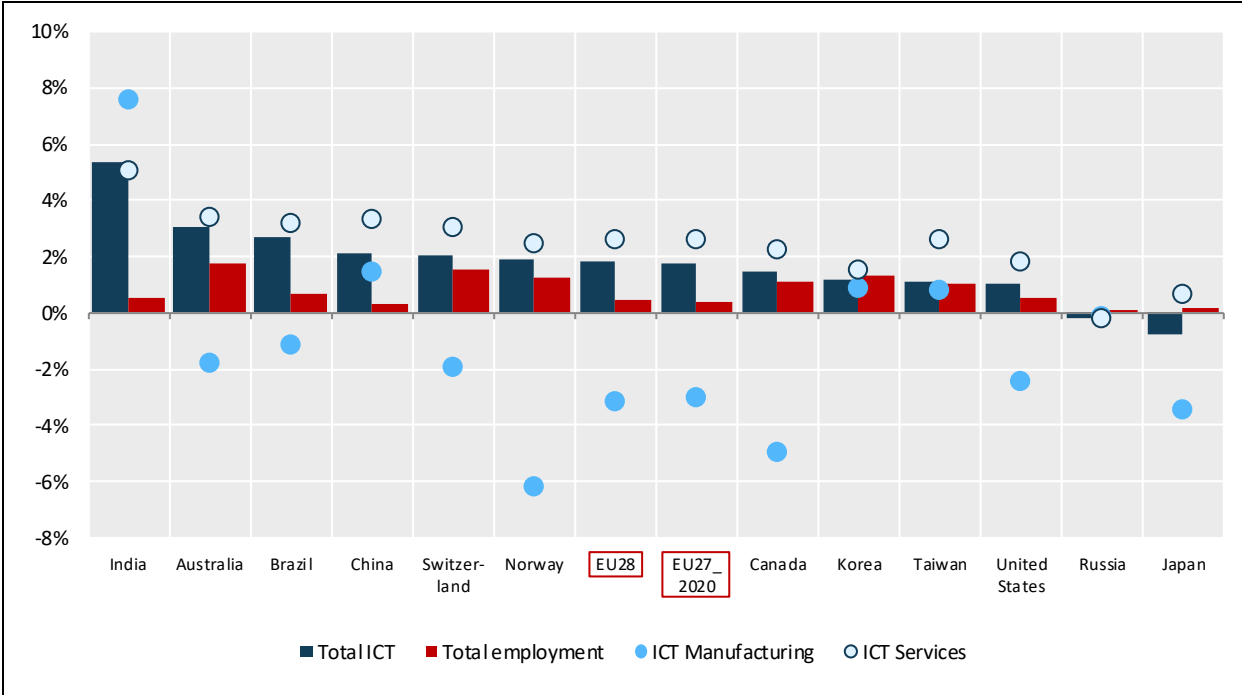
Figure A57: ICT sector employment share of total employment and comparison with non-ICT economic activities. EU28 and other non-EU28 economies (2017)



Note: Non-ICT service industries include total Trade

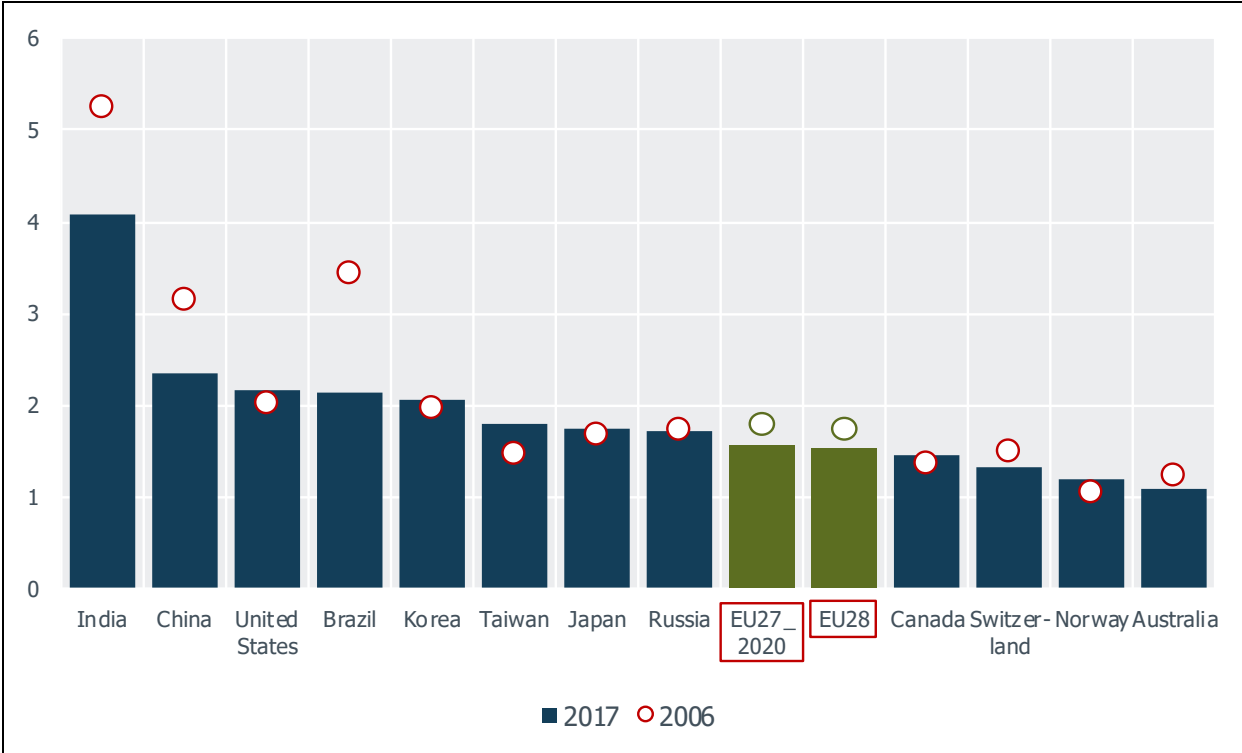
Source: 2020 PREDICT Dataset

Figure A58: Mean annual growth rate of ICT sector employment in the EU28 and other non-EU28 economies (2006-2017)



Source: 2020 PREDICT Dataset.

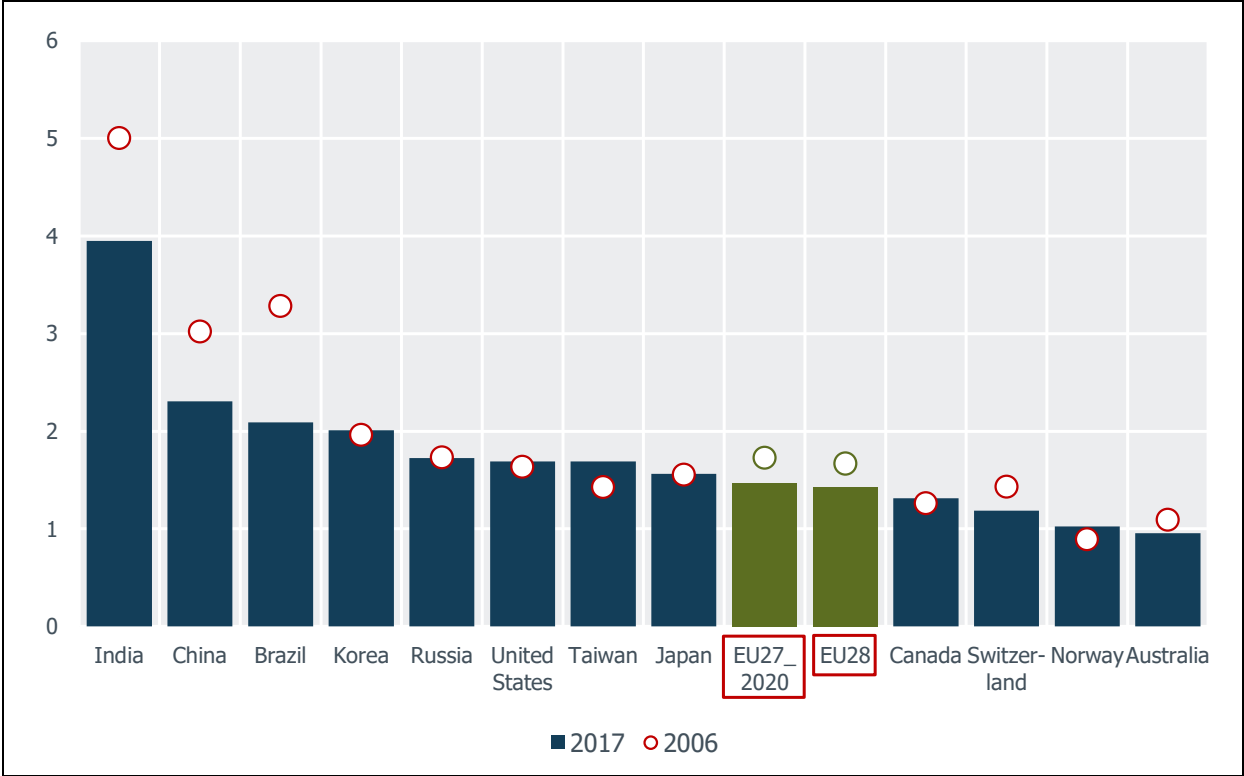
Figure A59: ICT sector productivity per person employed ratio over total economy productivity in EU28 and other non-EU28 economies (2006, 2017)



Note: 2016 for Canada.

Source: 2020 PREDICT Dataset.

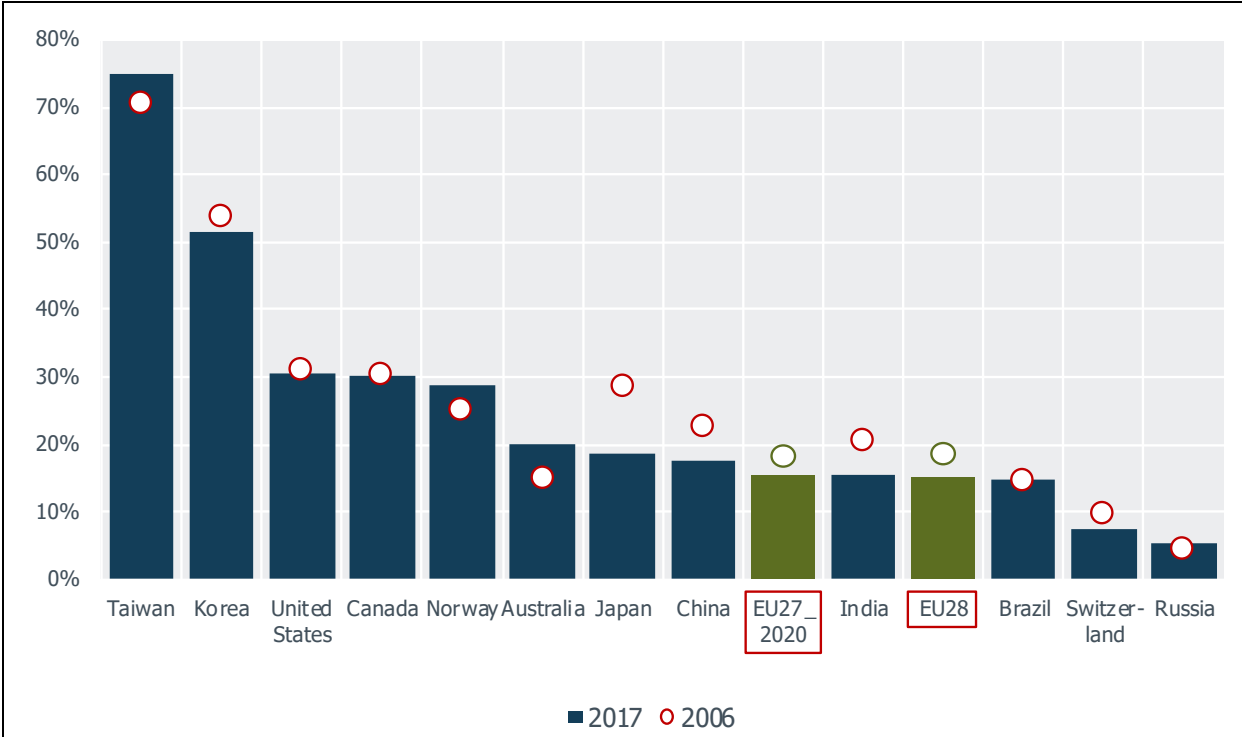
Figure A60: ICT sector productivity per hour worked ratio over total economy productivity in EU28 and other non-EU28 economies (2006, 2017)



Note: 2016 for Canada.

Source: 2020 PREDICT Dataset.

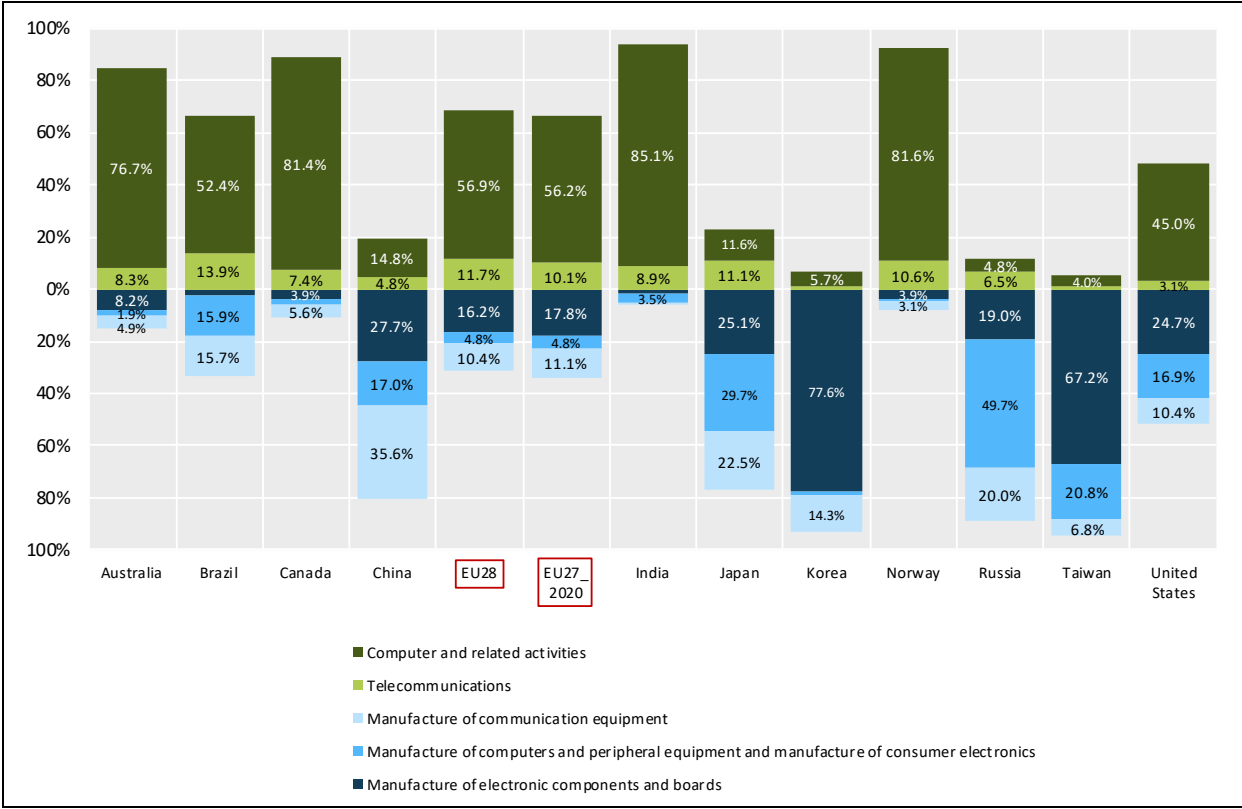
Figure A61: ICT sector BERD share of total BERD in the EU28 and other non-EU28 economies (2006, 2017)



Note: 2008 is the first year available for Brazil and Switzerland. 2013 is the last year available for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

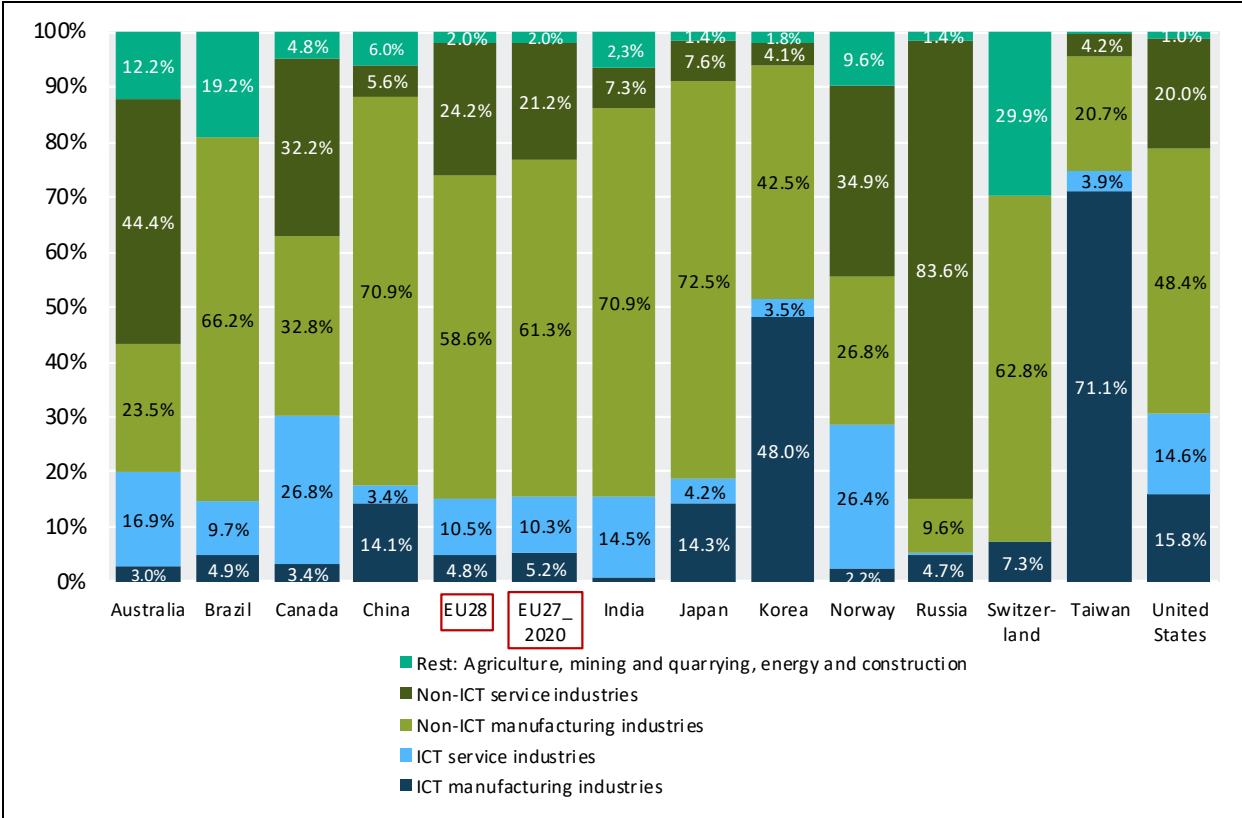
Figure A62: ICT sector BERD by sub-sectors in the EU28 and other non-EU28 economies (2017)



Note: 2013 for India and 2014 for Brazil. ICT BERD for Switzerland not included because of lack of sub-sector data.

Source: 2020 PREDICT Dataset.

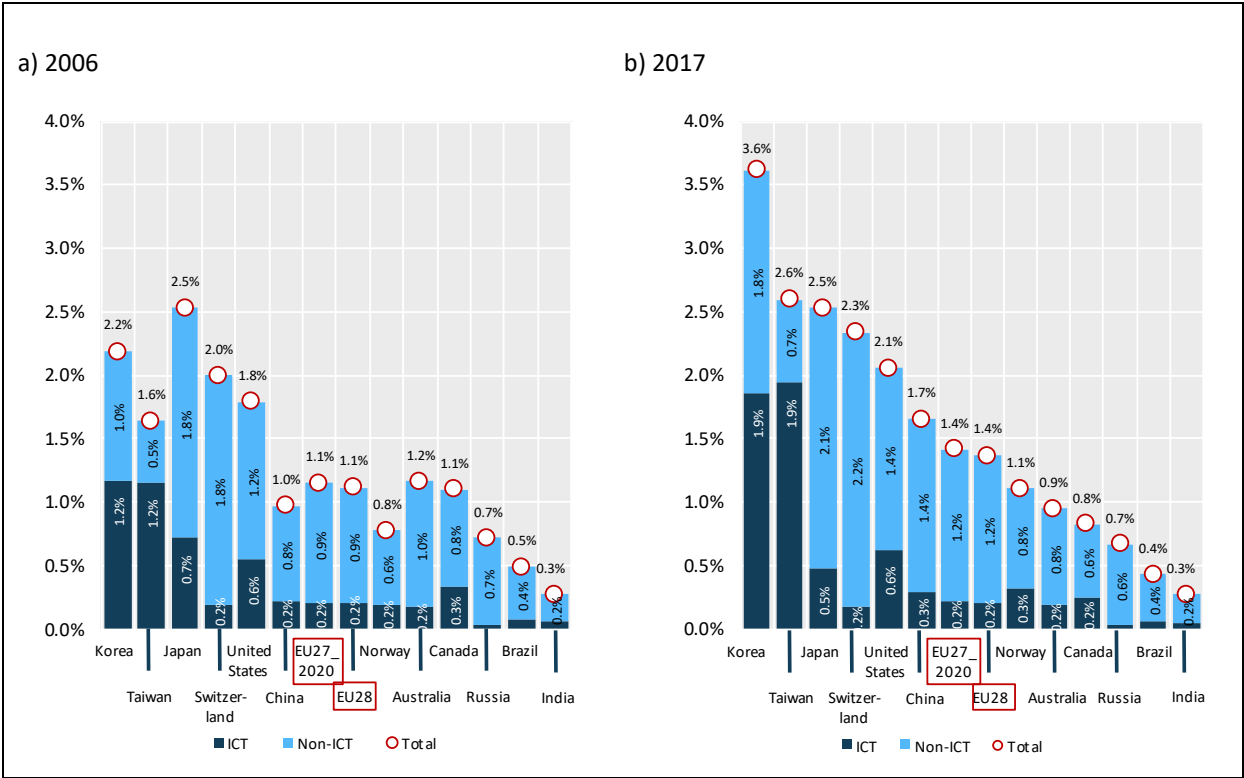
Figure A63: ICT sector BERD share of total BERD and comparison with non-ICT economic activities. EU28 and other non-EU28 economies (2017)



Note: 2013 for India and 2014 for Brazil. Rest include non-ICT service industries for Brazil and service industries (ICT and non-ICT services) for Switzerland.

Source: 2020 PREDICT Dataset.

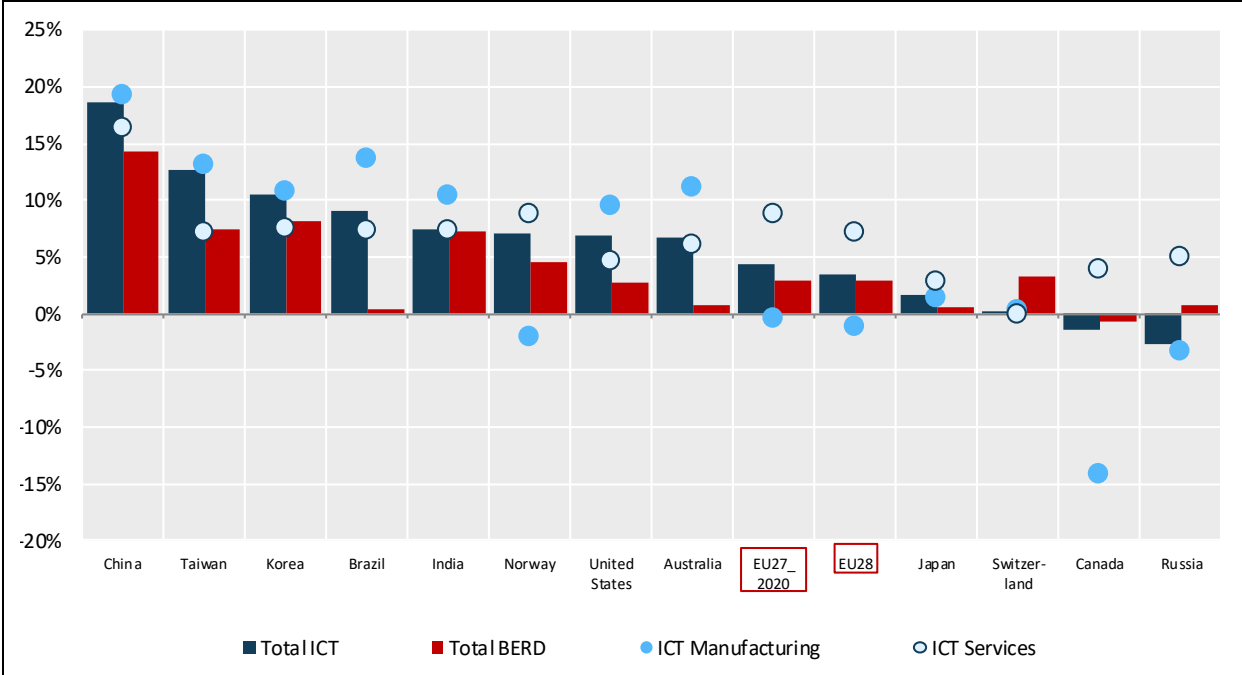
Figure A64: Contribution of ICT and non-ICT BERD to total BERD intensity (BERD/GDP) in the EU28 and other non-EU28 economies (2006, 2017)



Note: 2008 is the first year available for Brazil and Switzerland. 2013 is the last year available for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

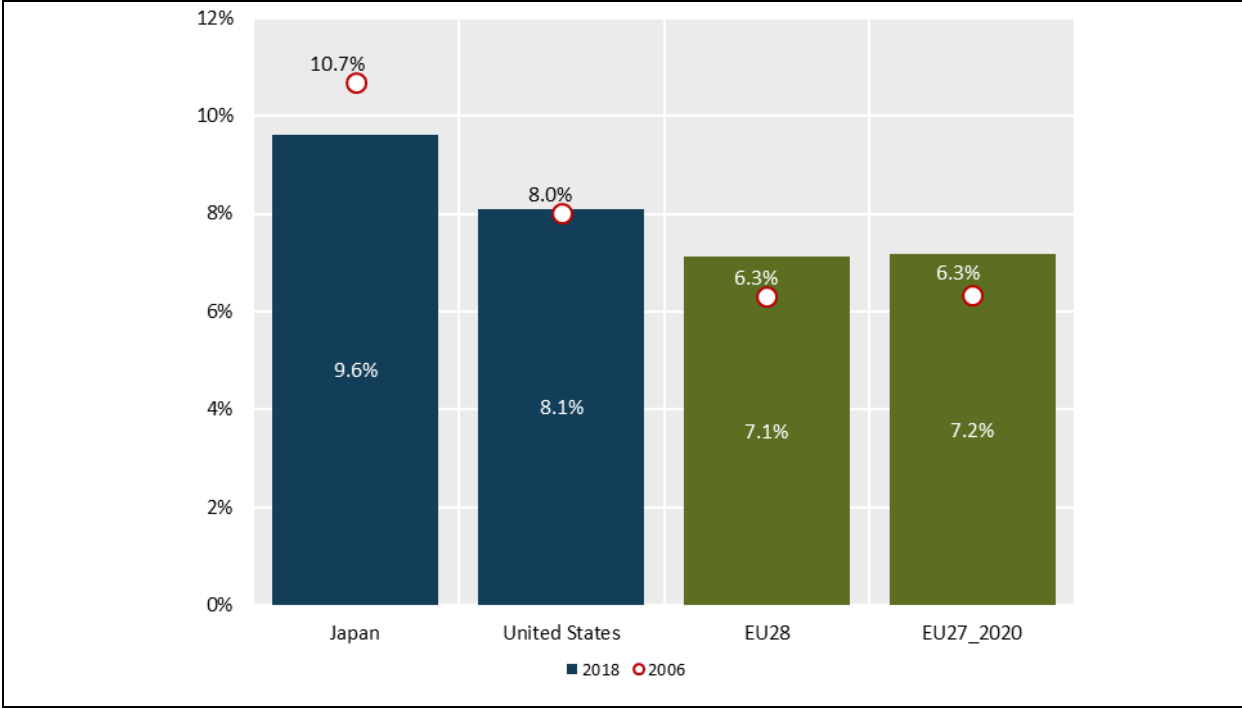
Figure A65: Mean annual real growth rate of ICT sector BERD in the EU28 and other non-EU28 economies (2006-2017)



Note: 2008-2014 for Brazil, 2006-2013 for India, 2006-2016 for Canada and 2008-2017 for Switzerland. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

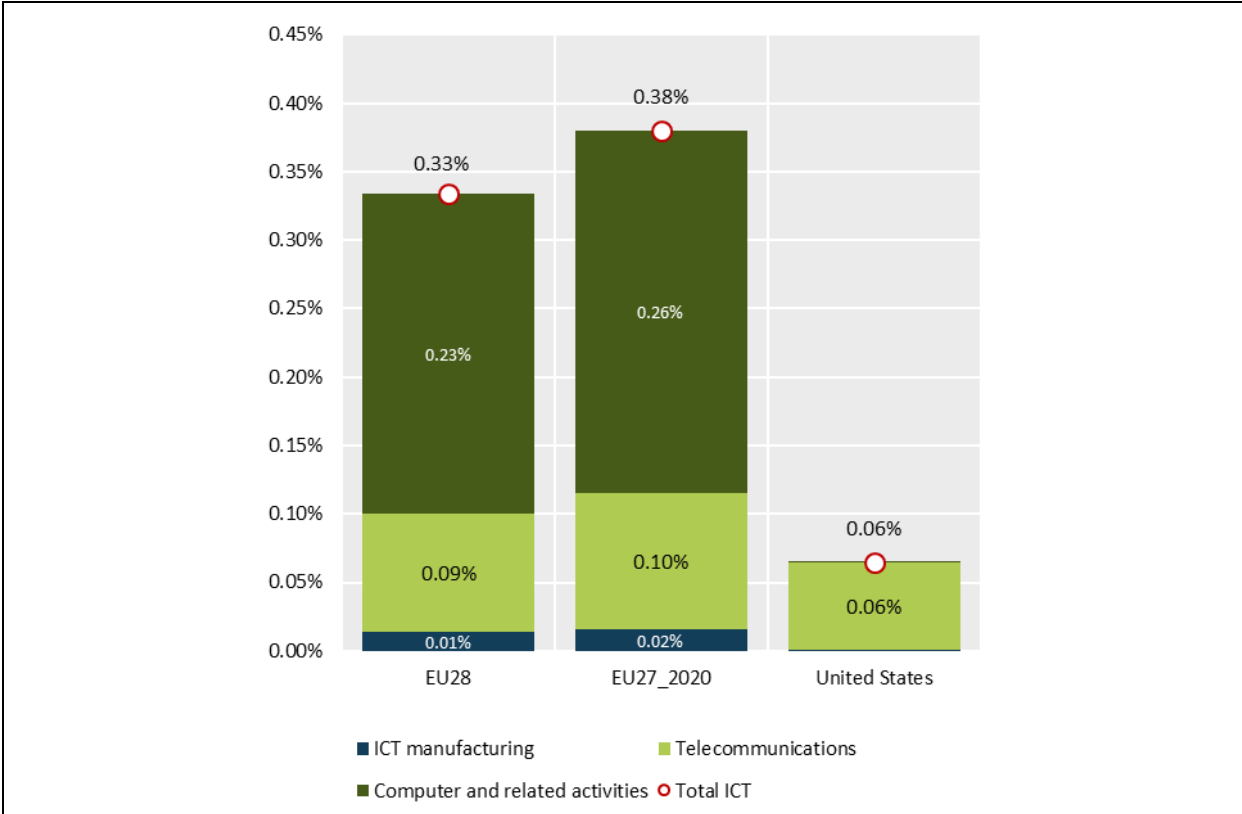
Figure A66: ICT GBARD share of total GBARD in the EU28 and other non-EU28 economies (2006, 2018)



Note: Figures for Japan not fully homogeneous with EU28 and the United States (see methodology).

Source: 2020 PREDICT Dataset.

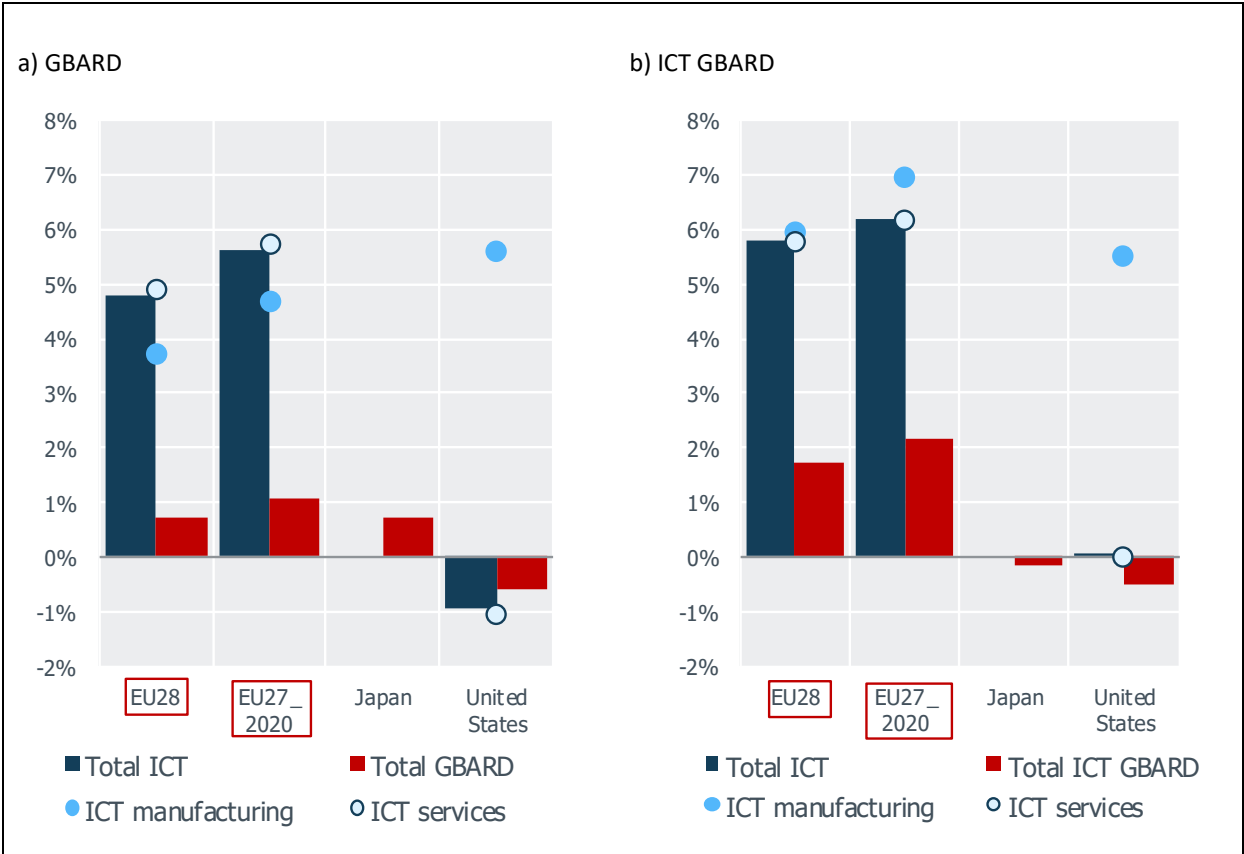
Figure A67: Contribution of ICT sub-sectors to ICT sector ICT GBARD intensity in the EU28 and United States (2018)



Note: ICT sector ICT GBARD for United States includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

Source: 2020 PREDICT Dataset.

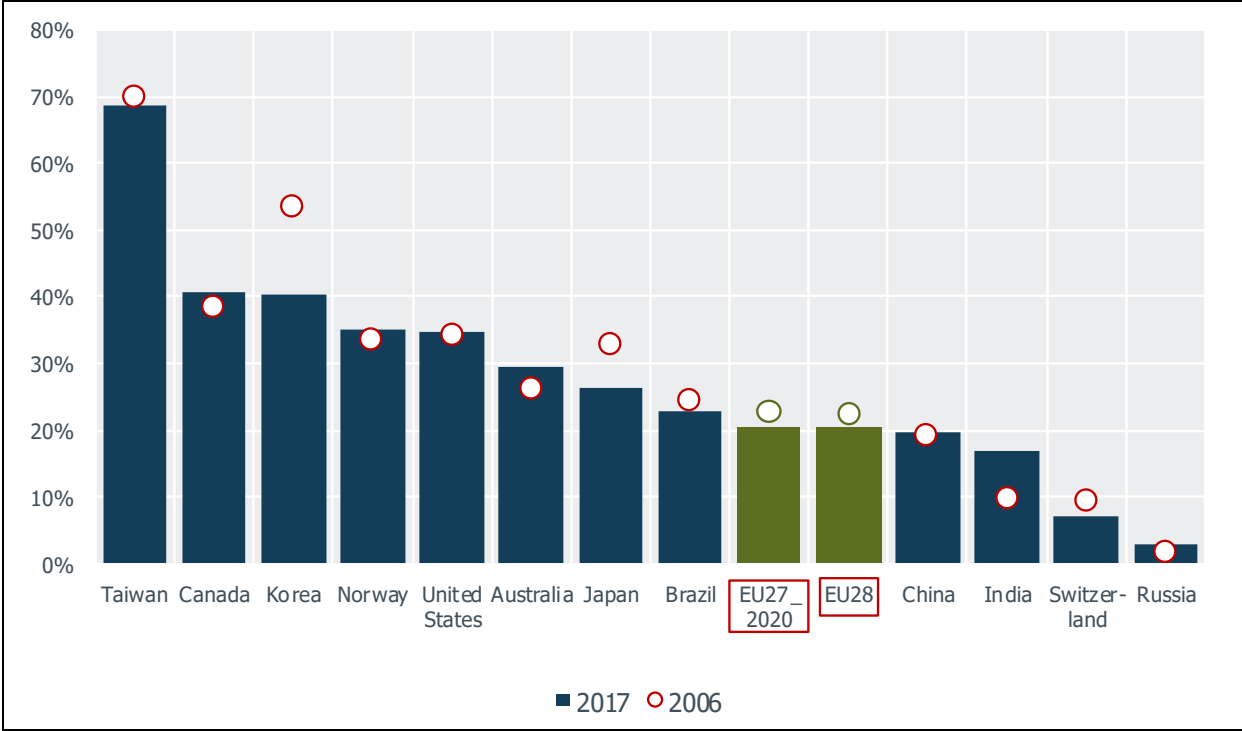
Figure A68: Mean annual real growth rate of ICT sector GBARD and ICT GBARD in the EU28 and other non-EU28 economies (2006-2018)



Note: ICT manufacturing for United States includes 268 NACE Rev.2 sector (Manufacture of magnetic and optical media).

Source: 2020 PREDICT Dataset.

Figure A69: ICT sector RERD share of total RERD in the EU28 and other non-EU28 economies (2006, 2017)



Note: 2008 is the first year available for Switzerland and 2011 for Brazil. 2013 is the last year available for India and 2014 for Brazil. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

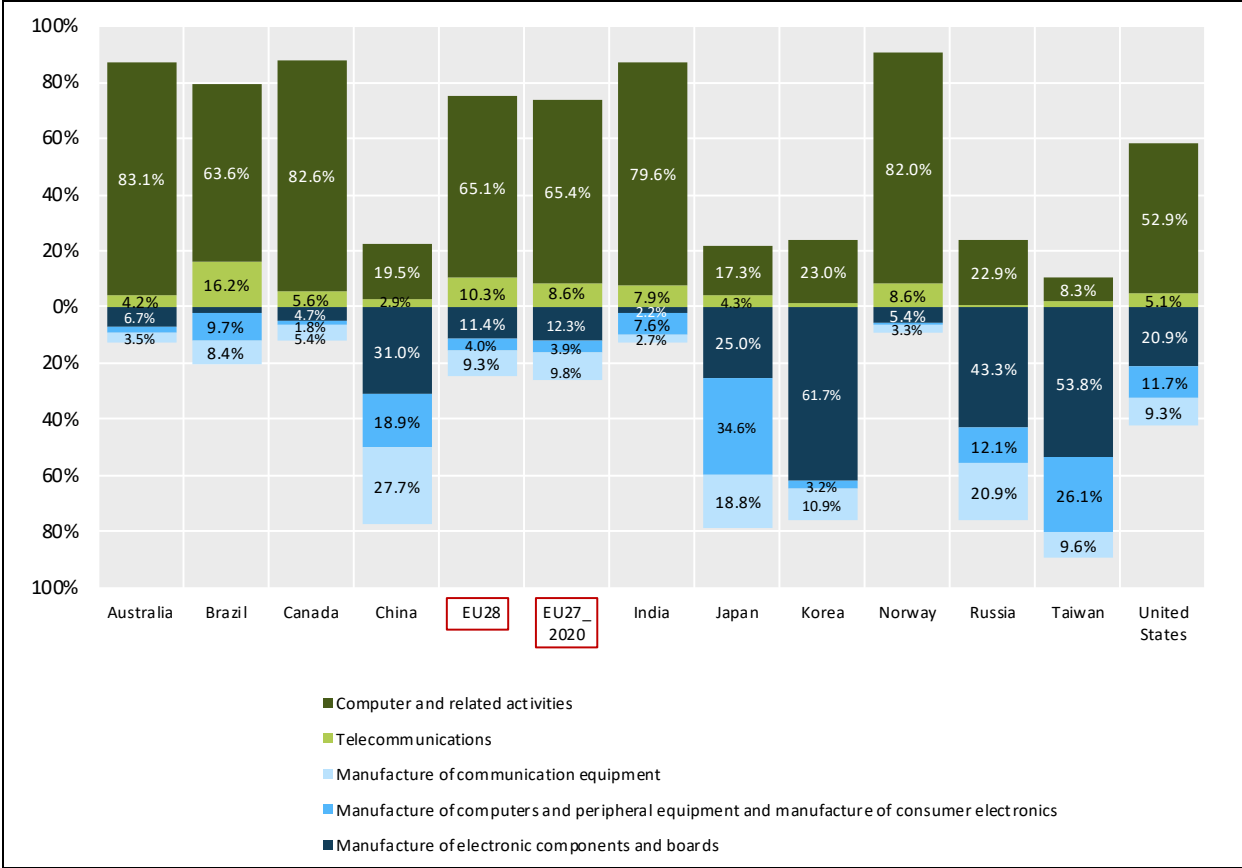
Figure A70: ICT sector PERD share of total PERD in the EU28 and other non-EU28 economies (2006, 2017)



Note: 2008 is the first year available for Brazil and Switzerland. 2013 is the last year available for India and 2014 for Brazil. ICT sector for United States not included because of lack of homogeneous data. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

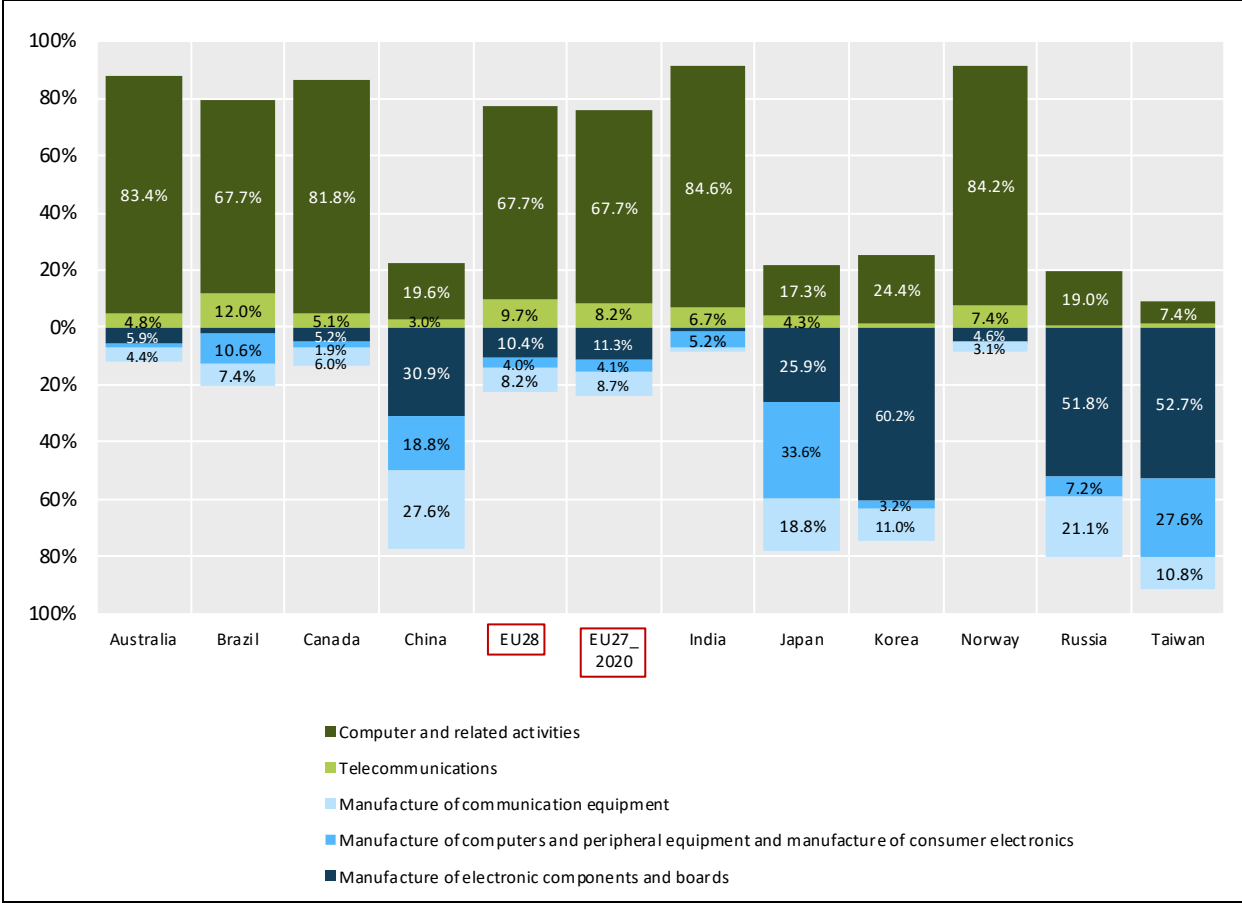
Figure A71: ICT sector RERD by sub-sectors in the EU28 and other non-EU28 economies (2017)



Note: 2013 for India and 2014 for Brazil. ICT sector for Switzerland not included because of lack of sub-sector data.

Source: 2020 PREDICT Dataset.

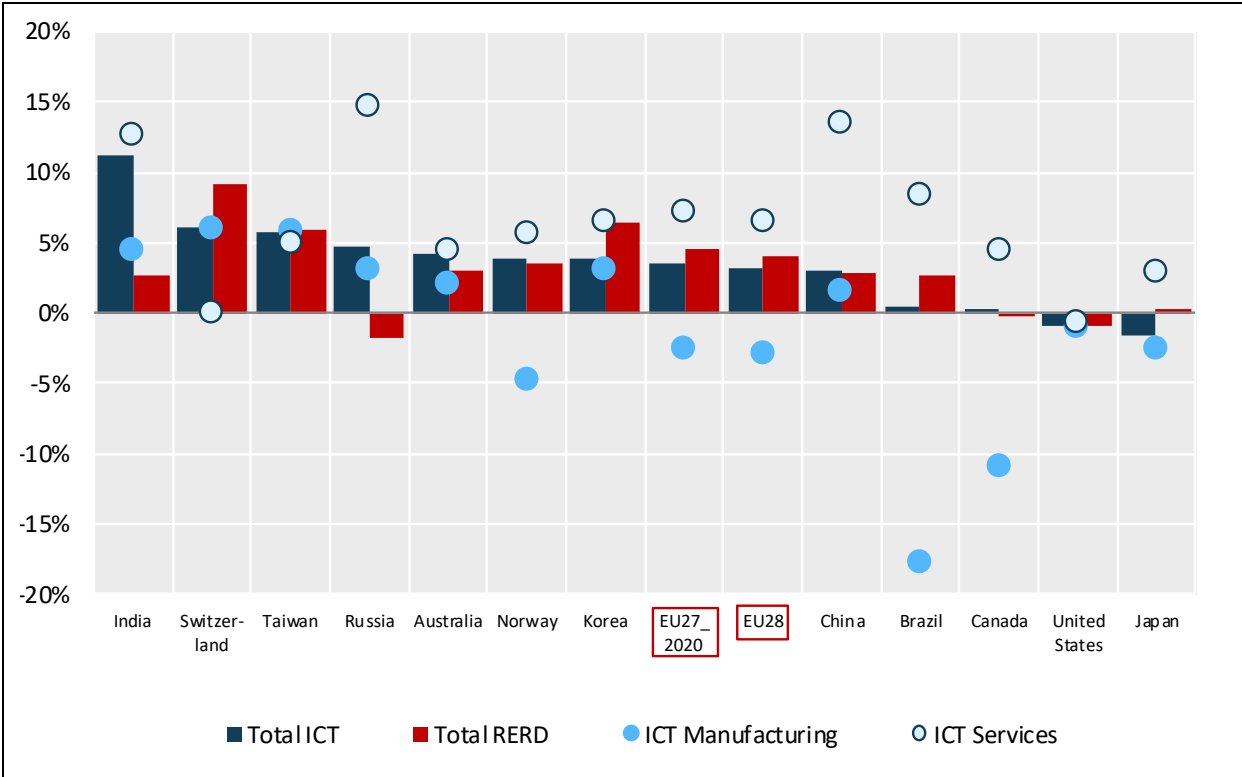
Figure A72: ICT sector PERD by sub-sectors in the EU28 and other non-EU28 economies (2017)



Note: 2013 for India and 2014 for Brazil. ICT sector for Switzerland not included because of lack of sub-sector data. ICT sector for United States not included because of lack of homogeneous data.

Source: 2020 PREDICT Dataset.

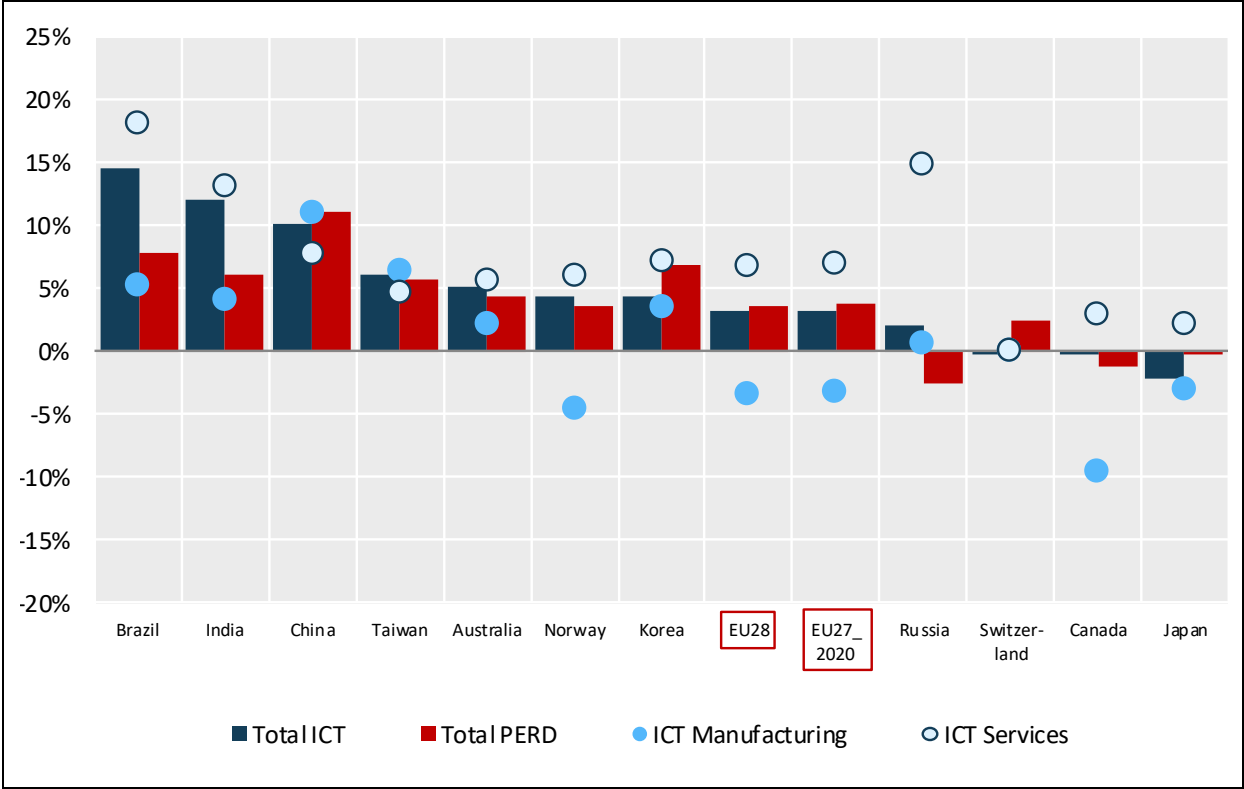
Figure A73: Mean annual growth rate of ICT sector RERD in the EU28 and other non-EU28 economies (2006-2017)



Note: 2011-2014 for Brazil, 2006-2013 for India and 2008-2017 for Switzerland. ICT sector for Switzerland includes only ICT manufacturing.

Source: 2020 PREDICT Dataset.

Figure A74: Mean annual growth rate of ICT sector PERD in the EU28 and other non-EU28 economies (2006-2017)



Note: 2008-2014 for Brazil, 2006-2013 for India and 2008-2017 for Switzerland. ICT sector for Switzerland includes only ICT manufacturing. ICT sector for United States not included because of lack of homogeneous data.

Source: 2020 PREDICT Dataset.

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