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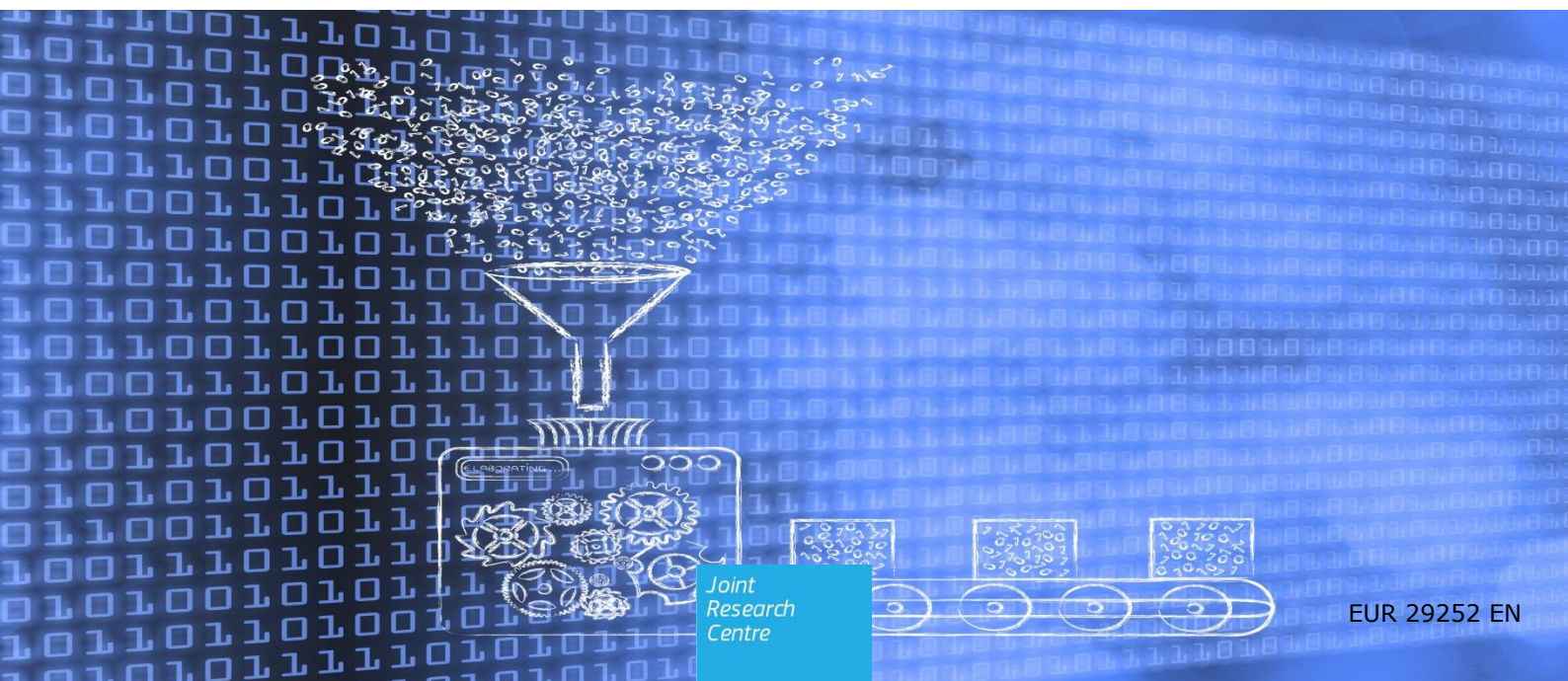
The 2018 PREDICT Key Facts Report

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

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2018



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JRC112019

EUR 29252 EN

PDF ISBN 978-92-79-86638-8 ISSN 1831-9424 doi:10.2760/984658

Luxembourg: Publications Office of the European Union, 2018

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How to cite this report: Mas, M., Fernández De Guevara Radoselovics, J., Robledo, J., Cardona, M., Lopez Cobo, M., Righi, R., Samoili, S. and De Prato, G., The 2018 PREDICT Key Facts Report. An Analysis of ICT R&D in the EU and Beyond, EUR 29252 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-86638-8, doi:10.2760/984658, JRC112019.

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Title: The 2018 PREDICT Key Facts Report. An Analysis of ICT R&D in the EU and Beyond

Abstract

The 2018 PREDICT Key Facts Report provides a detailed analysis of the state of ICT R&D activities in the EU. This is the eleventh 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 2015, 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 2015. Whenever possible, the report includes nowcasted data for 2016 and 2017. The statistical information provided by the figures allows comparing the ICT sector with the total economy; the ICT manufacturing sector with the ICT services sector; each of the four ICT manufacturing, two ICT services, MC and RS sectors' behaviour; the pace followed by each EU country; and the pattern of the EU in an international context, including the most relevant countries from the perspective of the role they play in the world economy today, especially from the ICT R&D perspective.

Keywords

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

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Acknowledgements

The authors acknowledge the valuable comments and suggestions made by the editor of this report: Giuditta De Prato. The authors also thank the Ivie team Eva Benages, Laura Hernández, Consuelo Mínguez, Juan Pérez, Jimena Salamanca and Marta Solaz for their contributions.

Foreword

PREDICT: Prospective Insights on R&D in ICT

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

Rationale

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

Statistics and indicators

PREDICT provides indicators in a wide variety of topics, including value added, employment, labour productivity and BERD, distinguishing fine grain economic activities in ICT and media and content industries (up to 22 individual activities, 14 of which are at the class level, i.e. at 4 digits in the ISIC classification) and at a higher level of aggregation for all the other industries in the economy. It also produces data on government financing of R&D in ICTs, and total R&D expenditure at the country level. Now-casting of more relevant data in these domains has also been performed for 2016 and 2017, 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).

Abstract

The 2018 PREDICT Key Facts Report provides a detailed analysis of the state of ICT R&D activities in the EU. This is the eleventh 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 2015, 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 2015. Whenever possible, the report includes nowcasted data for 2016 and 2017. The statistical information provided by the figures allows comparing the ICT sector with the total economy; the ICT manufacturing sector with the ICT services sector; each of the four ICT manufacturing, two ICT services, MC and RS sectors' behaviour; the pace followed by each EU country; and the pattern of the EU in an international context, including the most relevant countries from the perspective of the role they play in the world economy today, especially from the ICT R&D perspective.

Keywords

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

Introduction

The 2018 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). The 2018 PREDICT Report covers the period between 1995 and 2015. Therefore, it provides a long-term analysis of the European Union (EU) ICT sector and its R&D, covering a whole cycle from the initial expansion years, to the double recession that began in early 2008, and the most recent evolution up to 2015. Whenever possible, the report includes nowcasted data for 2016 and 2017. Throughout the report, the term billion refers to a thousand million. The EU aggregate (EU28) in the PREDICT Dataset always refers to the aggregate of the 28 countries of the current configuration regardless of the legal status of all 28 countries as Member state of the EU in the respective year. This is to allow for a comparison to the same aggregate.

The 2018 report has changed the arrangement of the information followed in previous editions with the objective of providing a straight forward presentation of the main results. With this objective in mind, the report is organized in three parts. The first part provides the *Executive Summary*, which offers, in a very synthetic way, the diagnosis of the EU ICT sector and its R&D. The second part contains the main body of the report with a selection of figures and tables accompanied by short comments summarizing the main findings. It is organised in three sections, combining figures with statistical information and a brief summary of the key findings. Section 1 focuses on the analysis of the *EU ICT sector* and presents the EU ICT sector trajectory, including its R&D, since 1995. Section 2 introduces the results corresponding to each individual EU Member state starting in 2006; and Section 3 extends the analysis to non-EU countries, facilitating the positioning of the EU in an international context. Finally, the third part provides additional information for readers interested in getting a deeper insight.

The information in the three sections is organized in a way that allows to follow the track of the most relevant facts for each of the variables which integrate the PREDICT database: Value added; Employment; Labour productivity, both in terms of persons and of hours worked; Business expenditure on R&D (BERD); BERD intensity (BERD/GDP); R&D Researchers (RERD); R&D personnel (PERD); Public funding of R&D (GBARD), and ICT GBARD, which is the part of GBARD devoted to fund ICT-related expenditures in any industry of the economy (see Box 1).

PREDICT analyses follow the definition of the ICT sector¹ according to the Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2. This definition of the ICT sector was adopted in 2006, and since 2008, all Member States have been required to adopt it when reporting ICT sector data². Regarding the Media and content sector³, which has been incorporated to the report due to its relevancy and its growing inter-relation with ICT, PREDICT follows OECD (2007) definition. Similarly, this report also includes data on Retail sale via order houses or via Internet. The 2018 edition of the PREDICT Key Facts Report is based on the *operational definition* shown in Box 2. This classification departs from the OECD (2007) definition as it does not include the *ICT trade* industry (NACE Rev. 2 465) and *Manufacture of magnetic and optical media* (NACE

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

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

³ The Media and content industries are those "engaged in the production, publishing and/or the electronic distribution of content products", OECD (2011).

Rev. 2 268). The adoption of the operational definition allows the comparison of data over a long-term period and with non-EU countries, which would have been impossible with the comprehensive definition, due to lack of data for the two above mentioned sectors, particularly for non-EU countries. Data according to the more comprehensive OECD definition is also available for the EU and its Member states at the [2018 PREDICT Dataset](#).

Box 1: Definition of GBARD and ICT GBARD

GBARD (Government budget allocations for R&D) is -according to Frascati Manual- 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.

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

This reports presents the data with different levels of sectoral disaggregation. It considers the total economy and the following sectors: ICT, Media and content (MC), and Retail sale via mail order houses or via Internet (RS). For the ICT sector, it distinguishes between ICT manufacturing and ICT service sectors. ICT manufacturing is further disaggregated into four sub-sectors: *Electronic components and boards*, *Computers and peripheral equipment*, *Communication equipment*, and *Consumer electronics*; while the ICT services sector is disaggregated into two sub-sectors: *Telecommunications* and *Computer and related activities*.

This way of presenting the information allows —by just taking a quick glance at the statistical information provided by the figures— comparing: a) the ICT sector with the total economy; b) the ICT manufacturing sector with the ICT services sector; c) each of the four ICT manufacturing, two ICT services, MC and RS sectors' behaviour; d) the pace followed by each EU country; and e) the pattern of the EU in an international context, including the most relevant countries from the perspective of the role they play in the world economy today, especially from the ICT R&D perspective.

This analysis will allow providing an answer to questions such as: Is the ICT sector still more dynamic than the total economy? Is the ICT sector a net contributor to employment creation? Is ICT manufacturing still the key sector for R&D expenditures? In which sector is productivity growing faster? Within the EU, 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 EU? The main body of the report contains 25 figures (each one of them containing detailed information for each variable) and 3 tables summarizing the main statistical information.

The Annex offers 74 additional figures providing detailed information for readers interested in getting a more in-depth knowledge of the EU ICT sector and its R&D. This additional information is organized in four sections. Section 1 refers to the ICT sector and its R&D in the EU; section 2 provides an analysis of the EU ICT sub-sectors; section 3 offers the information by EU Member States; and section 4 addresses the comparison with other non-EU economies.

For more details on how the 2018 PREDICT Dataset has been produced, see [The 2018 PREDICT Dataset Methodology](#).

Executive Summary

New Information and Communication Technologies (ICT) have transformed the production process of many existing economic sectors as they promote robotisation and automation. ICT determines competitive power in the knowledge economy and encompasses the technologies underpinning the digital transformation of the economy and of society. They have led to the creation of new sectors and adaptation of others, and they are also one of the factors behind the phenomenon of globalization and the fragmentation of production processes in different stages (the so called global value chains).

Besides the impact that technological uptake has on the organisation of businesses, the ICT sector also plays an important enabling role for innovation in other technological domains, and has affected in obvious and varied ways people's everyday life. This is reflected at the EU policy level, where the Digital Agenda for Europe in 2010, with the objective of maximising the social and economic potential of ICT, was identified as one of the seven pillars of the Europe 2020 Strategy for growth in the Union. In addition, the achievement of a Digital Single Market (DSM) has been one of the 10 political priorities of the Commission since 2015. Digitalisation is considered as one of the main influencers in globalisation in the Commission 2017 reflection paper on "Harnessing globalisation".

The 2018 PREDICT Key Facts Report focuses only on the ICT producing sector. That is, it provides data for all variables referring to the *production* of ICT goods and services by firms and of its R&D activity, but not to its use by society. In addition to the ICT sector, the report also provides information for two additional sectors closely related to ICT: *Media and content* (MC) and *Retail sale via mail order houses or via Internet* (RS). The results presented below are set out according to the three sections in which the main body of the report is organized.

Analysis of the EU ICT Sector

In 2015 the EU ICT sector Value Added (VA) amounted to 581 billion euros, employed 5.8 million people and spent 30 billion euros on R&D business expenditures (BERD). The ICT sector represented 3.9% of the EU value added, 2.5% of total employment, 15.7% of total BERD, and 18.6% and 20.6% of the R&D personnel and researchers in the EU, respectively.

The ICT producing sector is one of the most dynamic sectors in the economy, standing out for its high Research and Development (R&D) intensity and for a higher productivity than the whole economy. The information provided by PREDICT confirms the extent of these. From 1995 until 2015, the EU ICT sector multiplied its VA in real terms by a factor of 3.5, while the total economy did so by 1.4. The growth of employment was much more moderate. In 2015 it had multiplied its 1995 value by a factor of 1.5. According to PREDICT estimates, both variables continued growing in 2016 and 2017. Labour productivity growth in the ICT sector was much faster (both in terms of persons and hour worked) than in the total economy, multiplying its 1995 value by a factor of almost 2.5 in 2015. According to the estimations made within the project, it maintained this level in the following two years. Business R&D expenditure in the ICT sector also showed a more dynamic behaviour than for the total economy. Between 1995 and 2015, ICT BERD multiplied its value by a factor of 3.5, while BERD in total economy did so by a factor of only 1.7. The estimated values for 2016 and 2017 indicate that BERD also continued increasing during these years. However, BERD intensity (measured as the BERD/GDP ratio in nominal terms) declined along 1995-2015 and stagnated in the two following years according to PREDICT estimates. 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 almost 2 since 1995, but not the number of R&D personnel, which increased, again, at a faster rate in the ICT sector. Public funding of R&D is measured through Government budget

allocations for R&D (GBARD). The part of GBARD devoted to funding ICT-related expenditures in any industry (ICT GBARD) in the ICT sector was 60 % higher in 2016 than in 2006. In the total economy, ICT GBARD only grew by 1.3% annually (in nominal terms) between 2007 and 2016.

The more dynamic behaviour of the ICT sector in the EU is entirely due to the ICT services sector. ICT manufacture experienced a sharp contraction from the beginning of the economic crisis in 2007 in VA and BERD. ICT sector employment increased along the 1995-2017 period thanks to the positive contribution of the ICT service sector, while in the ICT manufacturing sector employment halved between 1995 and 2017. R&D researchers (RERD) and R&D personnel (PERD) also experienced a reduction albeit not as strong. As a counterpart, the latter two variables showed a fast growth in the ICT services sector. RERD in the ICT services sector multiplied its 1995 value by a factor of 4, and PERD by a factor of almost 4.5. The combined movements of VA and employment translated into a faster growth rate of ICT manufacture labour productivity than in ICT services sector. However, ICT manufacture has been suffering from a severe slowdown since 2013, while ICT services labour productivity has continued growing.

Since last year, the PREDICT Key Facts Report presents information for the period 2006 onwards for two additional sectors which are not included within the OECD definition of the ICT sector but which are closely related to it: *Media and content sector* (MC) and *Retail sale via mail order houses or via Internet* (RS). The MC industries are those "engaged in the production, publishing and/or the electronic distribution of content products", OECD (2011).

In 2015, the ICT service sector represented 3.6% of GDP and ICT manufacturing only did by 0.3%. Thus, the total ICT sector amounted to 3.9%. In 2015, it represented the same amount as in 2014 because of the increased share of ICT services together with the fall of ICT manufacturing. The MC sector has a share of 1% of GDP, higher than ICT manufacturing, but it has shown a declining trend since 2006. The share of the RS sector is much lower, 0.2%, but with a slightly increasing trend. According to PREDICT estimates, in 2016 and 2017 the ICT services sector increased its weight in the economy, while ICT manufacturing and MC decreased, and RS stagnated. Similar time profiles are offered by the employment variable. Labour productivity is higher than the total economy average in all studied sectors but RS. However, all of them have shown a declining trend. Only the RS sector has experienced a slight increase since 2013. The variable BERD in the ICT sub-sectors presents an interesting evolution. In the last two years preceding the economic crisis, the ICT manufacturing sector had a higher share (10%) of total BERD than ICT services (8.6%). However, since then, the former has followed a continuous declining path, while ICT services sector has shown the opposite evolution. For the remaining two sectors, the MC sector's share in BERD is practically negligible while RS has a higher weight (1.5%) than the one it has in terms of VA and employment. Similar profiles are offered by RERD and PERD. GBARD intensity (over GDP) in the total economy has suffered a severe drop since 2009, while ICT GBARD over GDP remained more stable along the period 2006-2016, although also decreasing after 2009. Both series follow a flatter evolution when focusing on the ICT sector. Thus, public funding of R&D related to the ICT sector and activities was more resilient than public funding to the rest of economic activities. As a result of the sustained public funding of ICT R&D with respect to total R&D public funding, the share of ICT GBARD over total GBARD showed a light but steady increase along the period 2006-2016.

The distinction by sub-sectors allows us to conclude that in terms of VA, employment, GBARD and ICT GBARD, the two ICT services sectors (*computer and related activities* and *telecommunications*), together with the MC sector, have the highest shares over the total economy. In terms of BERD, RERD and PERD, *computer and related activities* is the sector with, by far, the highest share. The *telecommunications* sector has the highest labour productivity ratio, more than 2.5 times higher than the total, and the RS sector the lowest. *Manufacture of communications equipment* has the highest BERD intensity,

and *Manufacture of computers* the highest GBARD and ICT GBARD intensity. Finally, *Computer and related activities* has the highest share of ICT GBARD over total GBARD.

The ICT sector in the EU Member states

In 2015 the largest ICT sectors in the EU in relative size (ICT sector VA / GDP) were Ireland, Malta, Luxembourg, Sweden and Romania, all above 5.0%. In terms of employment, the largest EU ICT sectors in relative size were Estonia, Malta, Ireland and Finland, with a share over total employment higher than 3.7%. On the other hand, Finland was the country with the highest ICT sector BERD intensity in 2015 (16.7% of total value added), followed by Austria, Sweden, France, Belgium and Denmark.

In the 2006-2015 period, the ICT sector in all countries of the EU (with the sole exceptions being Greece, Finland and Austria) had a positive VA growth. The highest growth rates corresponded to Bulgaria, Luxembourg and Poland. Employment growth was negative in Finland, Greece, Hungary, Italy and Ireland. The strongest positive growth corresponded to three eastern countries (Estonia, Bulgaria and Latvia) and Luxembourg. Ireland was the EU country with the highest growth rate of labour productivity, especially in the service sector. Poland and Slovakia presented the highest growth rates of BERD. In RERD and PERD Lithuania, Poland and Slovakia stand out. The countries with higher increases in GBARD and ICT GBARD were Malta (only in GBARD), Estonia, Poland and Luxembourg.

BERD intensity (BERD/GDP) in the ICT sector is very high in Finland and Sweden, especially in the ICT manufacturing sector, and comparatively low in Romania, Latvia, Luxembourg, Lithuania and Greece. ICT sector BERD intensity (measured as ICT sector BERD/ICT sector VA) is very high in Finland, followed by Austria, Sweden and France. The countries with the highest values of public funding of R&D (GBARD) in the ICT sector over VA are Belgium and Finland, with a rather homogenous split among ICT manufacturing, ICT services and MC sector. Finally, the weight of ICT GBARD over total GBARD is especially high in Ireland, Sweden, Finland, Hungary and Latvia.

The EU ICT sector in the international context

From the international perspective, Taiwan is the country in which the ICT sector has the highest share over the total economy of the thirteen (including the EU) countries considered in the PREDICT database. Its superiority is overwhelming in all variables, especially in ICT manufacturing. South Korea occupies the second position also for all variables. The third position is claimed by Japan in VA and employment; and by Norway and Canada in BERD, RERD and PERD. The EU's position depends on the selected variable. In VA the EU goes behind China and India, and in BERD it goes also behind China but not India. In terms of RERD and PERD, the shares of the ICT sector in the EU are only slightly higher than in these two countries. For all variables the ICT sector in the US has a higher share than in the EU. In the ICT sector, both the share of GBARD over total GBARD, and of ICT GBARD over total ICT GBARD is higher in the EU than in the US.

The US is the country with the largest labour productivity per hour worked in the ICT sector, ICT manufacturing and ICT services. It is followed by Norway, Taiwan, and the EU in the fourth position. The lowest productivity levels correspond to China and India. However, India is the country in which the ICT sector has the highest labour productivity per hour worked as compared with total economy (almost 4 times higher). Brazil, China and South Korea follows. In the EU the ratio is slightly lower than in the US, meaning that in the EU the gap between ICT sector productivity and total productivity is higher.

India and China were the countries showing the most dynamic behaviour during the 2006-2015 period in almost all variables. They presented the highest annual growth rates in VA and employment. In labour productivity per hour worked Taiwan stands out, followed by Korea, India, China and Russia. China also had the most dynamic behaviour in BERD, and India in RERD. In PERD, Brazil is the country occupying the first position. Compared with the Asian countries, the ICT sector has shown modest growth rates in all

dimensions in the EU and also in the US. Only in the two variables related to GBARD has the EU been more dynamic than the US, except for the ICT manufacturing industries. Despite the EU being more dynamic in comparison with the US, it has not been high enough as to achieve the objective established in the Digital Agenda strategy.

BERD intensity (BERD/GDP) for the whole economy is higher in the Asian countries and in the US than in the EU. South Korea, Japan and Taiwan present the highest ratios. In Korea and Taiwan ICT manufacturing sectors have the highest BERD intensity, while in Japan and in the US it is the non-ICT sector. BERD intensity for the total economy is higher in China than in the EU. When BERD intensity is defined as ICT sector BERD/ ICT sector VA, South Korea has the highest ratio for the ICT sector, followed by the US, Taiwan, Norway and Japan. The EU occupies the eighth position, with a BERD intensity lower than China.

The distinction by ICT sub-sectors allows us to confirm that the strength of Taiwan and Korea relies on *Manufactures of electronic components* regardless of the variable considered. The ICT sectors in Japan, China and Russia are concentrated in manufactures. For the rest of countries, including the EU and the US, the sub-sector with the highest share in all variables is *Computer and related activities* belonging to ICT services. GBARD and ICT GBARD in the EU ICT sector are concentrated in the ICT service sector, especially in *Computer and related activities*. In the US public funding in the ICT sector is concentrated exclusively in *Telecommunications*. Labour productivity per employed person in the US is higher than in the EU for all sub-sectors considered. Additionally, the gap has increased in four sub-sectors between 2006 and 2015. The exceptions are *Manufacture of consumer electronics* in which the gap decreased and *Manufacture of computers* that remained constant.

The information for the EU from an international context confirms that the centre of gravity of the world economy is moving fast to the East. China and India, especially the first, are showing a very dynamic behaviour in all variables, 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 of those within the ICT producing sector- as well as for 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, occupying positions which have, until now, been reserved for the most developed countries. Up to now the US is still the leading country in the world. However, the position of the EU is becoming weaker, showing a clearly less dynamic behaviour than most of the Asian countries, especially China which (due to the size of its economy) is already threatening a leading position in the international context. The results presented here are a serious warning for the future of the EU that should be taken into account.

1 The EU ICT sector

In 2015 the EU ICT sector VA was 581 billion euros, employed 5.8 million people and spent 30 billion euros on R&D (BERD) business expenditures. The ICT sector represented 3.9% of the EU value added in 2015, 2.5% of the employment, 15.7% of total BERD, and 18.6% of the R&D personnel and 20.6% of the researchers (see Table 1 (a)). In general, the ICT sector in 2015 was more dynamic than the whole EU economy, as value added increased 5.2%, employment 1.8% and BERD 2.9% (see Table 1 (b)). The ICT GBARD in the EU was 6.4 billion euros, which represented 6.7% of total public funding in R&D (total GBARD) and 0.04% of total GDP.

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

a) 2015

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	50,029.3	635.4	11,783.4	321.1	68.7	61.5	84.5
261	Manufacture of electronic components and boards	25,850.8	318.1	4,676.0	146.6	15.7	22.4	32.2
262	Manufacture of computers and peripheral equipment	6,469.1	87.7	1,179.7	59.5	24.7	7.3	10.1
263	Manufacture of communication equipment	13,460.9	160.1	5,492.6	94.9	25.1	29.3	38.4
264	Manufacture of consumer electronics	4,248.4	69.4	435.0	20.0	3.2	2.4	3.8
582, 61, 62, 631, 951	ICT services industries	531,332.2	5,196.5	18,669.8	3,451.8	1,701.1	125.5	207.5
61	Telecommunications	184,214.4	1,109.8	3,246.6	1,668.3	512.1	18.6	27.6
582, 62, 631, 951	Computer and related activities	347,117.8	4,086.6	15,423.2	1,783.5	1,188.9	106.9	179.9
261-264, 582, 61, 62, 631, 951	ICT total	581,361.5	5,831.9	30,453.2	3,772.9	1,769.8	187.0	292.0
	Total economy	14,796,828.5	229,307.7	194,013.4	96,082.8	6,444.3	906.1	1,573.7

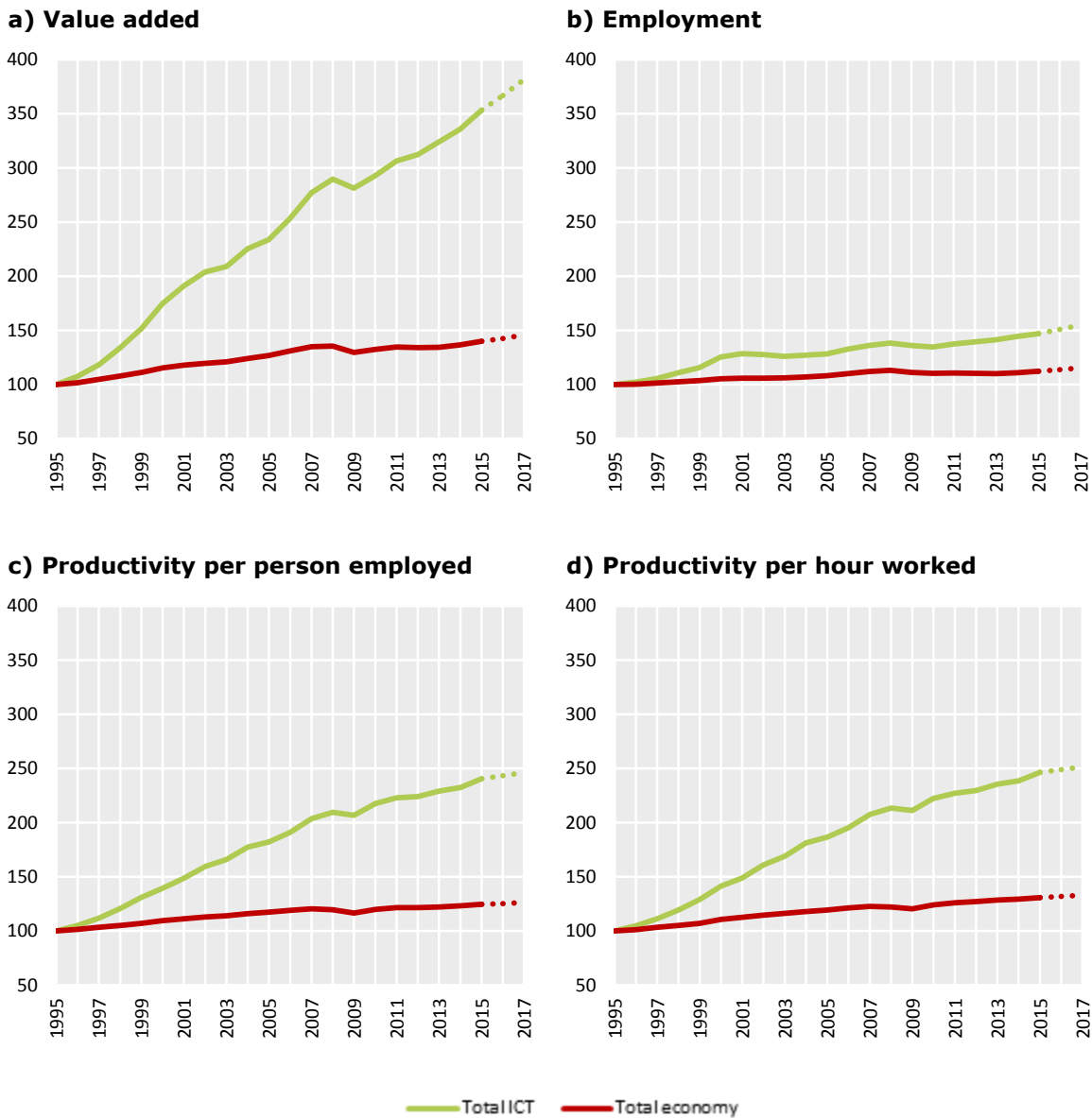
b) Annual growth rates (%) (2014-2015)

NACE Rev. 2	Description	VA	Employment	BERD	GBARD	ICT GBARD	RERD	PERD
261-264	ICT manufacturing industries	-2.7	-1.8	3.2	-0.6	-8.2	4.1	5.4
261	Manufacture of electronic components and boards	19.1	4.3	10.0	7.6	7.9	0.8	0.1
262	Manufacture of computers and peripheral equipment	-12.4	-2.9	8.5	-10.4	-13.7	-0.7	-2.1
263	Manufacture of communication equipment	-27.7	-12.2	-3.4	-3.5	-10.8	9.0	14.1
264	Manufacture of consumer electronics	15.1	0.3	10.8	-8.7	-9.5	-5.7	-5.5
582, 61, 62, 631, 951	ICT services industries	6.1	2.2	2.7	4.9	4.1	2.9	2.0
61	Telecommunications	10.6	3.4	-1.6	7.0	5.9	2.8	-8.8
582, 62, 631, 951	Computer and related activities	3.2	1.9	3.9	2.4	3.0	2.9	3.8
261-264, 582, 61, 62, 631, 951	ICT total	5.2	1.8	2.9	4.4	3.5	3.3	2.9
	Total economy	2.3	1.1	3.3	-0.6	0.0	6.6	4.9

Note: Monetary variables are expressed in real terms.

Source: 2018 PREDICT Dataset.

Figure 1: Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU (1995-2017, Index 1995=100)

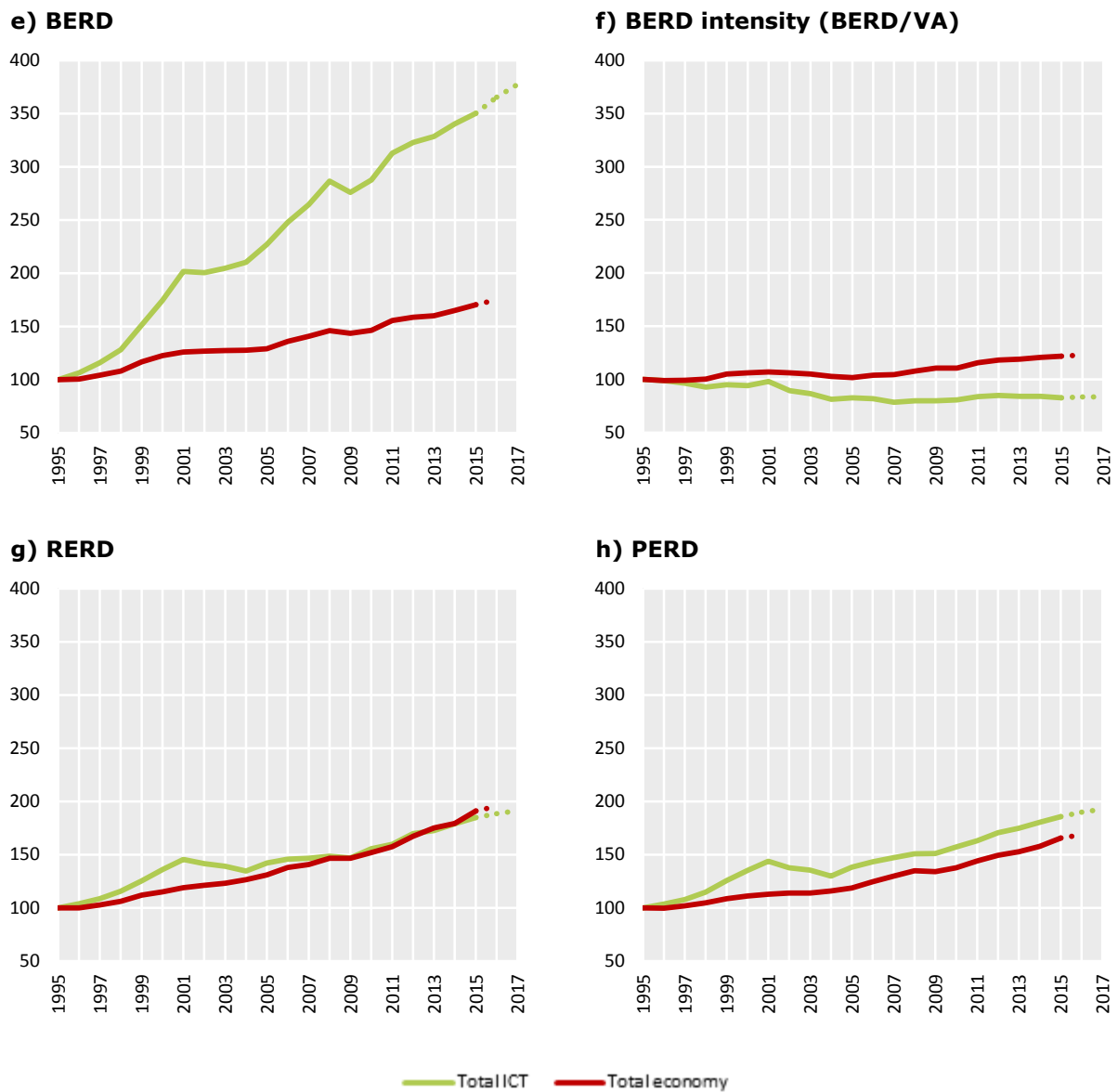


Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

The ICT sector in the EU (EU) 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). Between 1995 and 2015, both multiply by a factor of 3.5 in real terms. The differences in terms of labour are much less intense. Employment increased by only 1.5, the number of researchers by 1.8 and the R&D personnel by a factor of 1.9. As a consequence, labour productivity per hour worked in the ICT sector multiplied its level by 2.5 in 1995, 1.9 times higher than the growth for the aggregated economy (Figure 1). All the aforementioned variables were expected to increase according to the PREDICT estimates. The only exception to this general profile is BERD intensity (expressed as BERD/GDP in nominal terms) which presented a negative trend throughout the period in the ICT sector (Figure 1 cont.), while it increased slightly in the total economy.

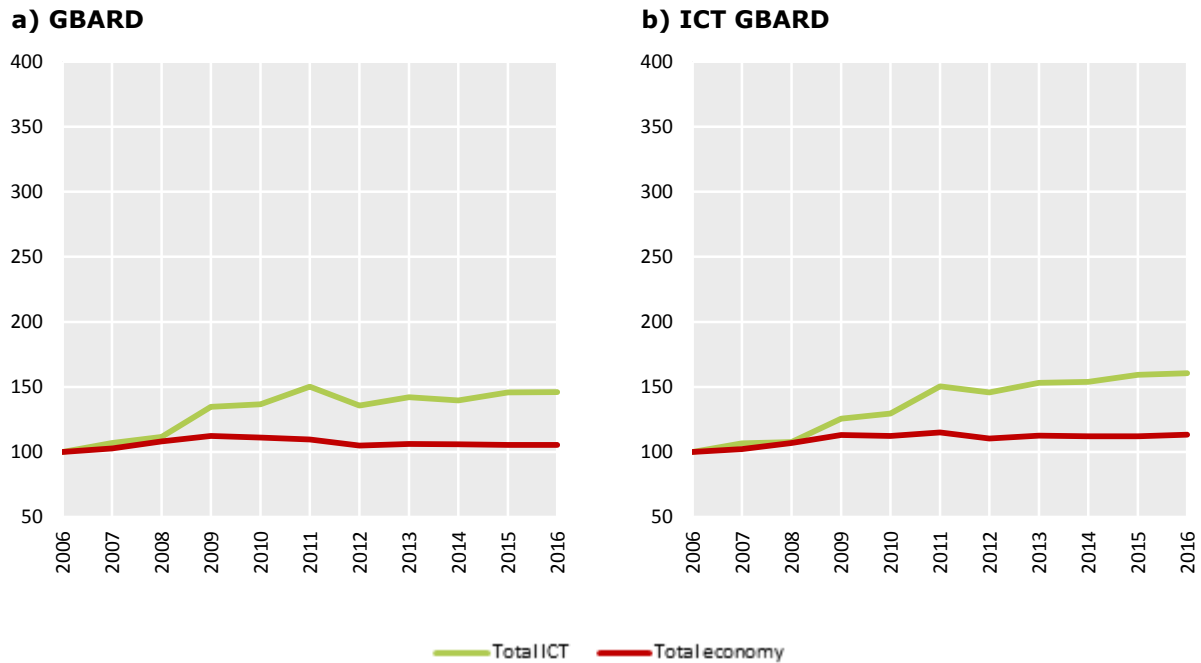
Figure 1 (cont.): Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU (1995-2017, Index 1995=100)



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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure 2: Total economy and ICT sector: GBARD and ICT GBARD in the EU (2006-2016, Index 2006=100)

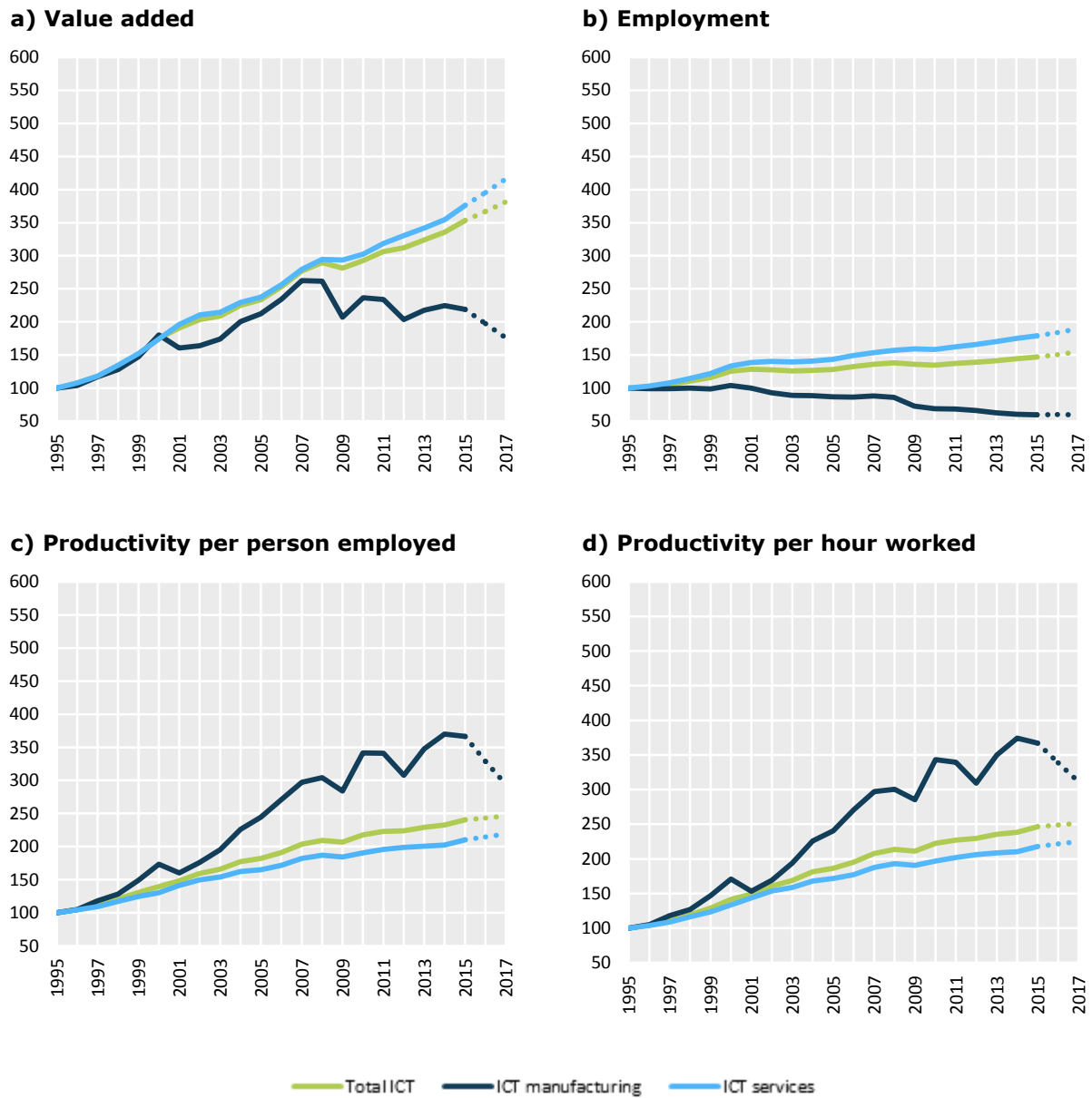


Note: GBARD and ICT GBARD are expressed in real terms. ICT GBARD is the part of GBARD (Government budget allocations for R&D) devoted to fund ICT assets in all industries of the economy. ICT GBARD is allocated to all sectors in the economy, not only the ICT sector (see Box 1 in the introduction).

Source: 2018 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 (Figure 2 panel a) as well as to ICT GBARD (Figure 2 panel b) which considers ICT related expenditures (see Box 1 in the introduction). In the first case, it multiplied its level between 2006 and 2016 by a factor of 1.5, while for total economy it did so by only 1.1. In the case of ICT GBARD, the corresponding values are 1.6 and 1.1.

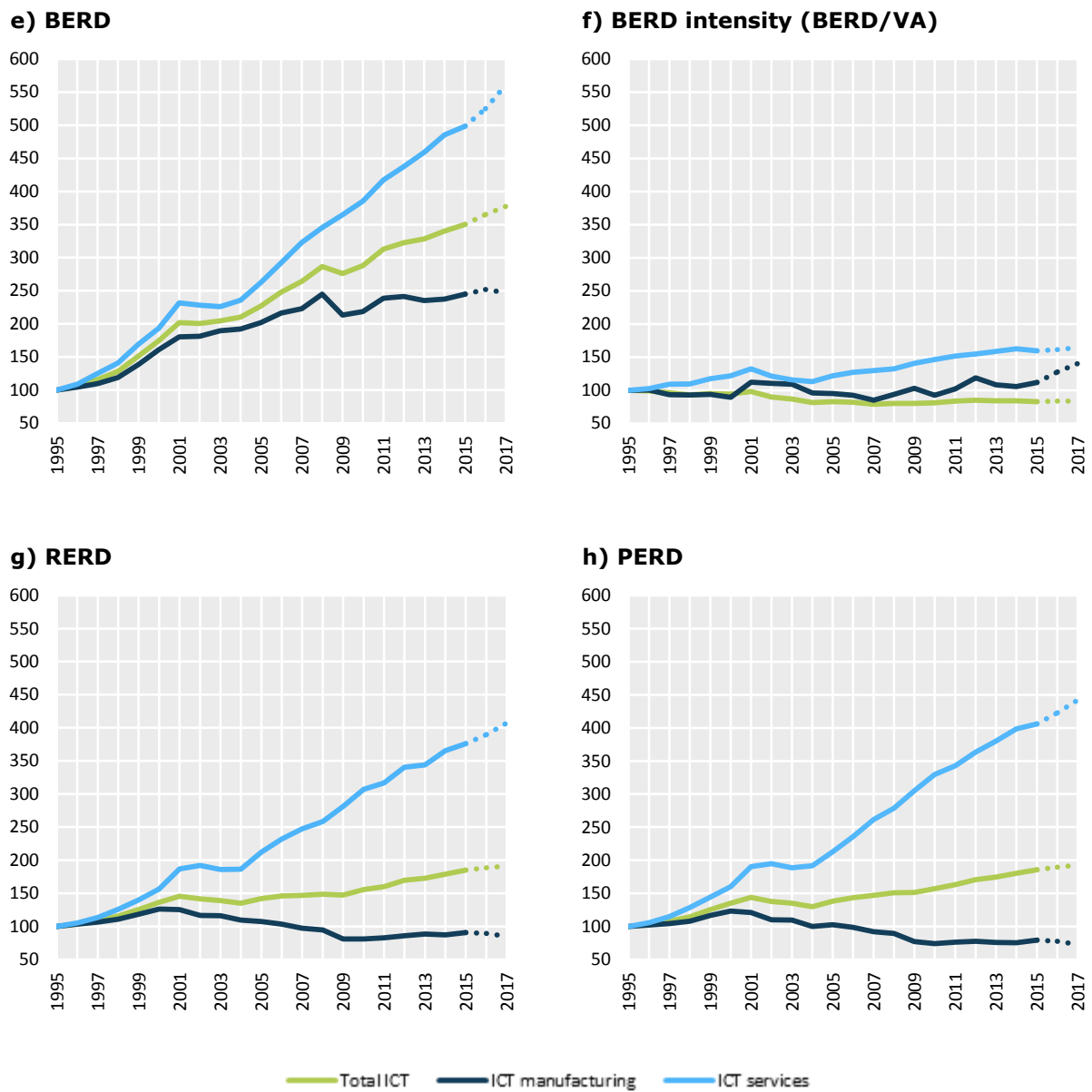
Figure 3: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU (1995-2017, Index 1995=100)



Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.
Source: 2018 PREDICT Dataset.

The more dynamic behaviour shown by the ICT sector has its origin in the ICT services sector (Figure 3). From 1995 to the aftermath of the crisis, value added in ICT manufacturing and ICT services sectors grew at 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. The pattern is similar, but more pronounced for R&D researchers and personnel(Figure3 cont.).

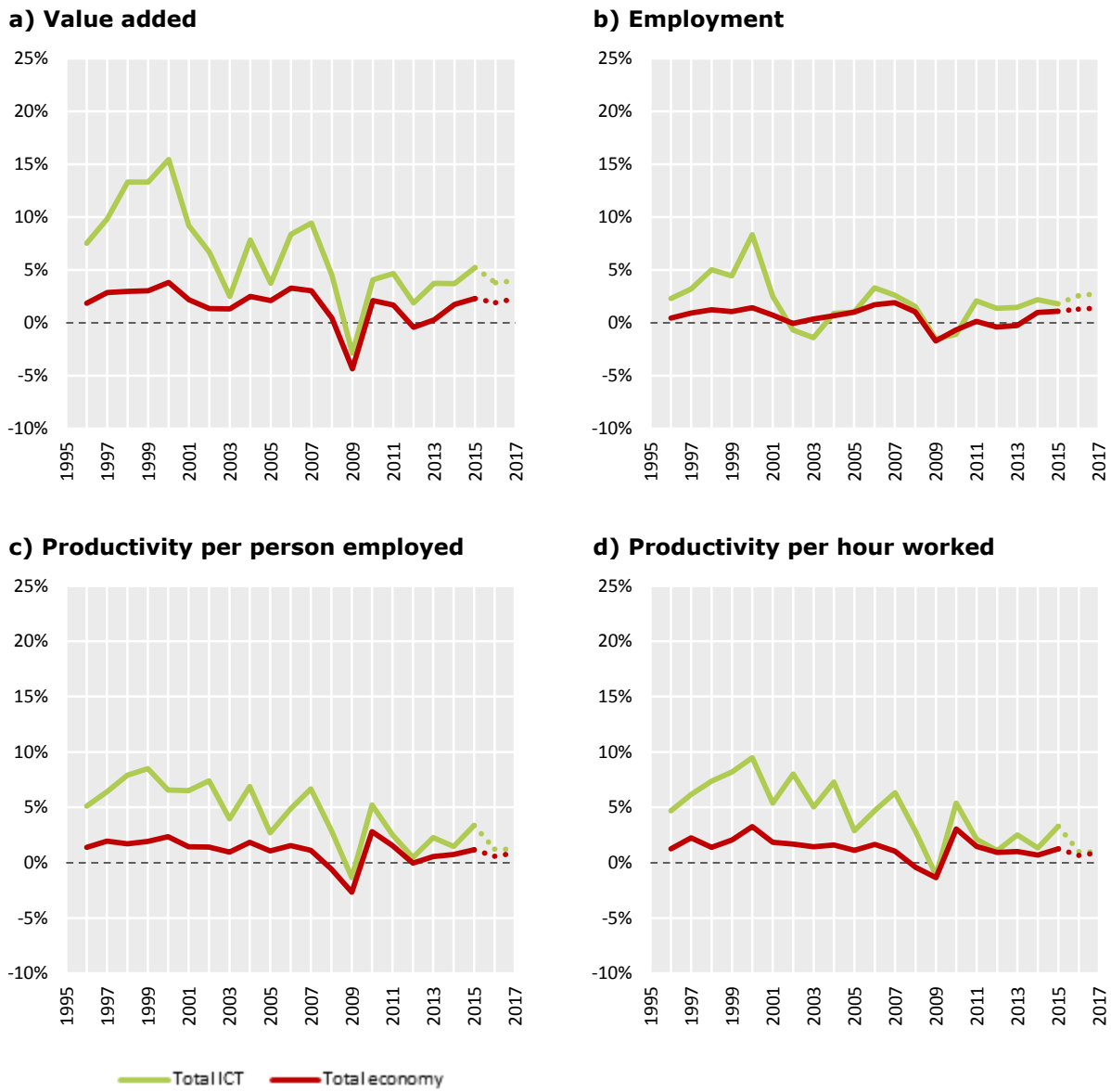
Figure 3 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU (1995-2017, Index 1995=100)



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

Source: 2018 PREDICT Dataset.

Figure 4: Total economy and ICT sector: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU. Annual growth rates (1995-2017)



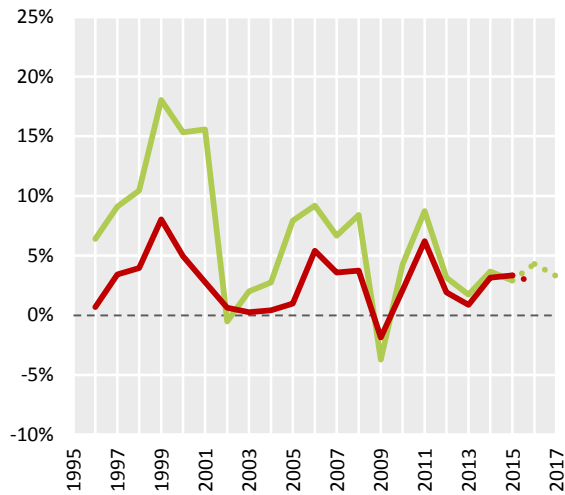
Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

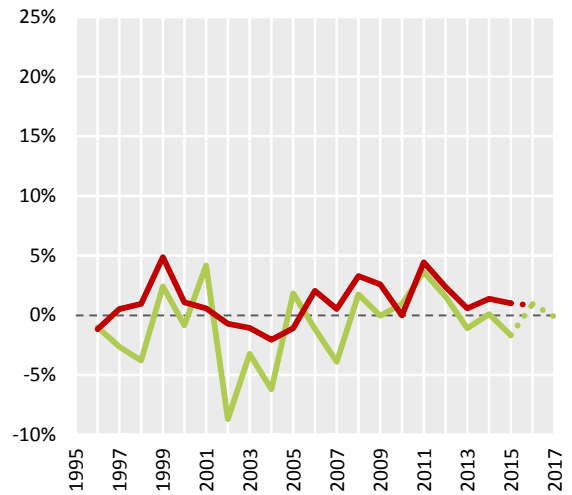
In terms of annual rates of change, all variables grew at a faster rate in the ICT sector than in the total economy, especially between 1995 and 2008 (Figure 4). The only exceptions were R&D researchers and R&D personnel, which presented lower rates during the first years of the century. Since the crisis started, the dynamics of the ICT sector has been similar to the total economy. In 2015 ICT sector VA, labour productivity, R&D researchers (RERD), and R&D personnel (PERD) showed an accelerated growth. However, ICT sector employment and BERD slowed down (Figure4 cont.). The ICT sector estimated figures for 2016-2017 show a deceleration for all variables except employment.

Figure 4 (cont.): Total economy and ICT sector : VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU. Annual growth rates (1995-2017)

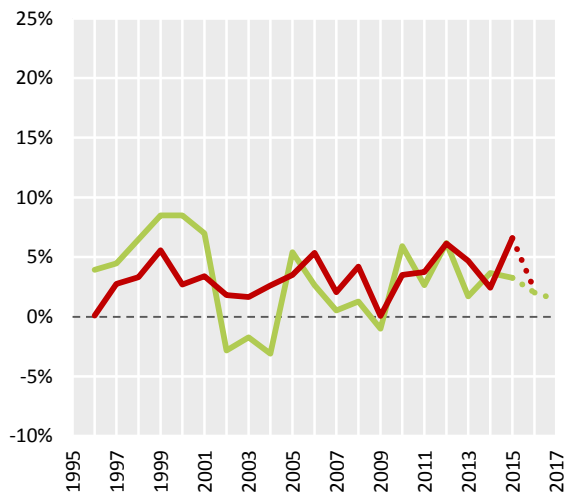
e) BERD



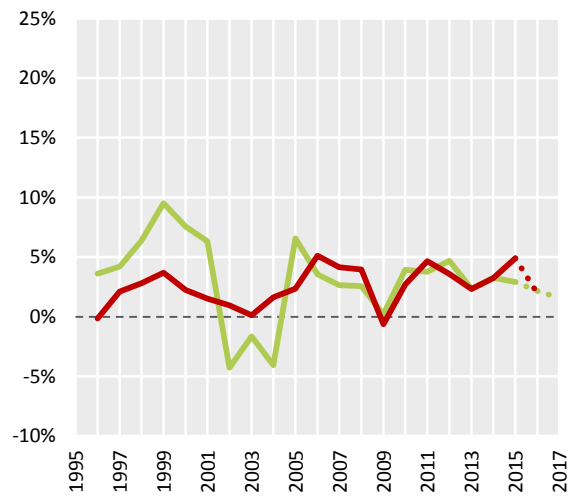
f) BERD intensity (BERD/VA)



g) RERD



h) PERD

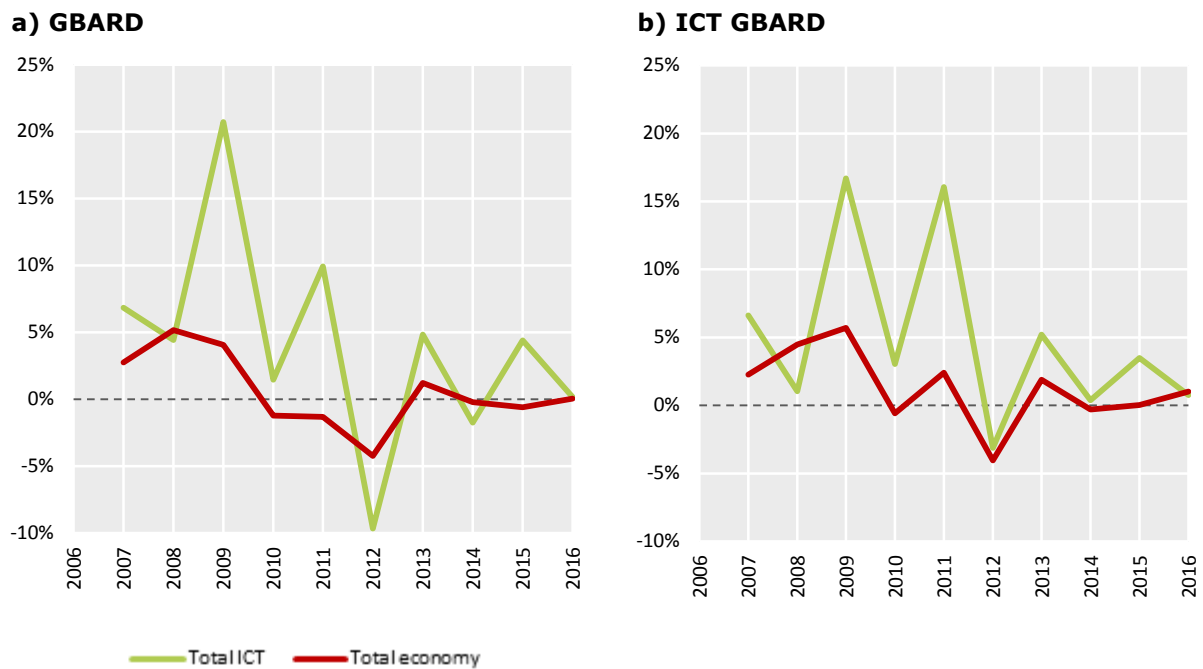


— Total ICT — Total economy

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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

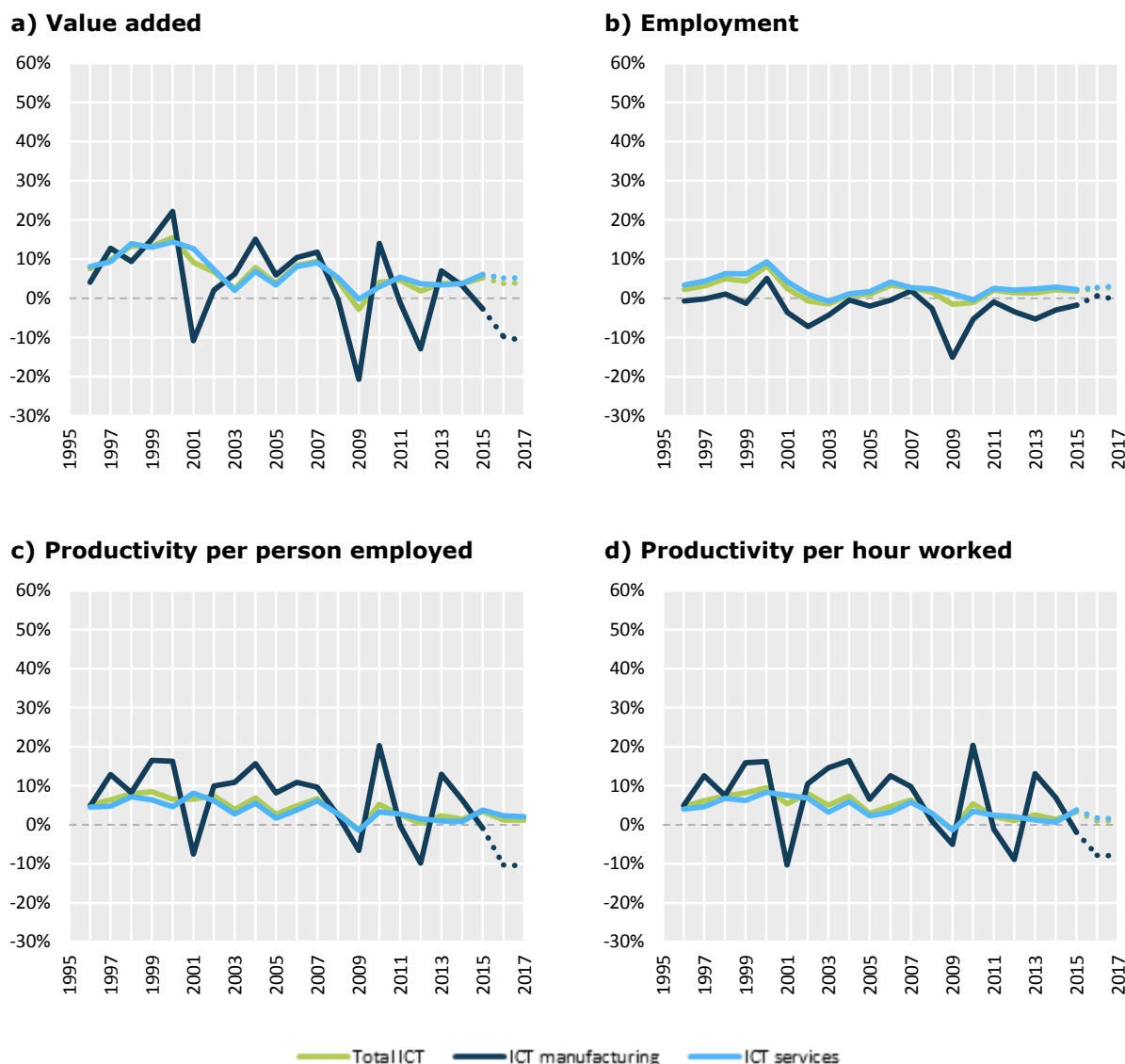
Figure 5: Total economy and ICT sector: GBARD and ICT GBARD in the EU. Annual real growth rates (2006-2016)



Source: 2018 PREDICT Dataset.

The real growth rate of GBARD in the ICT sector (Figure 5, panel a) has been higher (albeit more volatile) than for the total economy throughout the period, with the only exceptions being 2012 and 2014. A similar result can be observed for ICT GBARD (Figure 5, panel b). In 2016 GBARD and ICT GBARD for the ICT sector showed a downturn, while it slightly increased for the total economy.

Figure 6: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU. Annual growth rates (1995-2017)



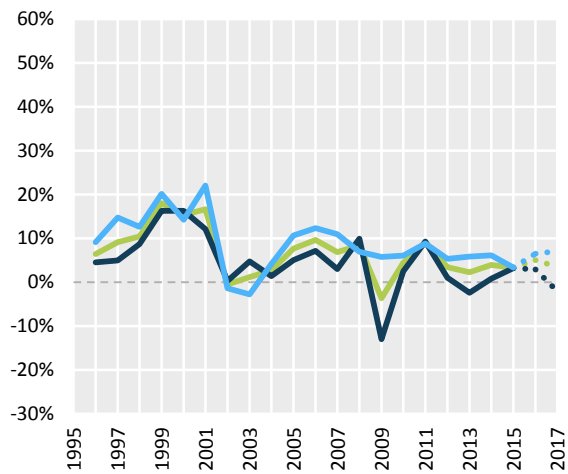
Note: Monetary variables are expressed in real terms. Dashed lines indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

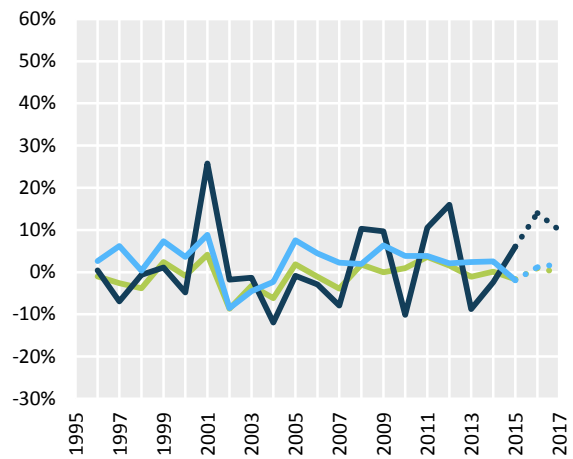
The cyclical profile (as measured by the annual growth rates) for total ICT producing sectors follows that of ICT services sectors due to their higher weight in the aggregate. The latter shows a much more stable rate than the ICT manufactures producing sector. This result holds for VA, employment, labour 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. In 2015 opposite trends can be observed depending on the variable. VA and productivity growth were positive for ICT services and negative for ICT manufactures (Figure 6). The contrary was the case for employment, BERD, BERD intensity, R&D researchers and R&D personnel (Figure 6, cont.). For 2016 and 2017, the provisional values point to a downturn for almost all ICT manufacturing (the exception being employment) and positive for ICT services.

Figure 6 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD and PERD in the EU. Annual growth rates (1995-2017)

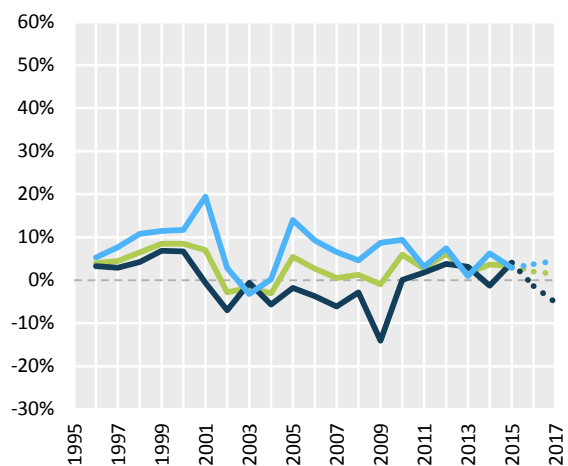
e) BERD



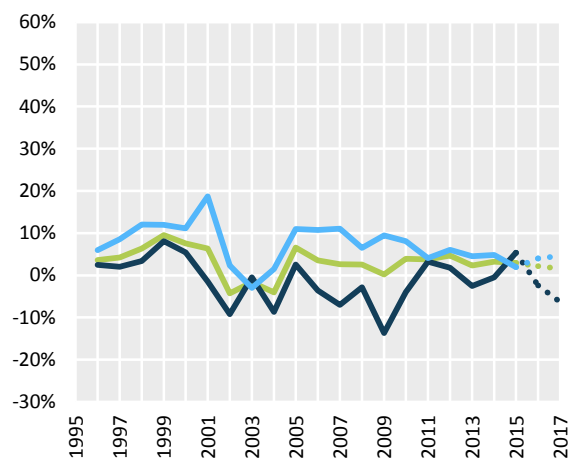
f) BERD intensity (BERD/VA)



g) RERD



h) PERD

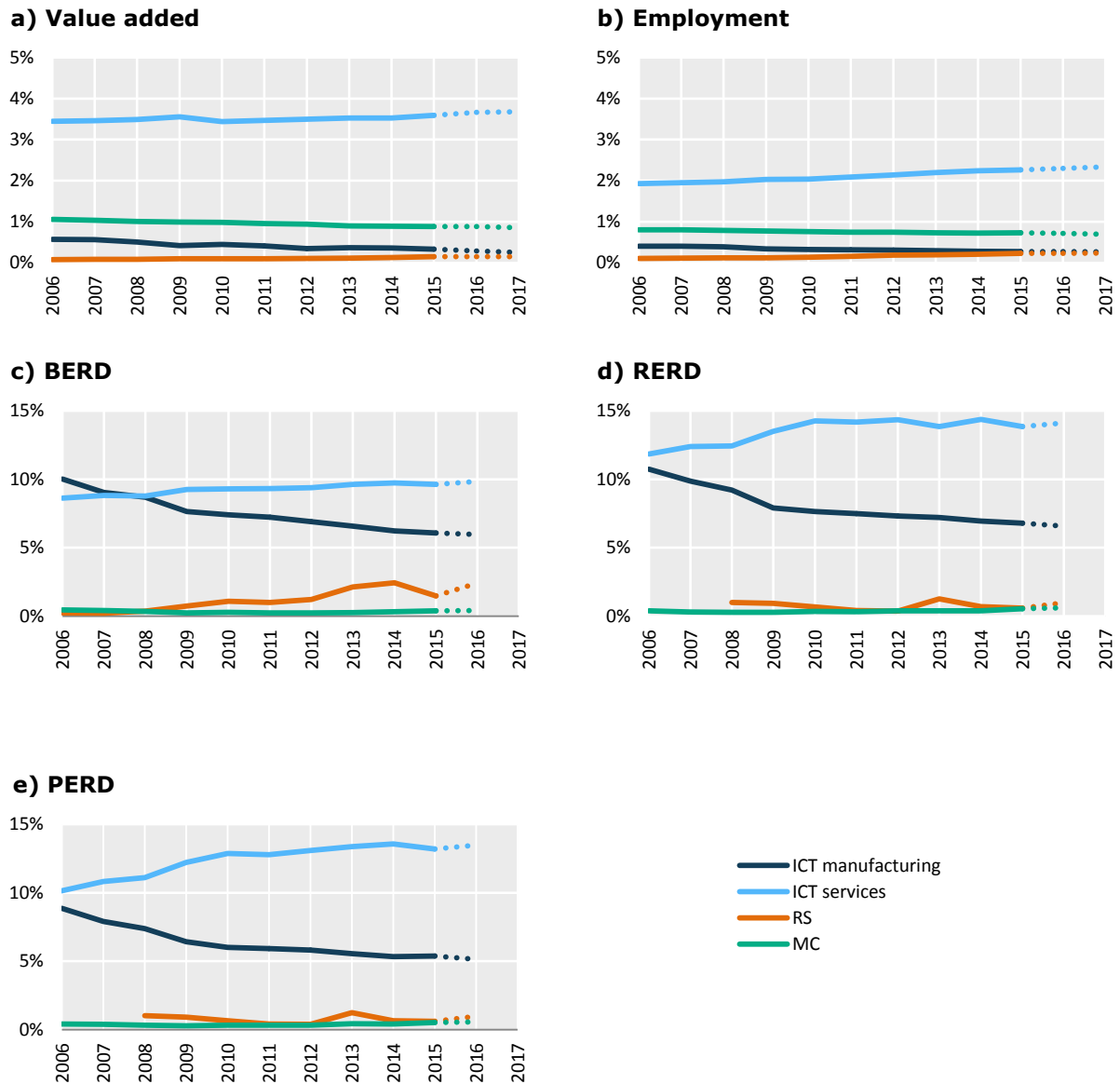


— Total ICT — ICT manufacturing — ICT services

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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure 7: ICT manufacturing, ICT services, MC and RS sectors share of the total economy in the EU (percentages, 2006-2017)

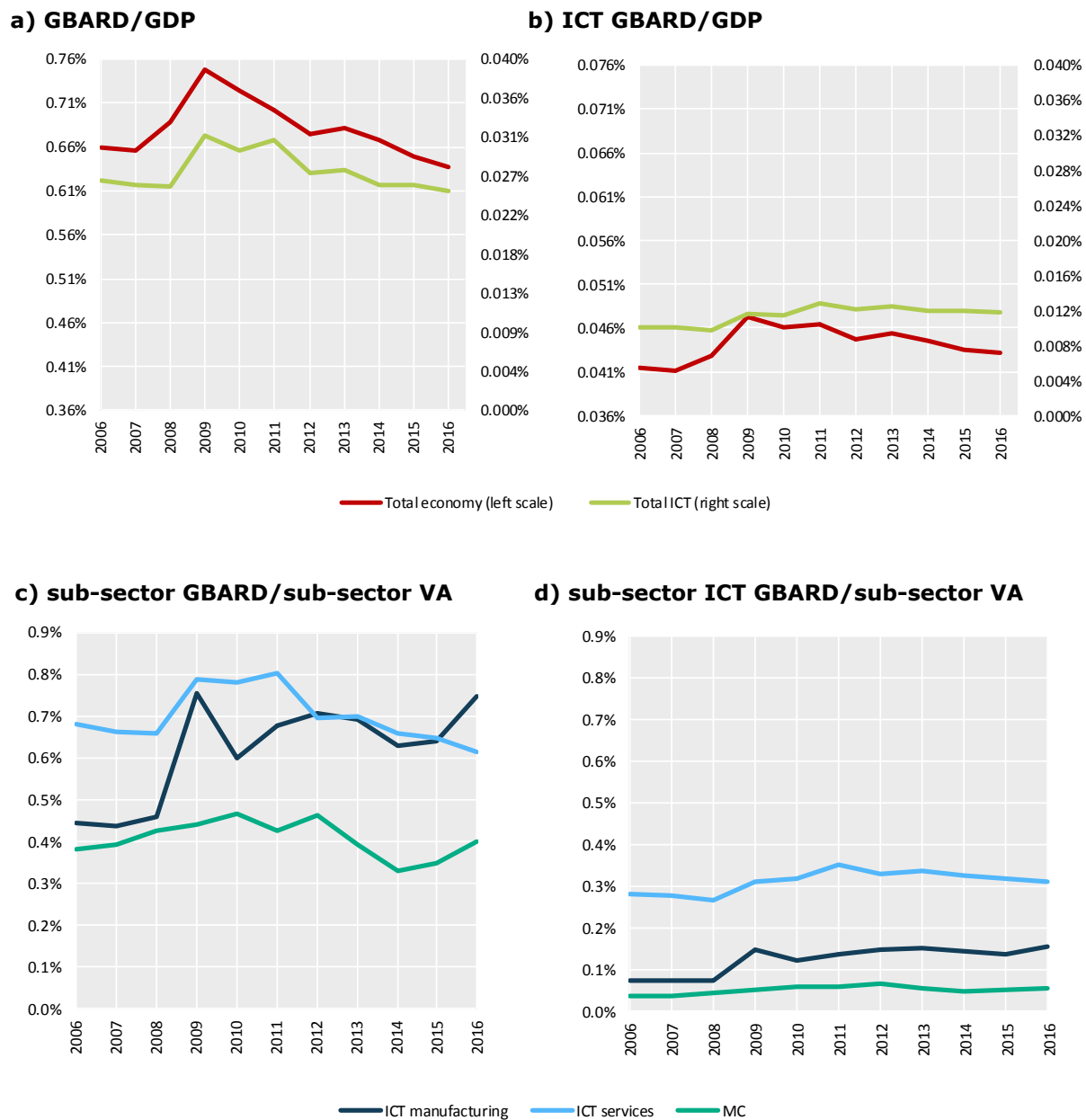


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

In 2015 the VA generated by the ICT service sector represents 3.6% of GDP, and by ICT manufactures 0.3%. The first one presented a slightly positive trend while the second showed a declining one (Figure 7). The ICT producing sectors altogether amounted to 3.9% of GDP. The weight of the media content sector in GDP doubles 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 EU but shows a positive trend in the most recent years. In terms of employment, the weight of all ICT-related sectors is lower (2.5%). 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 notice the relatively higher weight of the retail share in BERD, much higher than in the rest of variables.

Figure 8: Total economy, ICT sector, ICT manufacturing, ICT services and MC sector. GBARD and ICT GBARD intensities in the EU (percentages, 2006-2016)

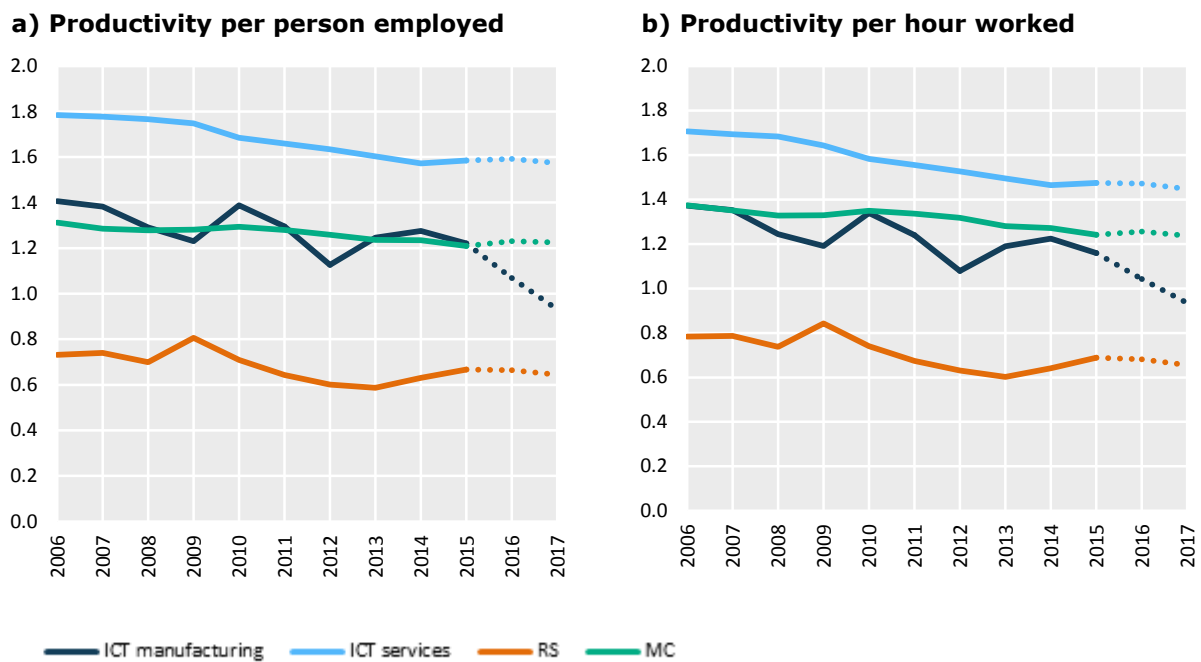


Note: MC: Media and Content. GDP nowcasted for 2016

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Total GBARD represented 0.64% of GDP in 2016 and 0.025% in the ICT sector. The first one has suffered a severe downturn since 2009, falling from a high 0.75%. This downturn is not observed (at least not as strongly) for the ICT sector (Figure 8). Similar profiles apply to ICT GBARD. In 2016 GBARD in the ICT manufacturing sector amounted to 0.75% 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 EU (2006-2017)



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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Labour productivity is higher in the ICT service sector, and similar in ICT manufacturing and media content. In all three cases, it is higher than in total economy, while it is lower in the RS sector. This result applies to both productivity in terms of persons and in terms of hours worked (Figure 9). It is interesting to notice that only the retail sector showed an increase in productivity from 2013 to 2015. The remaining three have followed a declining path since 2006. Only the ICT service sector showed a slight recovery in 2015. For 2016 and 2017, the tendency for ICT manufactures is to fall while for ICT services, MC and RS sectors there is stagnation.

Figure 10: ICT sector, MC and RS sector share of total economy by sub-sector in the EU (percentages, 1995, 2008, 2015)

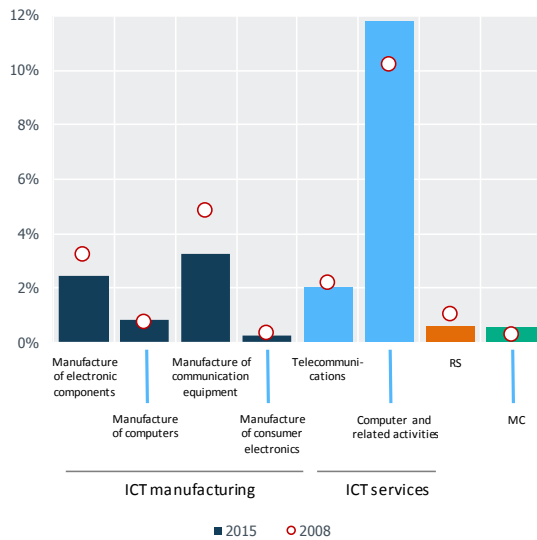


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet
 Source: 2018 PREDICT Dataset.

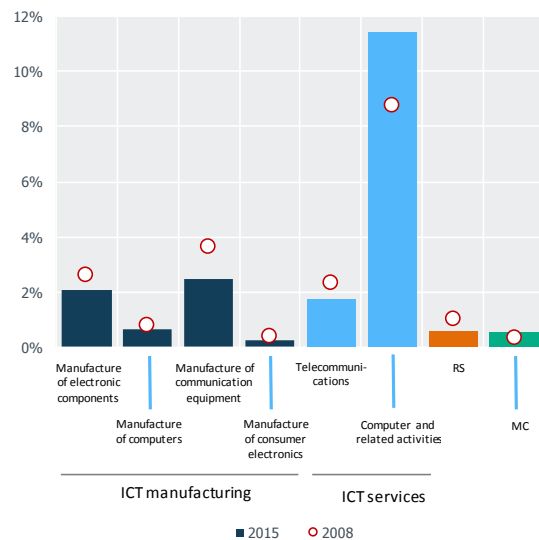
Computer and related activities is the ICT service sector with the highest weight over total economy in terms of all PREDICT variables, VA (2.3%), employment (1.8%), Public funding (GBARD) (1.9%) and BERD (8.0%) (Figure 10), but especially in ICT GBARD (18.9%), R&D researchers (11.8%) and R&D personnel (11.4%). The percentages in brackets refer to 2015 (2016 for GBARD and ICT GBARD), showing a continuous increase over time (Figure 10, cont). Depending on the variable, the second in importance is *Telecommunications* for VA, employment, public funding (GBARD), and ICT GBARD. *Manufacture of communications equipment* stands out in the second place according to R&D researchers, R&D personnel and also BERD. However, shares in the three variables have fallen in recent years. The *Media and content* sector had important shares in terms of value added and employment (0.89% and 0.73% respectively) in 2015, but they were lower than 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 EU (percentages, 1995, 2008, 2015)

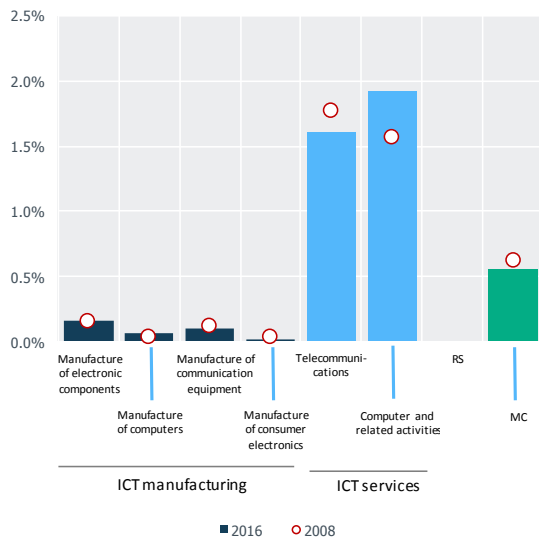
d) RERD



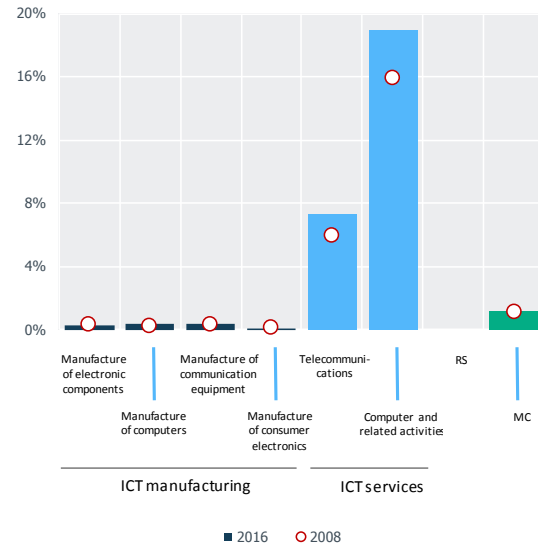
e) PERD



f) GBARD



g) ICT GBARD



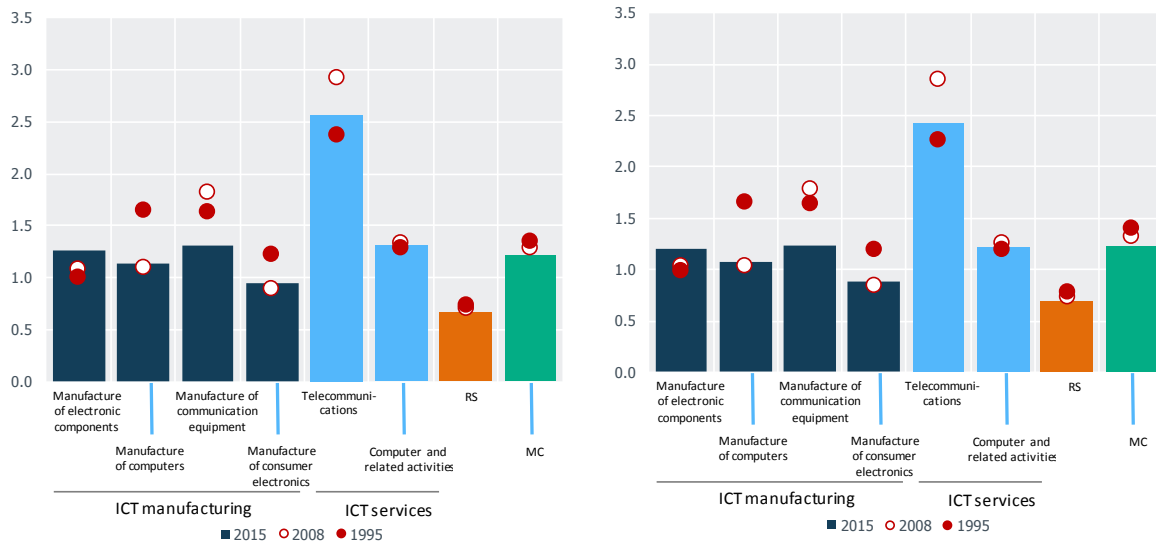
Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. 2016 for GBARD and ICT GBARD. RS sector is not available.

Source: 2018 PREDICT Dataset.

Figure 11: ICT sub-sectors, MC and RS sector productivity as a ratio over productivity in total economy in the EU (1995, 2008, 2015)

a) Productivity per person employed

b) Productivity per hour worked

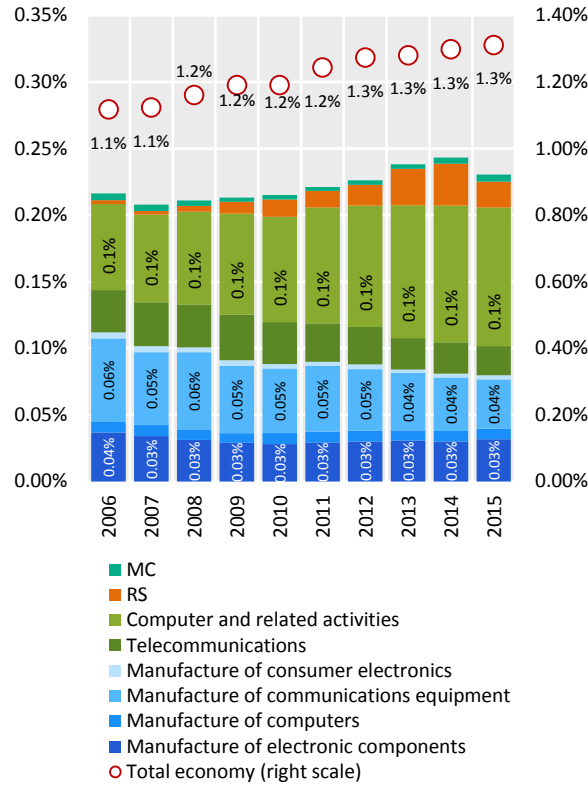


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet
 Source: 2018 PREDICT Dataset.

All sub-sectors belonging to the ICT sector except *Manufacture of consumer electronic* and RS have a higher labour productivity than total economy, both in terms of persons and hours worked. *Telecommunications* has the highest ratio, followed by *Computer and related activities*, *Manufacture of communication equipment* and *Media and content* (Figure 11). However, only the sectors of *Manufacturing of electronic components* and *Telecommunications* have increased the gap since 1995, although the second one fell with respect to 2008. For the rest it has narrowed.

Figure 12: Total economy, ICT manufacturing, ICT services, RS and MC sectors BERD intensity in the EU (percentages, 2006-2015)

a) BERD/GDP

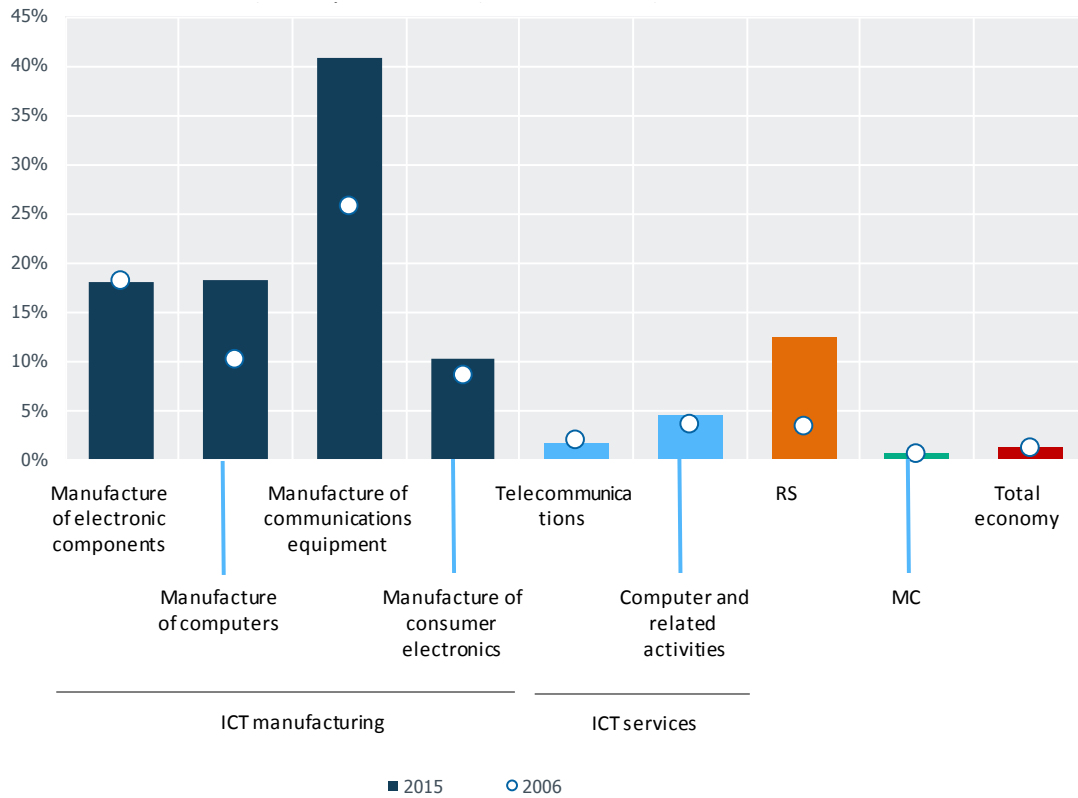


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet
 Source: 2018 PREDICT Dataset.

In 2015 the share of BERD over GDP amounted to 1.3% for the total economy and 0.21% in ICT, 0.01% in MC and 0.02% in RS sectors. Of those shares, the highest ones corresponded to *Computer and related activities* (0.10%)(Figure 12). BERD intensity for each sub-sector (sub-sector BERD/sub-sector VA) is higher in *Manufacture of communications equipment* (40.8%), followed by *Manufacture of computers* (18.2%) and *Manufacture of electronic components* (18.1%) (Figure12, cont). For almost all sub-sectors, BERD intensity was higher in 2015 than in 2006. The exceptions were *Manufacture of electronic components* and *Telecommunications*.

Figure 12 (cont.): Total economy, ICT manufacturing, ICT services, RS and MC sectors BERD intensity in the EU (percentages, 2006-2015)

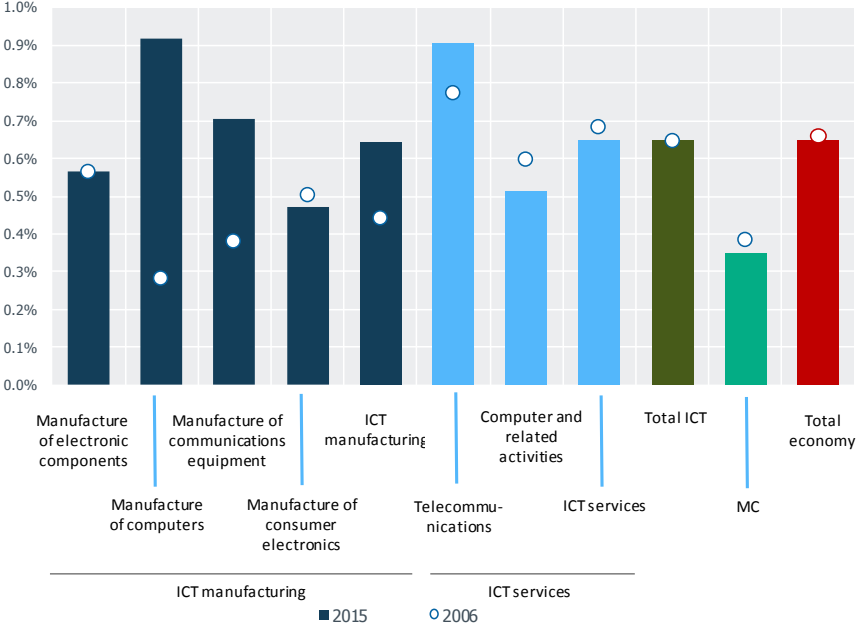
b) Sub-sector BERD/sub-sector VA (2006, 2015)



Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet
 Source: 2018 PREDICT Dataset.

Figure 13: ICT manufacturing and ICT services, GBARD and ICT GBARD in the EU (percentages, 2006, 2015)

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

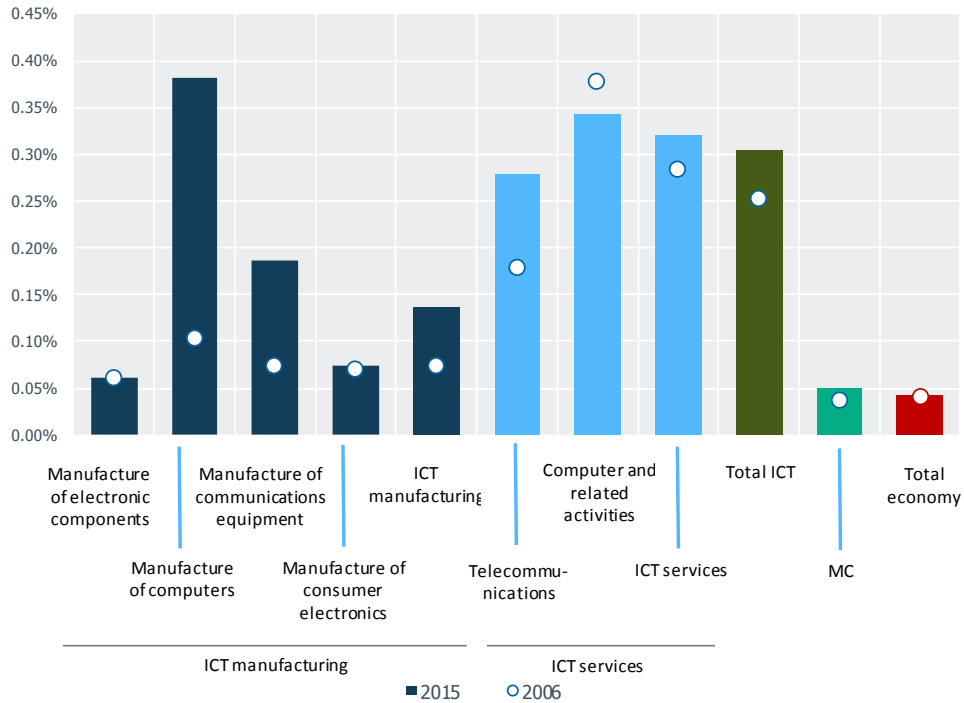


Note: MC: Media and Content.
Source: 2018 PREDICT Dataset.

In 2015 GBARD intensity (defined as sub-sector GBARD/sub-sector VA in Figure 13) was of a similar magnitude for ICT manufacturing and ICT services. However, while in the first it had increased since 2006, in the second it had decreased. For the MC sector, this ratio is about half and has also decreased. *Manufacture of computers* and *Telecommunications* are the sub-sectors with the highest ratio. ICT GBARD intensity is higher in ICT services, more than doubling ICT manufacturing and about seven times higher than that of the MC sector or total economy (Figure 13, cont. panel b). 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 47.6% in 2016 (Figure 13, cont. panel c), a percentage seven times higher than for the total economy. *Computer and related activities* was, again, the sub-sector with the highest ratio.

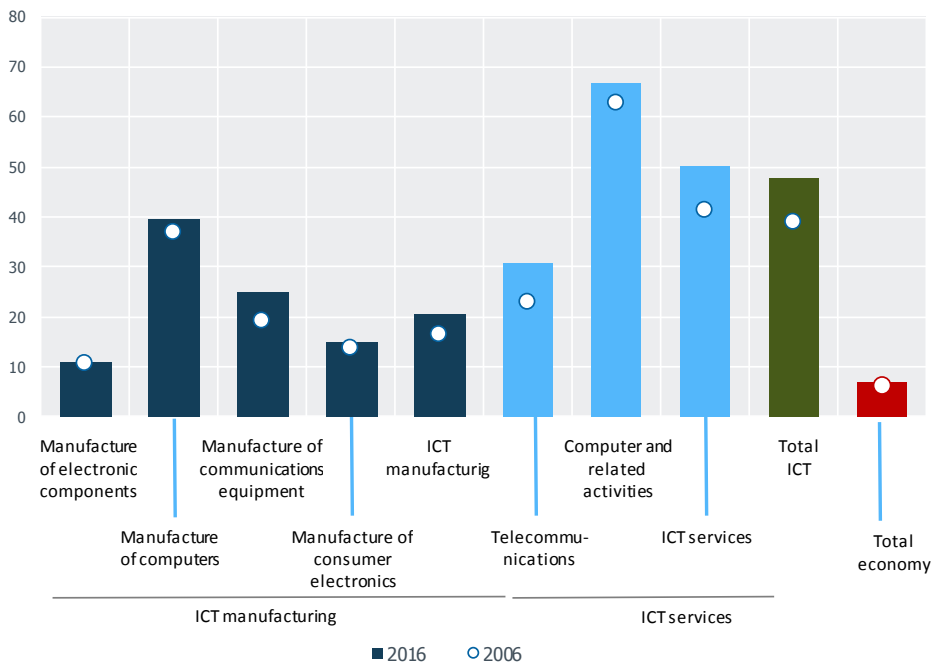
Figure 13 (cont.): ICT manufacturing and ICT services, GBARD and ICT GBARD in the EU (percentages, 2006, 2015)

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



Note: MC: Media and Content.

c) Sub-sector ICT GBARD /sub-sector GBARD (2006, 2016)



Source: 2018 PREDICT Dataset.

2 The ICT sector in the EU Member states

Table 2: Summary table of total ICT sector by European country. European Union

a) 2015

	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)	(1000 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)	(1000 Full Time Equivalent)	(1000 Full Time Equivalent)
Austria	9,794.5	98.0	937.3	79.9	2,572.3	35.5	216.5	5.1	8.2
Belgium	12,207.2	95.2	868.9	202.5	2,374.3	100.2	227.2	5.7	7.8
Bulgaria	4,007.9	76.2	89.2	10.8	234.4	7.6	17.1	1.0	1.6
Croatia	2,492.5	32.4	52.3	1.8	575.2	1.3	47.4	0.2	0.8
Cyprus	785.5	7.6	11.4	0.1	67.5	0.0	17.7	0.1	0.1
Czech Republic	12,489.1	144.9	497.4	73.8	1,623.4	45.7	145.9	4.8	7.9
Denmark	6,693.7	74.1	468.4	36.0	2,093.0	20.3	116.9	3.9	5.8
Estonia	1,317.5	25.6	79.2	6.4	197.2	3.8	11.5	0.4	0.6
Finland	8,082.0	91.4	1,345.8	100.1	1,652.3	54.1	191.5	9.0	12.1
France	82,815.1	725.2	6,177.4	628.0	13,230.3	196.4	645.2	43.4	51.7
Germany	110,442.0	1,025.1	6,510.1	781.4	25,609.3	321.6	1,482.5	32.7	53.9
Greece	6,040.6	50.2	104.0	26.0	1,118.7	7.4	77.5	1.1	1.8
Hungary	9,603.5	157.2	173.1	21.9	549.5	9.7	57.6	2.2	2.8
Ireland	18,223.8	72.6	797.0	59.2	683.1	21.1	106.9	4.0	7.2
Italy	52,390.8	565.4	2,113.2	604.9	8,594.1	233.3	567.1	9.7	23.6
Latvia	1,492.0	23.3	11.0	3.3	70.3	1.8	7.2	0.1	0.2
Lithuania	1,802.2	23.7	24.0	4.5	205.0	2.3	8.7	0.4	0.6
Luxembourg	2,409.0	14.4	15.7	22.5	268.6	8.7	26.9	0.1	0.2
Malta	678.5	8.0	22.5	0.7	30.3	0.4	0.5	0.3	0.5
Netherlands	25,004.0	224.0	1,085.5	140.3	4,520.7	71.5	380.8	9.7	16.3
Poland	25,063.8	370.6	813.8	252.5	3,106.4	133.0	207.9	9.5	12.4
Portugal	6,379.6	78.6	265.7	68.3	2,245.4	28.2	104.0	3.0	4.4
Romania	16,417.9	198.1	96.1	50.4	842.4	21.4	52.8	0.7	1.5
Slovakia	4,836.0	62.4	65.2	21.2	509.0	13.1	21.1	0.5	0.8
Slovenia	1,726.1	25.0	94.7	5.0	204.1	2.2	13.1	0.6	1.5
Spain	39,879.0	398.4	986.6	330.9	6,758.8	145.7	517.9	7.5	15.7
Sweden	20,627.5	164.1	1,793.4	46.6	2,772.5	24.4	357.9	8.9	9.9
United Kingdom	84,981.6	1,057.7	3,251.4	274.6	10,972.5	138.0	705.9	22.6	42.1
European Union	581,361.5	5,831.9	30,453.2	3,772.9	96,082.8	1,769.8	6,444.3	187.0	292.0

Source: 2018 PREDICT Dataset.

Table 2 (cont.): Summary table of total ICT sector by European country. European Union

b) Annual growth rates (%), 2014-2015

	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	1.2	0.2	4.3	-10.2	1.3	-10.6	-0.4	10.3	11.0
Belgium	5.3	0.7	3.1	-23.6	-8.0	-18.3	-11.5	10.5	4.8
Bulgaria	-2.4	8.3	72.6	20.0	0.6	54.5	18.8	66.0	61.6
Croatia	4.2	3.3	-8.6	-47.1	16.1	-51.1	13.2	11.4	9.0
Cyprus	3.1	7.9	24.2	24.2	-2.4	28.9	7.3	-1.4	1.0
Czech Republic	7.7	3.0	3.4	-10.9	0.8	-5.7	-2.4	8.5	3.8
Denmark	13.4	2.0	13.0	-12.0	2.2	-15.6	-2.5	16.3	10.0
Estonia	3.1	15.6	38.5	-14.9	-2.2	-24.7	-14.3	5.2	8.4
Finland	-5.0	0.6	-22.3	-11.8	-2.0	-10.8	0.1	6.0	7.9
France	3.1	0.9	8.7	23.6	-5.4	23.8	2.8	2.8	1.8
Germany	4.1	1.8	0.4	6.4	1.9	8.1	3.0	8.8	6.2
Greece	-3.1	-12.9	-3.3	-8.2	19.3	-6.0	16.1	-11.2	-8.1
Hungary	7.9	-1.7	-56.7	18.0	3.8	61.7	33.2	-63.4	-60.7
Ireland	13.4	4.0	5.1	-10.1	1.1	-10.6	-7.9	-17.8	-3.4
Italy	1.5	1.5	7.3	2.5	-1.8	2.9	-0.9	13.0	3.3
Latvia	12.6	-3.1	17.4	-7.0	22.0	-8.2	8.9	0.0	-4.2
Lithuania	6.8	16.8	-35.0	2.6	-3.4	9.9	3.7	8.4	-13.8
Luxembourg	19.4	3.6	85.7	40.4	-1.4	61.9	10.7	44.6	14.3
Malta	6.5	6.3	6.3	-	23.7	-	-	13.5	-5.8
Netherlands	4.6	3.3	-4.3	-8.2	-0.7	-4.5	-0.7	3.9	2.7
Poland	12.0	4.2	27.4	60.4	-1.5	107.7	72.1	39.7	23.1
Portugal	1.2	8.5	-5.1	4.4	5.8	-1.5	14.4	7.1	3.6
Romania	5.6	14.5	60.7	93.6	26.0	57.2	32.4	-24.4	12.4
Slovakia	-1.3	1.8	25.8	39.8	14.5	46.3	37.2	10.8	19.3
Slovenia	6.7	4.7	0.5	-14.1	-1.9	-11.2	-4.8	-6.4	3.1
Spain	3.9	7.9	-5.0	8.9	4.0	2.6	-0.1	-5.9	-4.6
Sweden	5.0	-1.5	12.9	10.7	-1.2	16.6	-1.3	16.5	10.3
United Kingdom	6.5	3.3	0.4	6.7	-1.7	5.0	-2.0	-4.0	3.4
European Union	5.2	1.8	2.9	4.4	-0.6	3.5	0.0	3.3	2.9

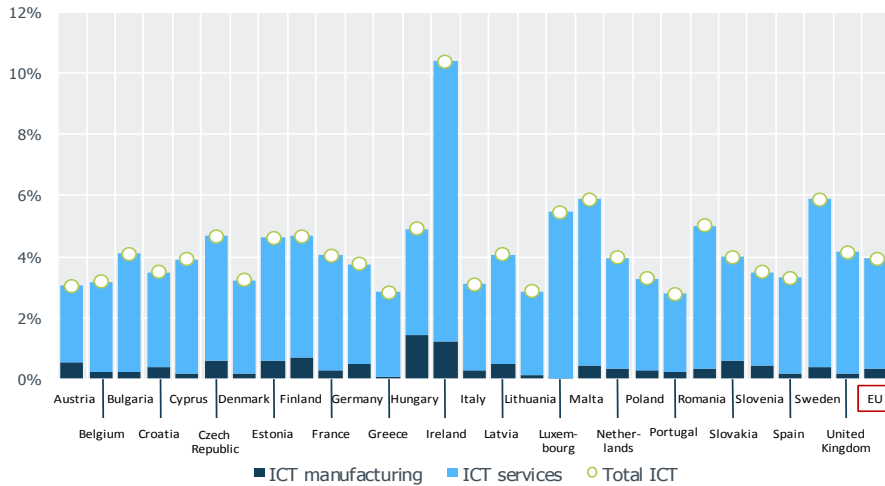
Note: Monetary variables are expressed in real terms. 2013-2014 for Ireland ICT sector VA. ICT sector and total economy GBARD and ICT GBARD for Malta is available but has been excluded due to quality concerns.

Source: 2018 PREDICT Dataset.

In 2015 the largest ICT sectors in the EU in relative size (ICT sector VA / GDP) were Ireland, Malta, Luxembourg, Sweden and Romania, all above 5.0%. In terms of employment, the largest EU ICT sectors in relative size were Estonia, Malta, Ireland and Finland, with a share over total employment higher than 3.7%. On the other hand, Finland was the country with the highest ICT sector BERD intensity in 2015 (16.7% of total value added), followed by Austria, Sweden, France Belgium and Denmark. The most dynamic countries in Europe in 2015 were Luxemburg, Ireland and Denmark in VA, Romania, Estonia and Lithuania in employment, and Romania, Bulgaria and Luxembourg in BERD. The countries with the highest ICT GBARD in relation to GDP were Finland and Sweden, where it represented more than 0.1%. ICT GBARD increased at a higher rate in Greece, Latvia, Malta and Romania in 2015.

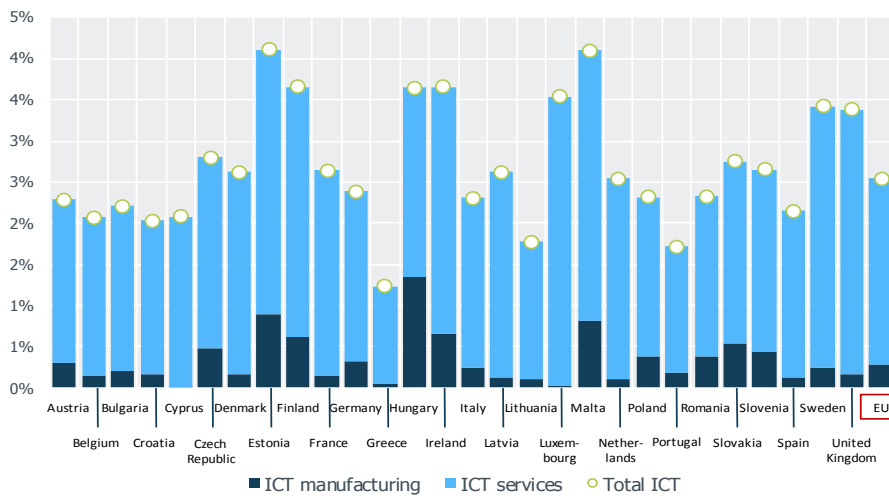
Figure 14: ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU Member state (2015)

a) ICT sector VA share of GDP



Note: 2014 for Ireland.

b) ICT sector employment share of total employment

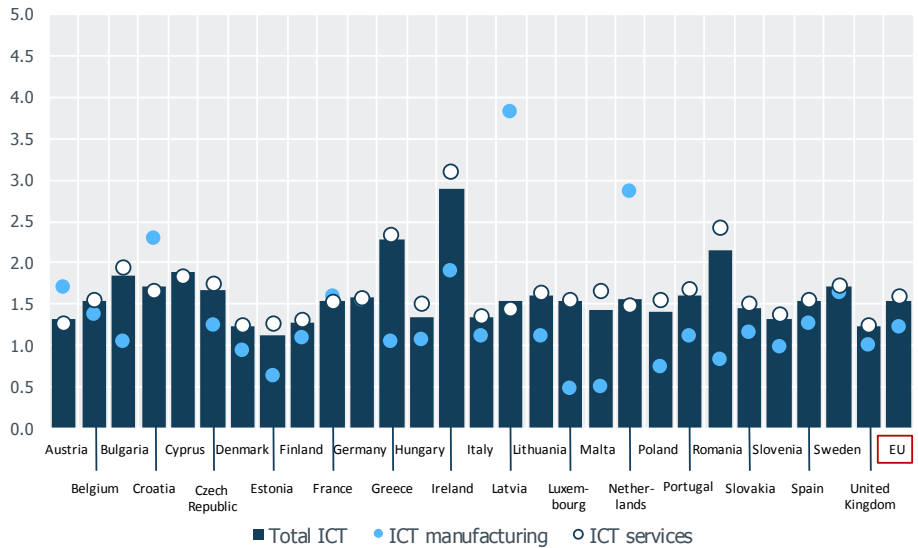


Source: 2018 PREDICT Dataset.

Ireland is, by far, the EU country with the highest share (10.4%) of ICT sector VA over total GDP, multiplying the EU average by a factor of 2.6 (Figure 14, a). This country also had the highest ratio of productivity in the ICT sector over total productivity (Figure 14, panel c). All in all, the productivity of EU countries in the ICT service sector is higher than in ICT manufactures. Hungary had the highest share of ICT manufactures VA over GDP. In terms of employment in the ICT sector, Estonia and Malta (whose information must be taken with caution), followed by Finland, Hungary and Ireland, presented the highest share over the total (Figure 14, b). The share of BERD in the ICT sector over total BERD is very uneven among EU countries. Besides Malta and Cyprus (whose information must also be taken with caution), three countries stand out in this variable: Finland, Estonia and Ireland (Figure 14, e). The share of the ICT sector GBARD over total GBARD is also very uneven among EU countries; Belgium, Ireland and Poland showed the highest shares.

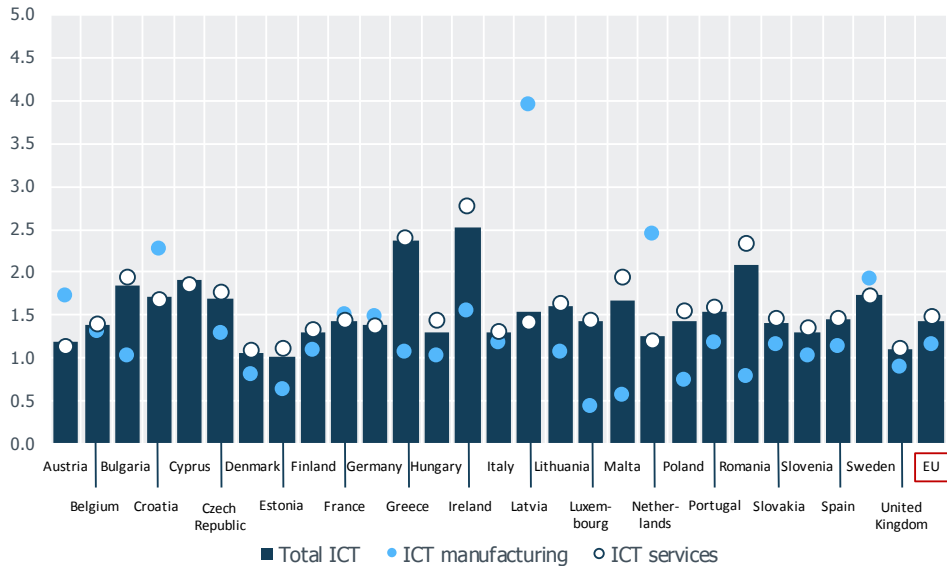
Figure 14 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU Member state (2015)

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



Note: 2014 for Ireland. ICT manufacturing for Cyprus is available but has been excluded due to high value (9.2).

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

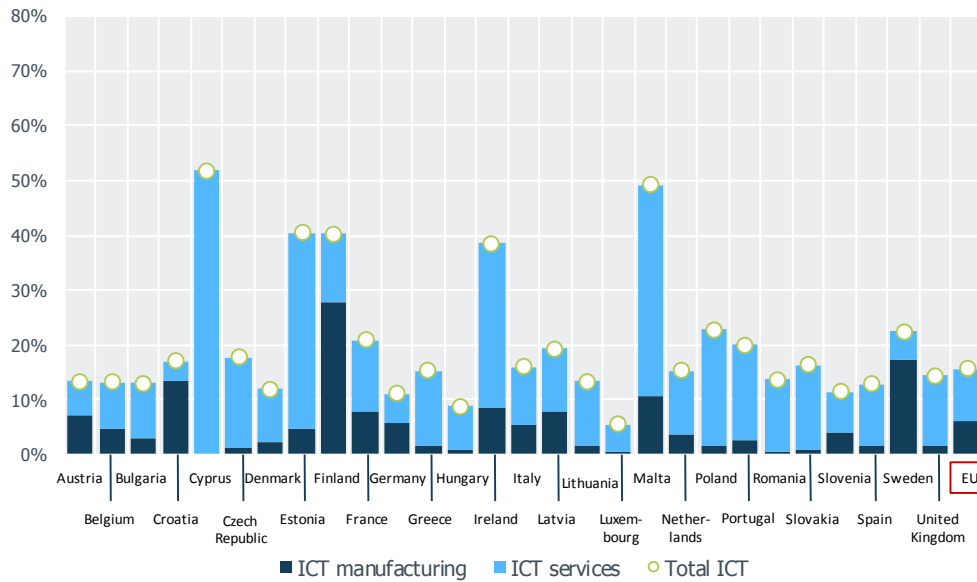


Note: 2014 for Ireland. ICT manufacturing for Cyprus is available but has been excluded due to high value (9.1).

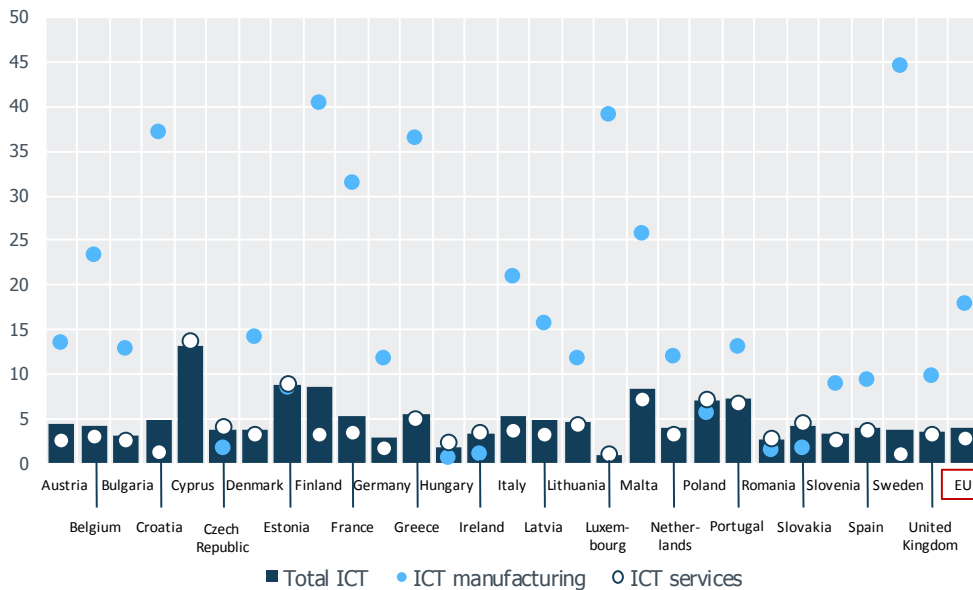
Source: 2018 PREDICT Dataset.

Figure 14 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU Member state (2015)

e) Share of ICT sector BERD on total BERD



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

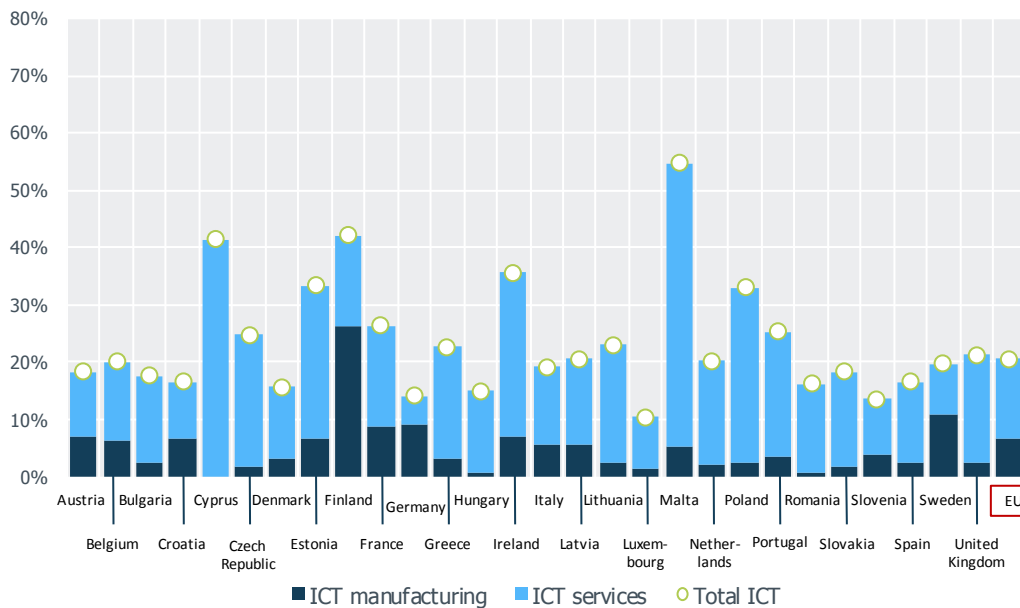


Note: 2014 for Ireland.

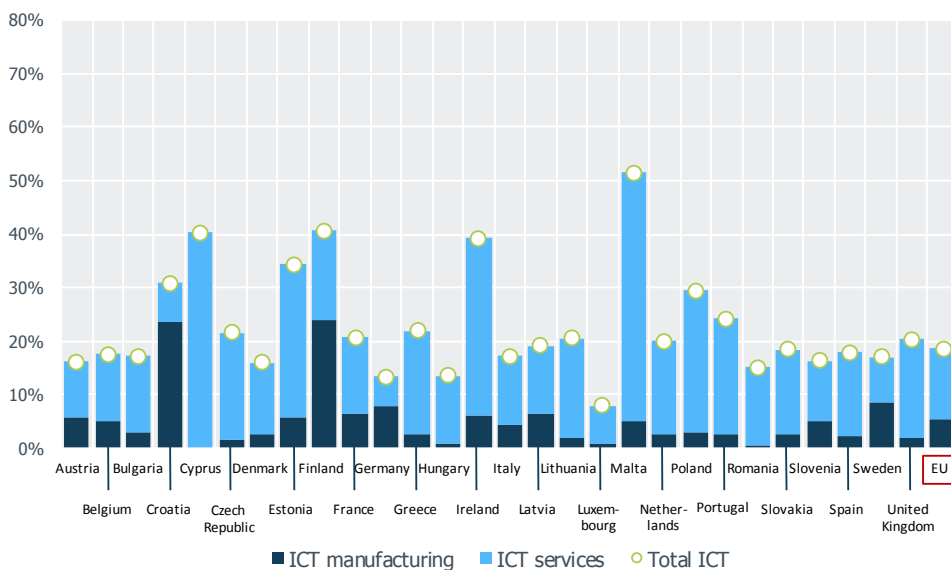
Source: 2018 PREDICT Dataset.

Figure 14 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU Member state (2015)

g) ICT sector RERD share of total RERD



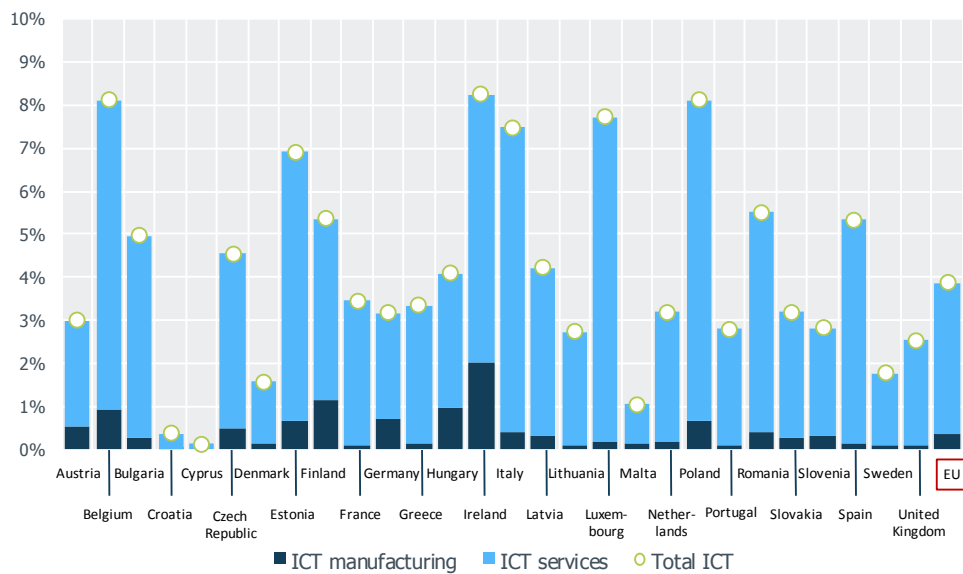
h) ICT sector PERD share of total PERD



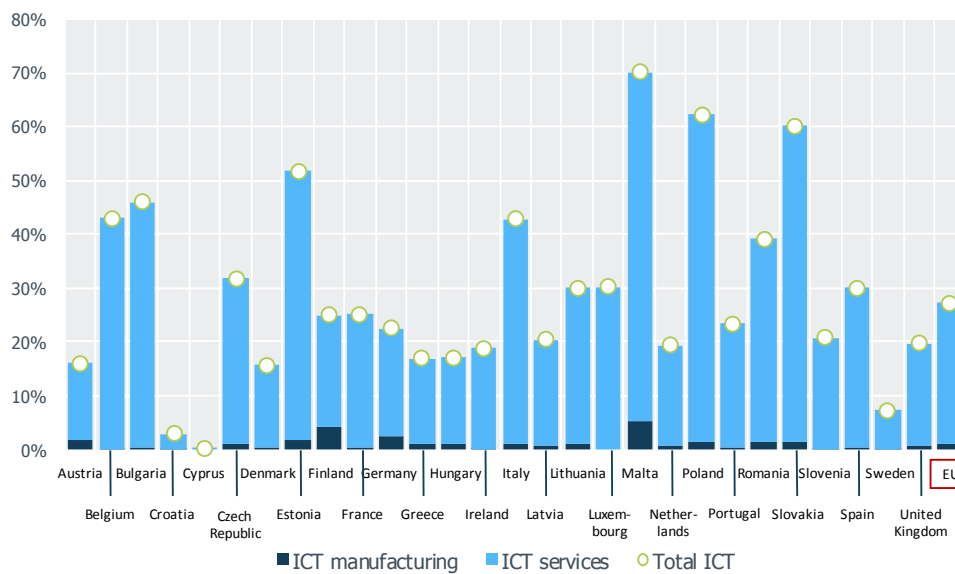
Source: 2018 PREDICT Dataset.

Figure 14 (cont.): ICT sector, ICT manufacturing and ICT services: VA, employment, labour productivity, BERD, BERD intensity, RERD, PERD, GBARD and ICT GBARD by EU Member state (2015)

i) ICT sector GBARD share of total GBARD



j) ICT sector ICT GBARD share of total ICT GBARD

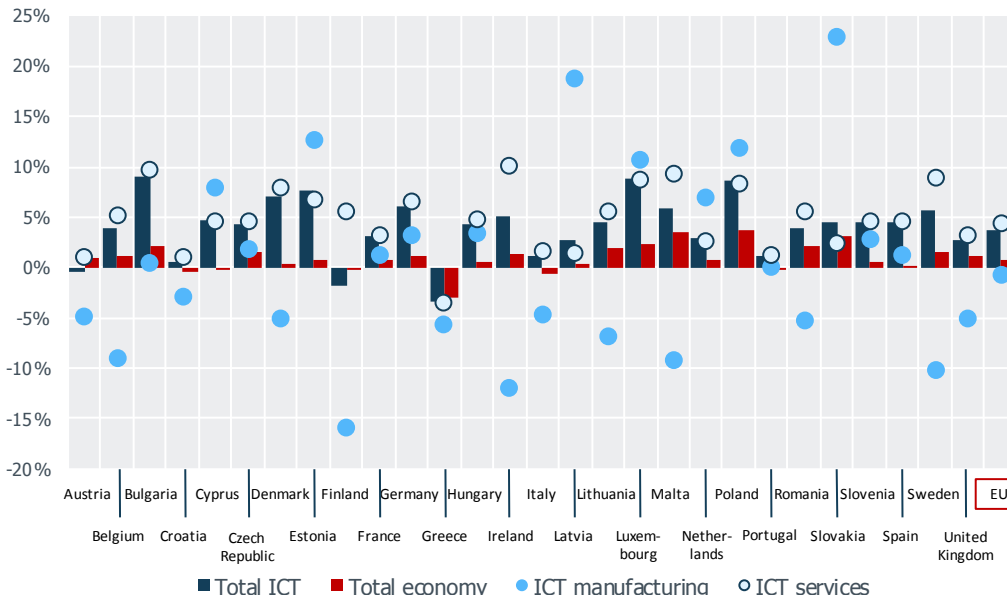


Note: 2016 for GBARD and ICT GBARD.

Source: 2018 PREDICT Dataset.

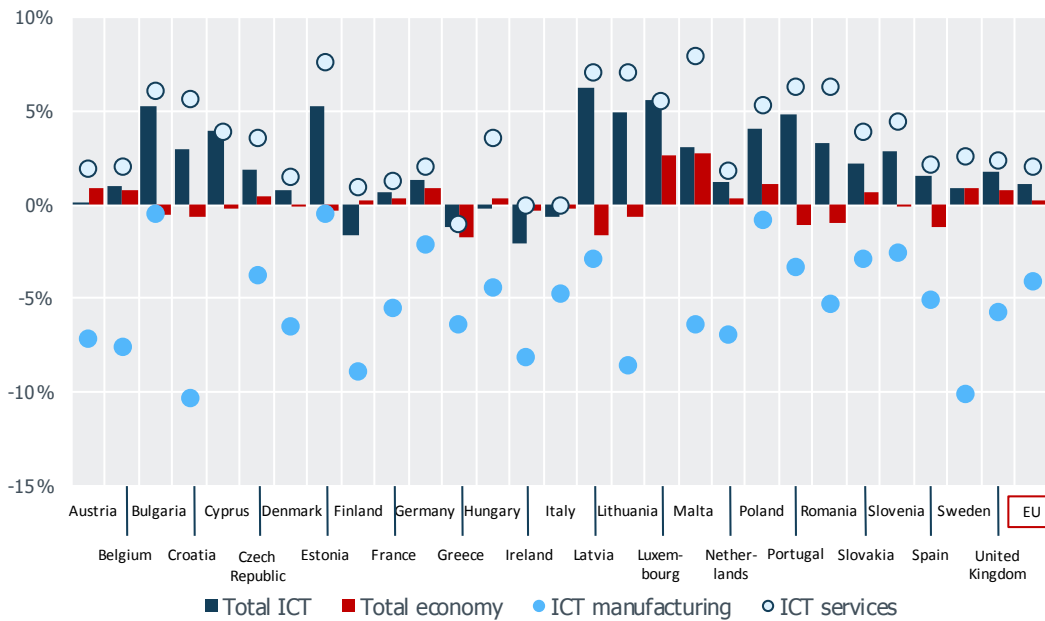
Figure 15: Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU Member state. Mean annual growth rates (%) (2006-2015)

a) VA



Note: 2006-2014 for Ireland.

b) Employment

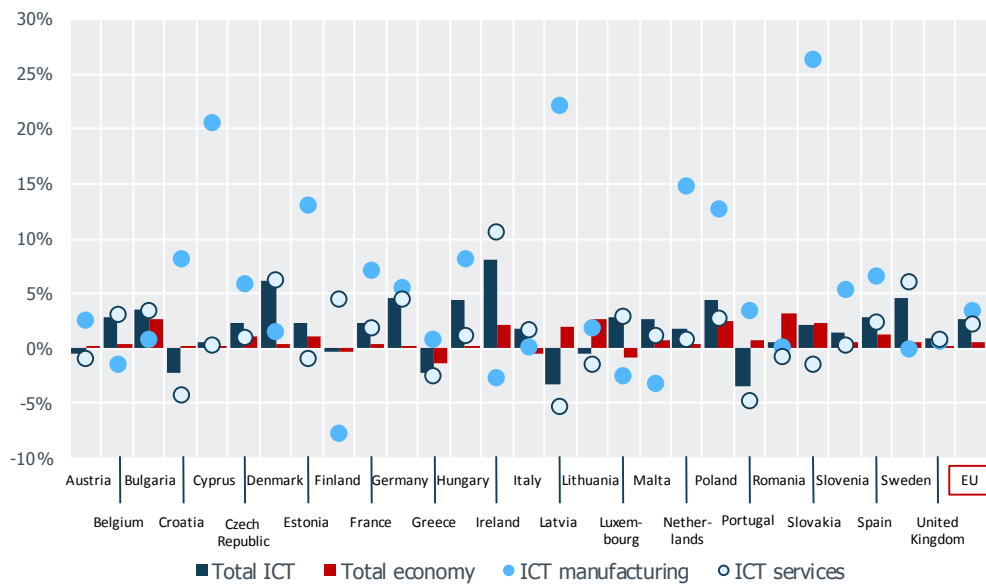


Note: Monetary variables are expressed in real terms.

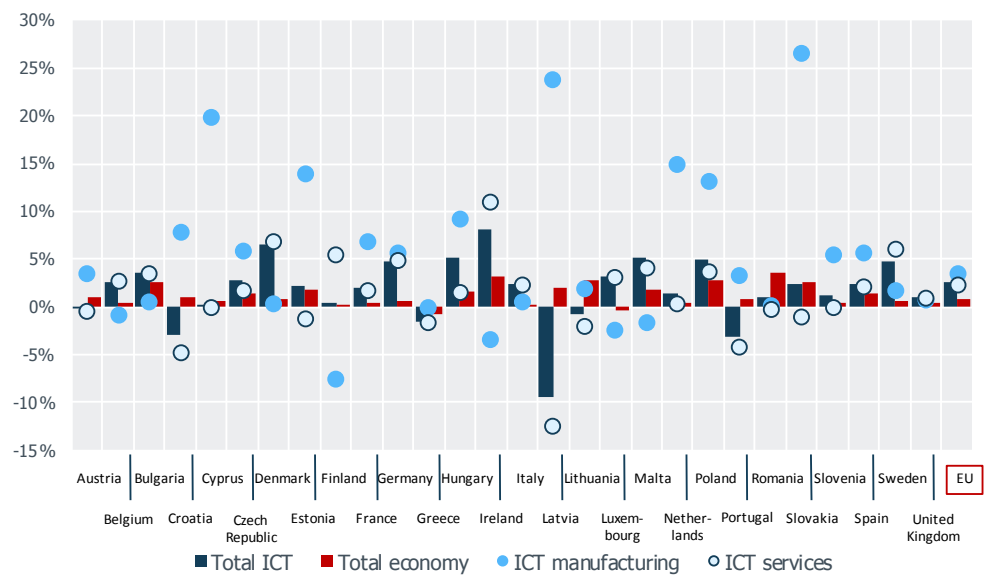
Source: 2018 PREDICT Dataset.

Figure 15 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU Member state. Mean annual growth rates (%) (2006-2015)

c) Productivity per person employed



d) Productivity per hour worked

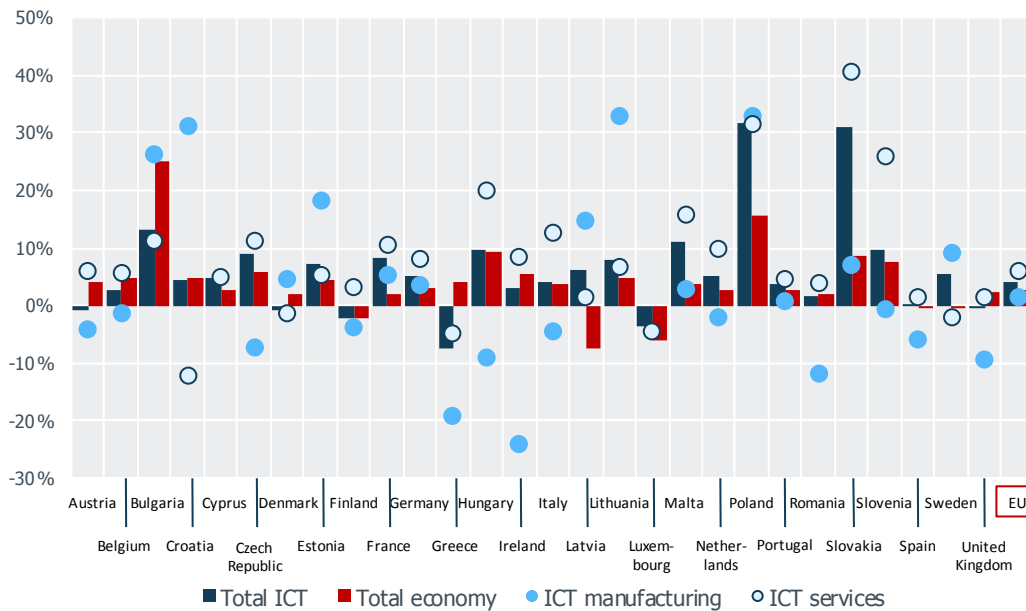


Note: Monetary variables are expressed in real terms. 2006-2014 for Ireland.

Source: 2018 PREDICT Dataset.

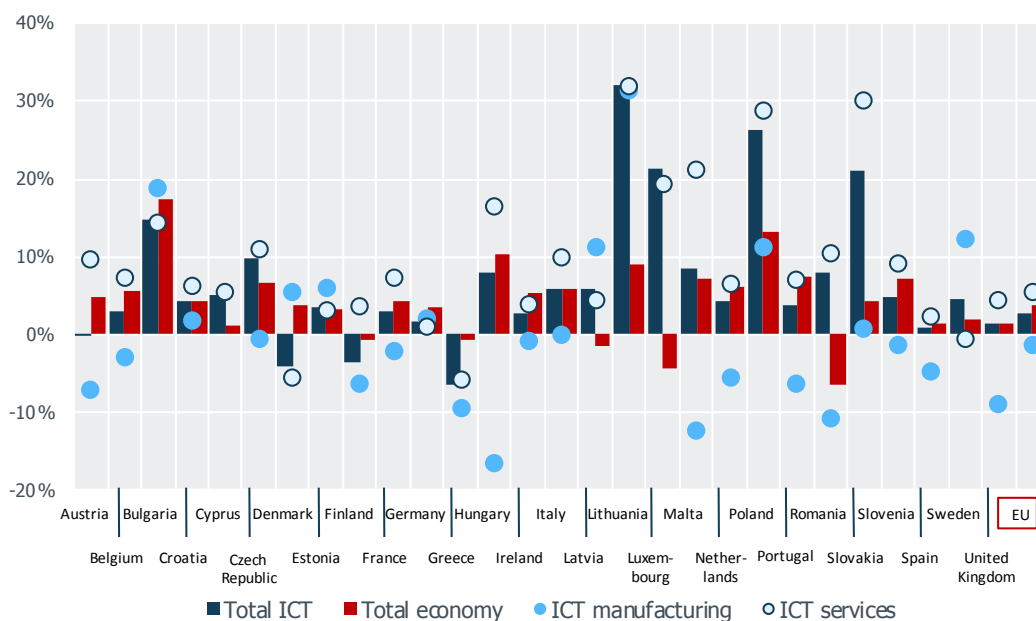
Figure 15 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU Member state. Mean annual growth rates (%) (2006-2015)

e) BERD



Note: 2006-2014 for Ireland.

f) RERD

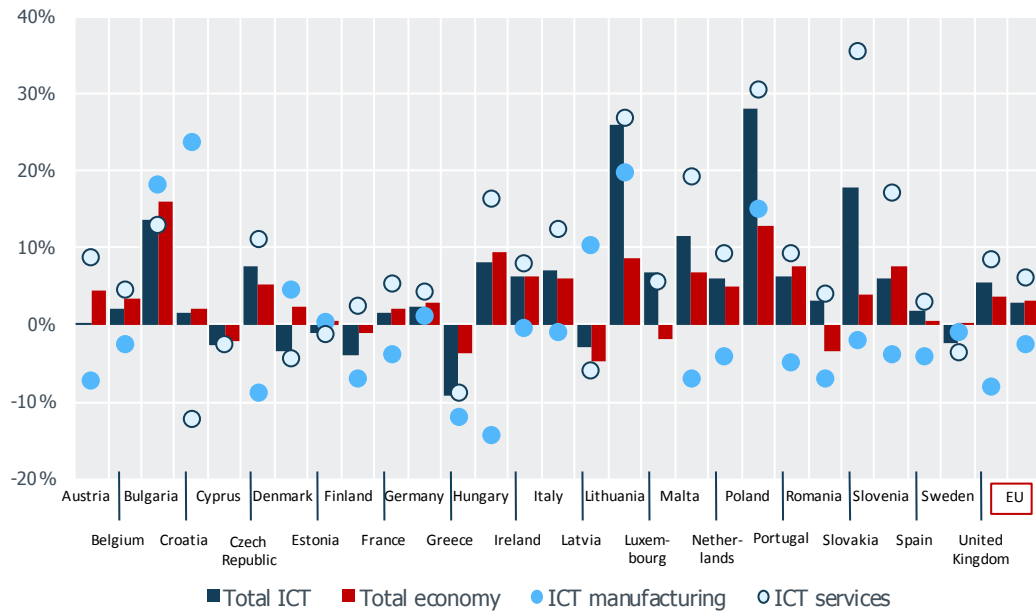


Note: Monetary variables are expressed in real terms.

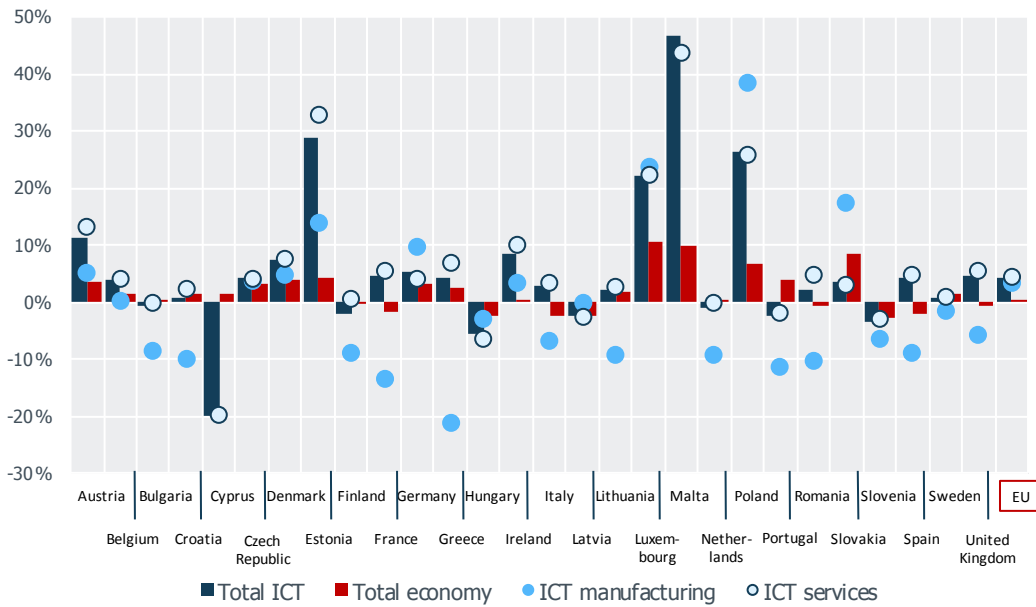
Source: 2018 PREDICT Dataset.

Figure 15 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU Member state. Mean annual growth rates (%) (2006-2015)

g) PERD



h) GBARD



Note: 2008-2015 for Croatia and 2006-2014 for Ireland. Monetary variables are expressed in real terms.
Source: 2018 PREDICT Dataset.

Figure 15 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services: VA, employment, productivity, BERD, RERD, PERD, GBARD and ICT GBARD by EU Member state. Mean annual growth rates (%) (2006-2015)

i) ICT GBARD

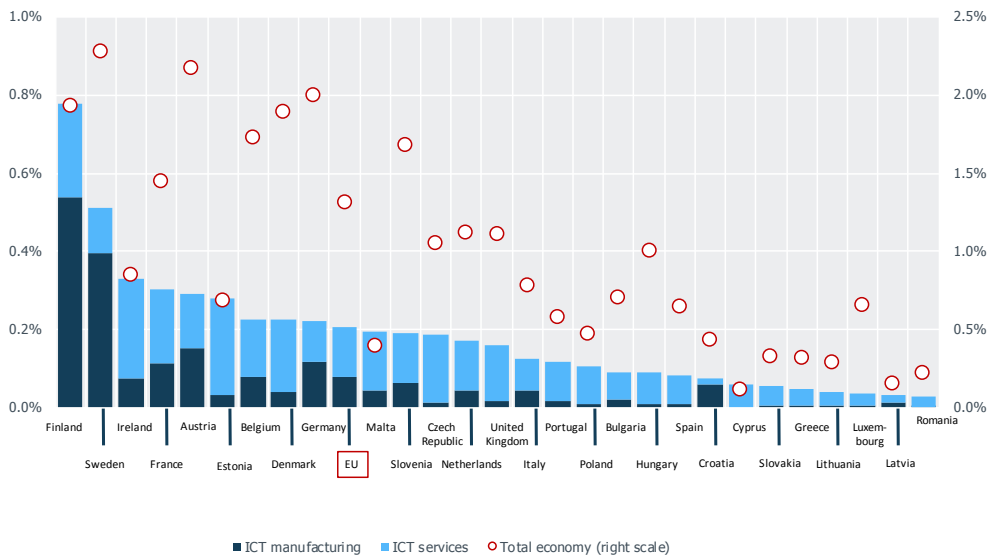


Note: Monetary variables are expressed in real terms. 2008-2015 for Croatia and 2006-2014 for Ireland.
Source: 2018 PREDICT Dataset.

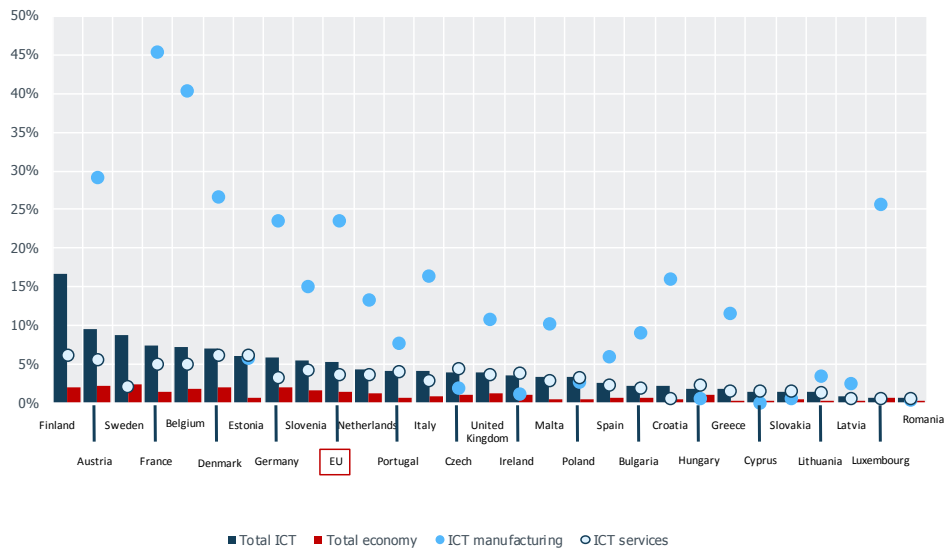
In all EU countries (with the sole exceptions of Greece, Finland and Austria), ICT sector VA growth was higher than GDP during the 2006-2015 period (Figure 15, a). Thirteen out of 28 EU countries experienced a negative change in ICT manufacturing, and only Greece also suffered a change in ICT services 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 EU countries, both in terms of persons and per hour worked. For almost all countries, labour productivity growth was higher in ICT manufacturing than in ICT services. For the EU, growth of BERD in the ICT sector was faster than for the total economy, and also faster in ICT services than ICT manufactures. However, this pattern cannot be considered a general one. The countries with the highest growth rate of BERD in the ICT sector were Poland and Slovakia (Figure 15, e), while Finland, Greece and Luxembourg showed a negative change. R&D researchers (RERD) and R&D personnel (PERD) in the ICT sector were especially high in three Eastern countries, Lithuania, Poland and Slovakia. GBARD in the ICT sector grew at the fastest rate in Luxembourg, Poland and Estonia.

Figure 16: BERD intensity by EU Member state (2015)

a) BERD/GDP



b) ICT sector BERD/ICT sector VA



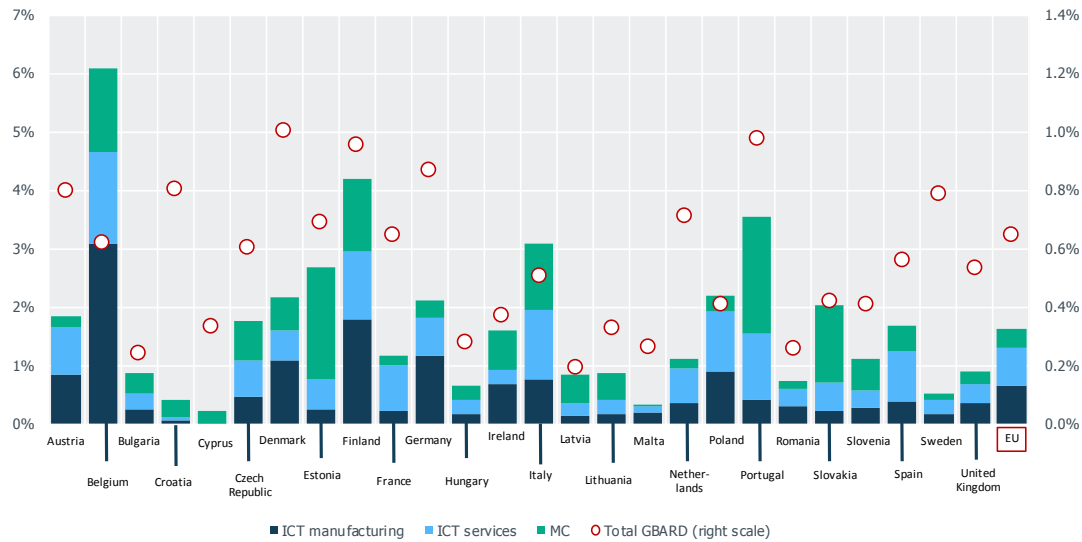
Note: 2014 for Ireland. ICT manufacturing for Finland and Sweden is available but has been excluded due to high value (78,2% and 101,5%, respectively)

Source: 2018 PREDICT Dataset.

BERD intensity (BERD/GDP) is very different among EU countries. Sweden and Austria showed the highest ratio for the total economy in 2015. In the case of the ICT sector, Finland and Sweden stand out (Figure 16, a). 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 16, b).

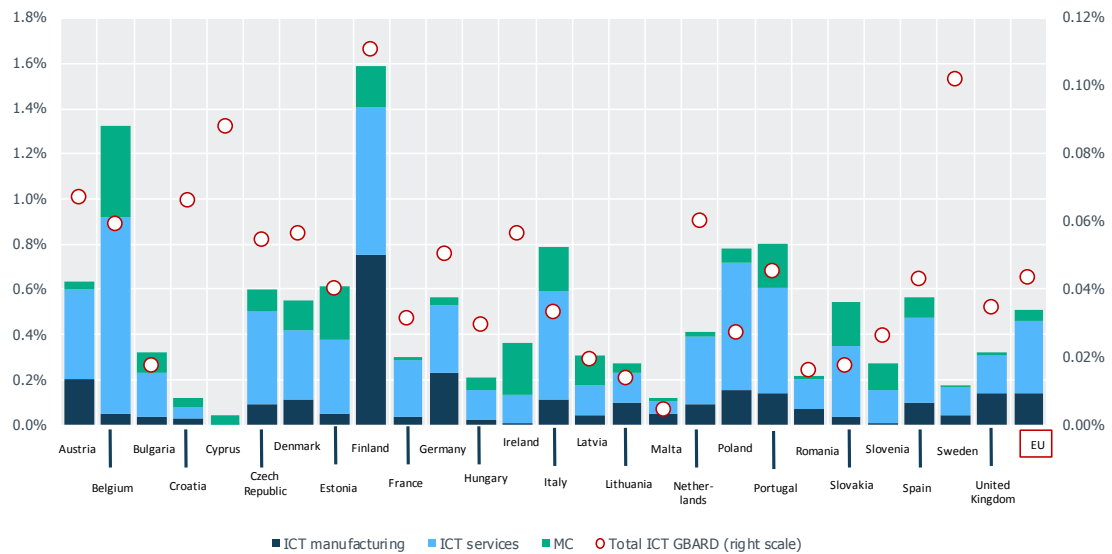
Figure 17: ICT manufacturing, ICT services, MC and Total GBARD and ICT GBARD by EU Member state (2015)

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



Note: 2014 for Ireland. Data for Greece and Luxembourg not reliable.

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

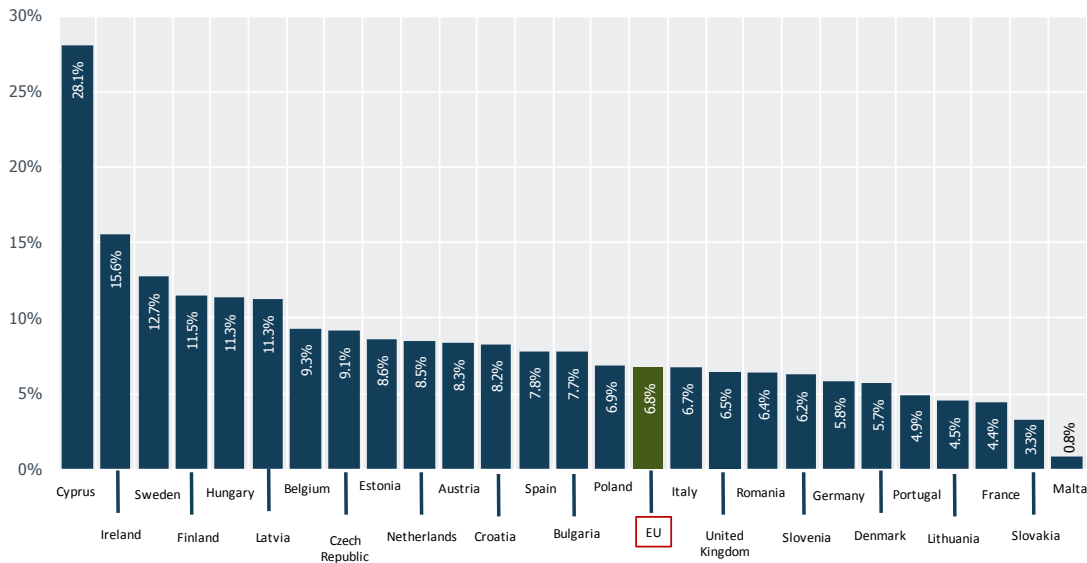


Note: 2014 for Ireland. Data for Greece and Luxembourg not reliable.

Source: 2018 PREDICT Dataset.

Figure 17 (cont.): ICT manufacturing, ICT services, MC and Total GBARD and ICT GBARD by EU Member state (2015)

c) ICT GBARD/GBARD



Note: 2016 for GBARD and ICT GBARD. Data for Greece and Luxembourg not reliable.

Source: 2018 PREDICT Dataset.

GBARD intensity (defined as sub-sector GBARD/sub-sector VA) is very different among EU countries for the total economy and also for ICT manufactures, ICT services and MC sector (Figure 17,a). In the case of the total economy, the highest values (around 1%) correspond to Denmark and Portugal. For ICT manufacturing, ICT services and MC Belgium and Finland stand out. Similar results apply for ICT GBARD where, again, Belgium and Finland stand out for the highest values of the sum of the three sub-sectors(Figure 17,b). 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 Ireland, Sweden, Finland, Hungary and Latvia as well as Cyprus, whose data must always be taken with caution.

3 The EU ICT sector in the international context

The EU holds an intermediate position in value added, employment and BERD in the international context. Whereas the EU ICT sector represented 3.9% of total VA in the economy and 2.5% of the employment in 2015, the ratios in Taiwan (15.8% in VA, 9.0% in employment), Korea (8.7%, 4.4%), Japan (5.8, 3.2%) or even in the US (5.2%, 2.7%) were notably higher (Figure 18). Europe also lagged behind the leaders according to its BERD intensity (BERD / VA) in the ICT sector. The EU ICT sector BERD intensity (5.2%) was less than half of the ratio of Korea (19.9%), the US (12.0%) and Taiwan (11.1%) in 2015, and it was similar to China (5.6%) and Australia (4.9%) (Table 3,a). The growth of the EU ICT sector VA (5.2%) was the fourth highest out of the 13 countries analysed, behind India (17.2%), US (6.7%) and China (5.7%) (Table 3,b). In employment, the growth of the EU ICT sector was modest, the sixth of the countries included in PREDICT. Although the EU BERD growth in 2015 (2.9%) was the fourth largest among the counties available, the difference with the more dynamic countries is remarkable: Norway (17.9%), China (14.3%), India (8.9%) and Taiwan (7.2%). The ICT GBARD (ICT GBARD/GDP) in the EU (0.04%) was lower than in the US (0.07%) or in Japan (0.06%). ICT GBARD remained stable in 2015, showing a growth rate of only 0.03% with respect to 2014. In Japan ICT GBARD fell by 8.2%, while in the US it increased by 3.1%.

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

a) 2015

	VA	Employment		BERD	GBARD		ICT GBARD		RERD	PERD
	ICT sector (Millions current PPS)	ICT sector (thousand employed)	persons	ICT sector (Millions current PPS)	ICT sector (Millions current PPS)	Total Economy (Millions current PPS)	ICT sector (Millions current PPS)	Total Economy (Millions current PPS)	ICT sector (thousand full-time equivalent)	ICT sector (thousand full-time equivalent)
	of EUR	of EUR	of EUR	of EUR	of EUR	of EUR	of EUR	of EUR	of EUR	of EUR
Australia	26,548.3	301.7		1,310.1	-	-	-	-	8.2	15.5
Brazil	64,770.9	1,269.2		1,390.9	-	-	-	-	16.4	21.7
Canada	41,746.3	500.3		2,371.4	-	-	-	-	34.6	44.3
China	715,247.9	15,121.6		39,000.8	-	-	-	-	191.9	475.1
European Union	581,361.5	5,831.9		30,453.2	3,772.9	96,082.8	1,769.8	6,444.3	187.0	292.0
India	300,914.8	6,536.4		1,937.9	-	-	-	-	12.5	23.5
Japan	225,170.9	2,148.1		20,173.5	-	25,311.8	-	2,581.3	128.4	141.3
Korea	113,569.6	1,150.5		22,577.0	-	-	-	-	121.6	134.1
Norway	7,402.3	69.9		653.6	-	-	-	-	5.0	6.6
Russia	55,148.2	1,009.8		938.4	-	-	-	-	5.5	10.6
Switzerland	16,463.0	147.5		5.7	-	-	-	-	0.2	0.3
Taiwan	129,885.1	1,004.4		14,498.2	-	-	-	-	69.3	126.5
United States	704,291.5	4,247.9		84,368.1	2,368.1	103,423.1	680.6	8,606.4	373.1	-

Note: 2014 for Canada (VA, Employment, RERD and PERD). 2011 for Brazil (BERD, RERD and PERD), 2012 for Switzerland (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 ICT GBARD) includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media).

Source: 2018 PREDICT Dataset.

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

b) Annual growth rates (%), 2014-2015

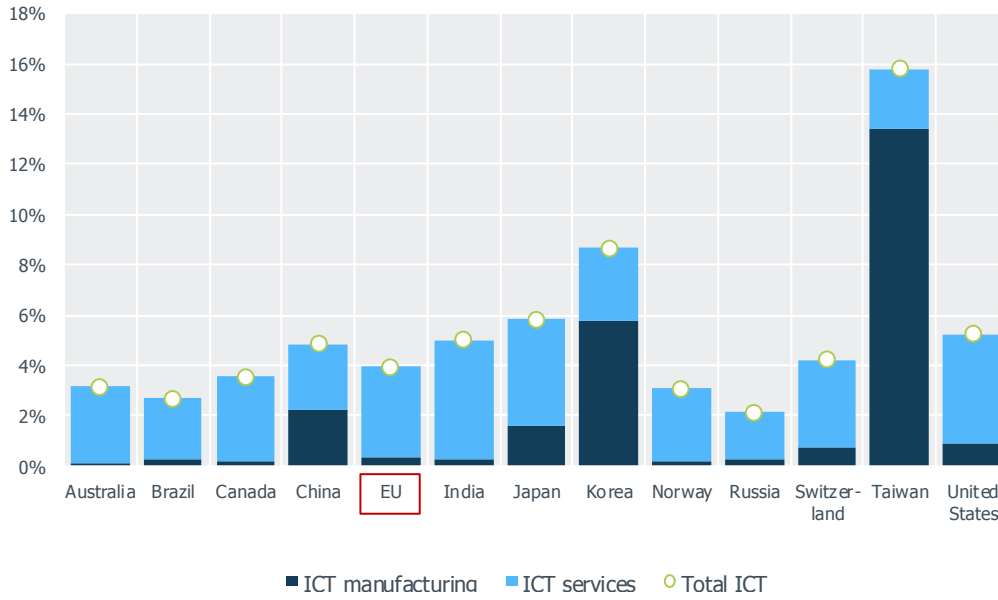
	VA	Employment	BERD	GBARD		ICT GBARD		PERD	PERD
	ICT sector	ICT sector	ICT sector	ICT sector	Total Economy	ICT sector	Total Economy	ICT sector	ICT sector
Australia	2.3	-0.2	-4.3	-	-	-	-	-6.5	-3.7
Brazil	0.5	-4.9	-	-	-	-	-	-	-
Canada	2.6	1.4	-2.3	-	-	-	-	7.9	4.3
China	5.7	1.6	14.3	-	-	-	-	13.7	-0.7
European Union	5.2	1.8	2.9	4.4	-0.6	3.5	0.0	3.3	2.9
India	17.2	7.1	8.9	-	-	-	-	11.4	19.0
Japan	1.9	2.9	-5.3	-	-6.7	-	-8.2	-8.9	-7.8
Korea	2.3	5.8	-3.8	-	-	-	-	-1.2	-1.2
Norway	4.4	-0.5	17.9	-	-	-	-	13.1	12.8
Russia	1.1	4.6	2.8	-	-	-	-	5.8	16.3
Switzerland	2.0	-0.8	-	-	-	-	-	-	-
Taiwan	1.9	1.5	7.2	-	-	-	-	3.0	3.6
United States	6.9	2.6	0.4	-5.7	0.7	-5.6	3.1	0.8	-

Note: Monetary variables are expressed in real terms. 2013-2014 for Canada (VA, Employment, RERD and PERD), 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 ICT GBARD) includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media).

Source: 2018 PREDICT Dataset.

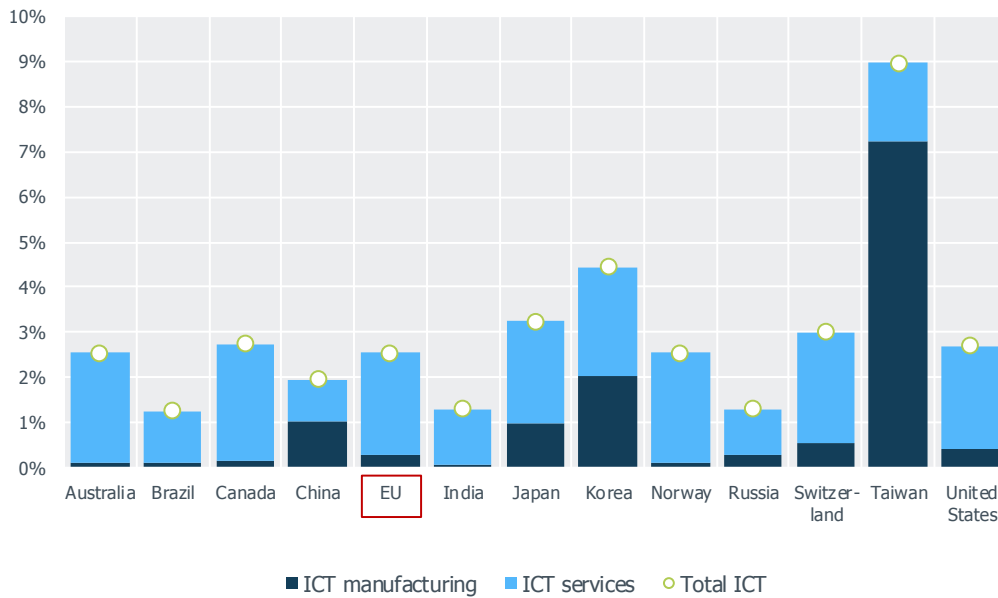
Figure 18: ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

a) ICT sector VA share of GDP



Note: 2014 for Canada.

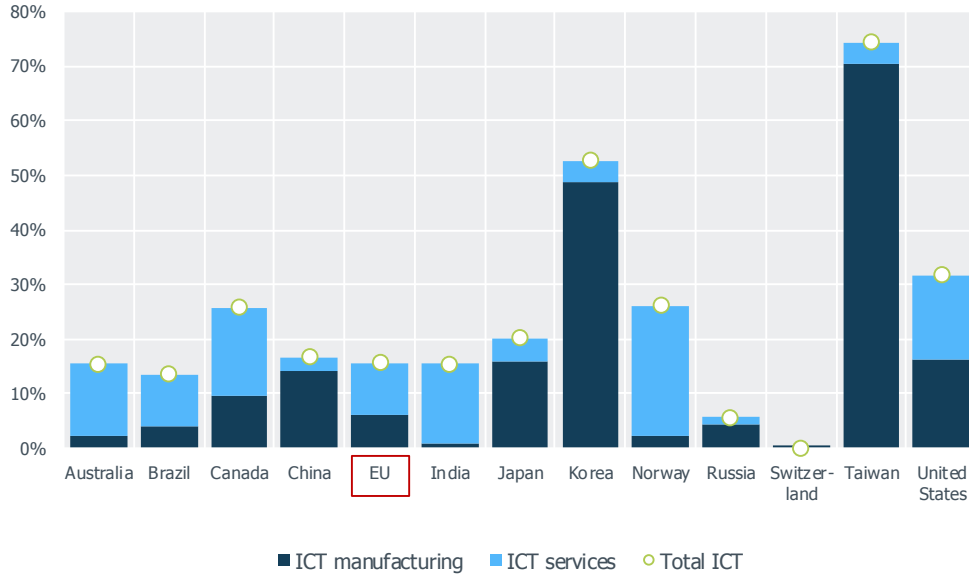
b) ICT sector employment share of total employment



Source: 2018 PREDICT Dataset.

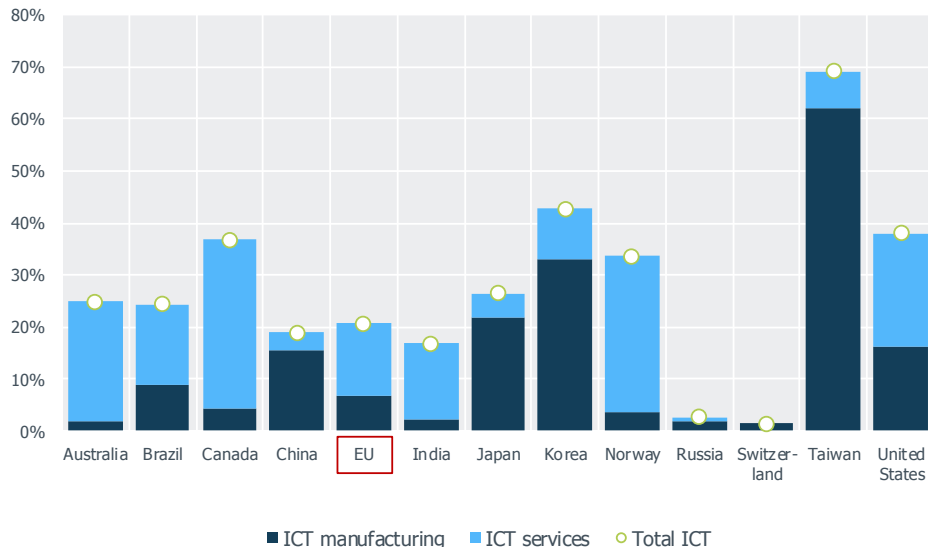
Figure 18 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

c) ICT sector BERD share of total BERD



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

d) ICT sector RERD share of total RERD

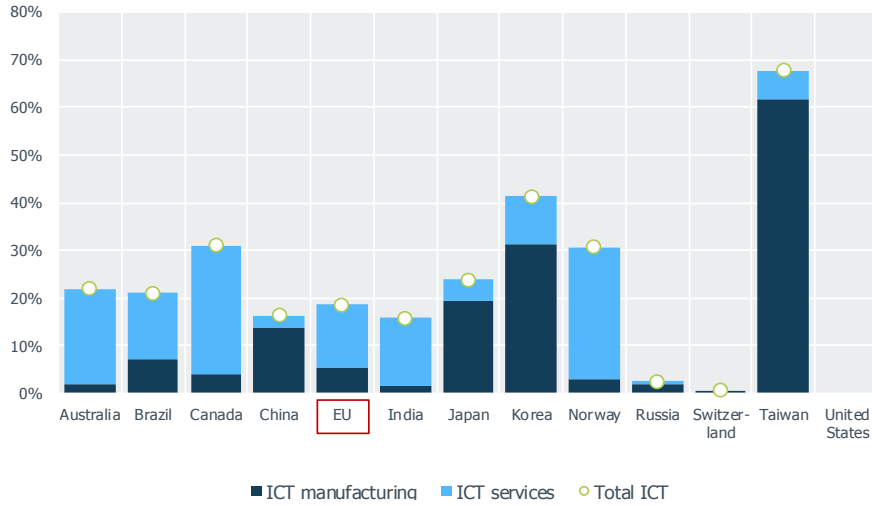


Note: 2011 for Brazil, 2012 for Switzerland, 2013 for India and 2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing

Source: 2018 PREDICT Dataset.

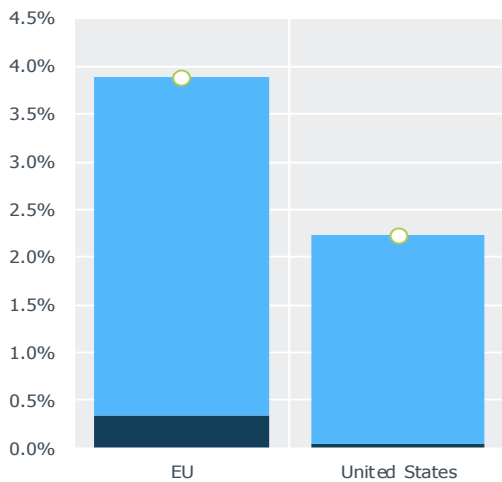
Figure 18 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

e) ICT sector PERD share of total PERD

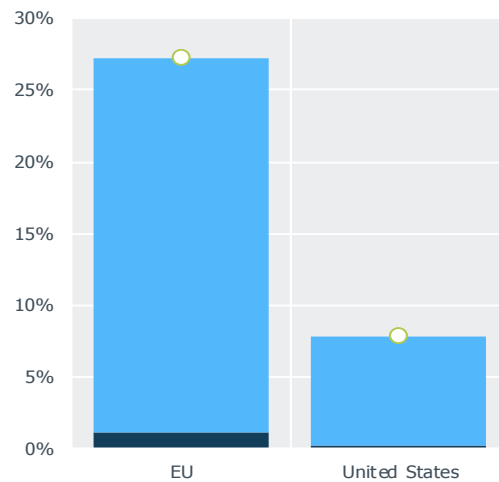


Note: 2011 for Brazil, 2012 for Switzerland, 2013 for India and 2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing. ICT sector for United States not included because of lack of homogeneous data.

f) ICT sector GBARD share of total GBARD



g) ICT sector ICT GBARD share of total ICT GBARD



Note: 2016 for GBARD and ICT GBARD. ICT manufacturing for United States includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media)

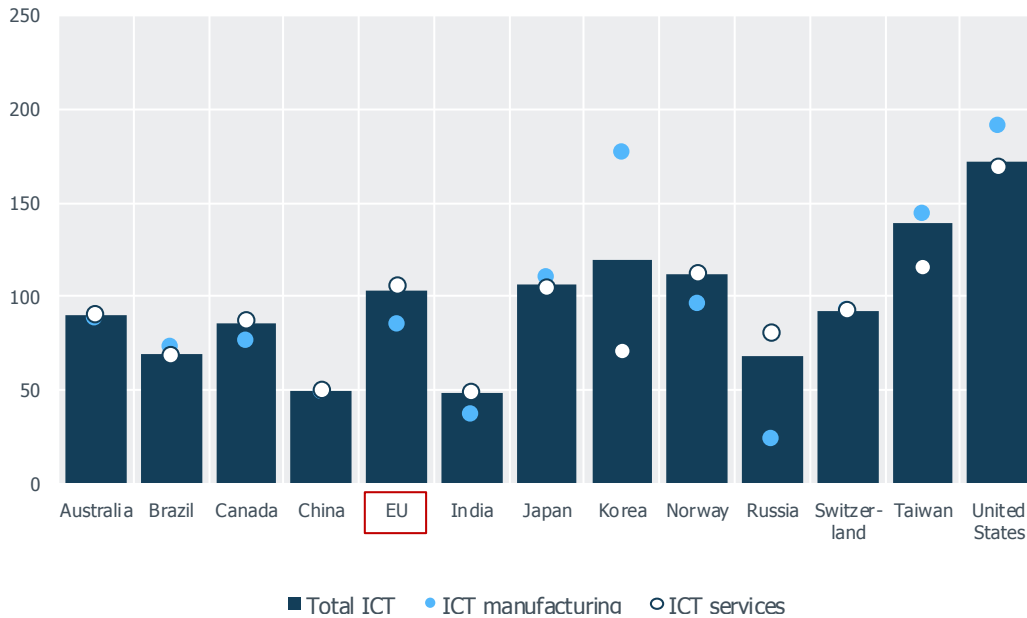
Source: 2018 PREDICT Dataset.

The Asian countries, Taiwan (15.8%), South Korea (8.7%) and Japan (5.8%), have the largest ICT sector measured as ICT VA share over total GDP (Figure 18,a). In 2015 India (5.0%) had a similar share to the US (5.2%), with China (4.8%) approaching it. All the countries aforementioned had a larger share than the EU. Taiwan (9.0%), Korea (4.4%) and Japan (3.2%) also take the lead in terms of employment, followed by Switzerland (3.0%), US (2.7%) and Canada (2.7%), all of which had larger shares than the EU (2.5%). China (2.0%) and India (1.3%) lagged behind (Figure 18,b). Taiwan, Korea and the US are the countries with the largest share of BERD (Figure 18,c), R&D researchers and R&D personnel⁴ (Figure 18, d,e) in the ICT sector over the total. Those countries also stand out for the size of their ICT manufacturing sector. The EU occupies 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 18,f).

⁴ No data on R&D personnel available for the US.

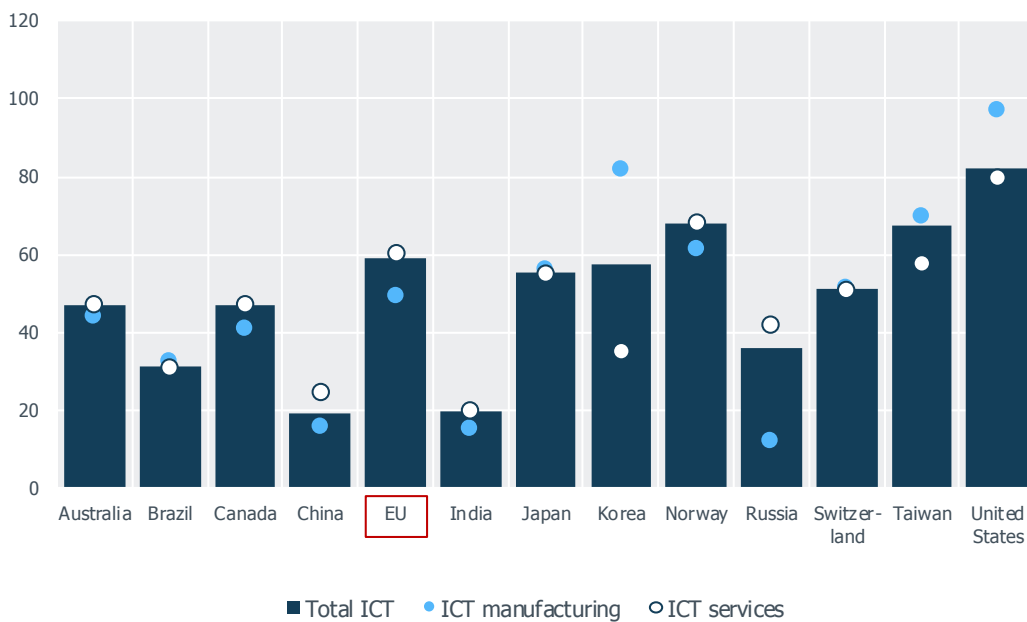
Figure 19: ICT sector, ICT manufacturing and ICT services in the international context: labour productivities (2015)

a) ICT sector productivity per person employed (Thousands of euros PPS 2010 per person)



Note: 2014 for Canada.

b) ICT sector productivity per hour worked (Euros PPS 2010 per hour worked)

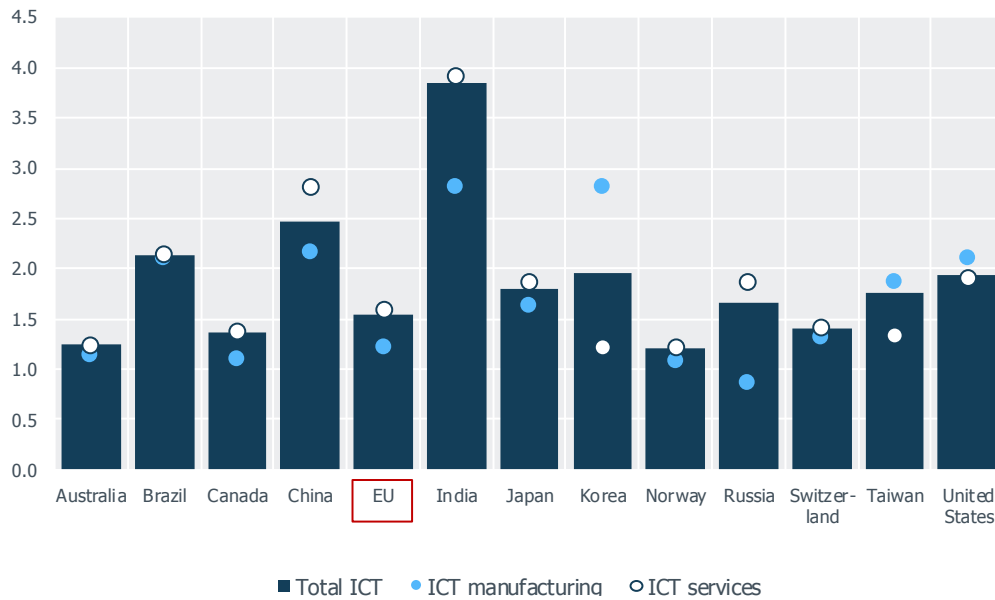


Note: 2014 for Canada

Source: 2018 PREDICT Dataset.

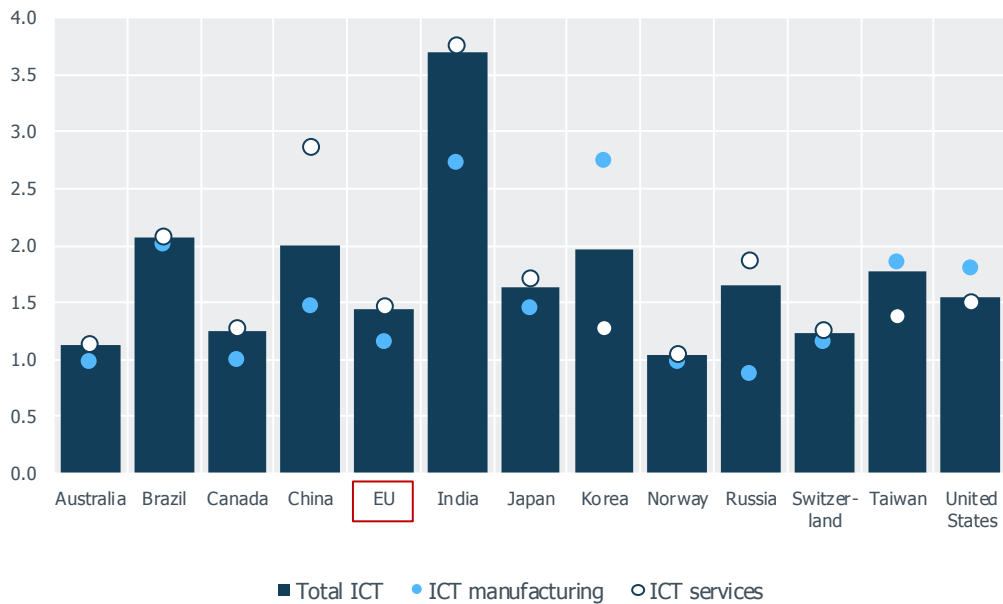
Figure 19 (cont.): ICT sector, ICT manufacturing and ICT services in the international context: labour productivities (2015)

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



Note: 2014 for Canada.

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



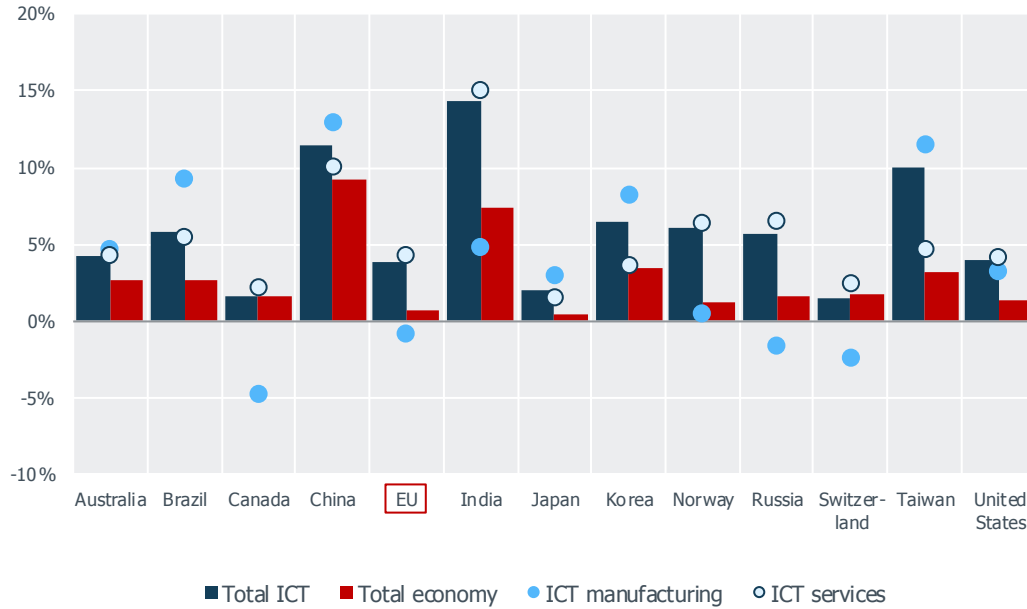
Note: 2014 for Canada.

Source: 2018 PREDICT Dataset.

The US is the country with the highest labour productivity in the ICT sector, in terms of persons and also per hour worked (Figure 19, a, b) . Its leadership is especially noticeable in the ICT manufacturing sector. Norway and Taiwan follow. The EU occupies the sixth position when productivity is defined by person employed and the fourth per hour worked. In the EU, labour productivity is higher in the ICT service than in ICT manufacturing. In all countries considered, labour productivity in the ICT sector is higher than for the total economy, both in terms of persons and hours worked (Figure 19, c, d). In India it is almost 4 times higher and in China more than double. Productivity by hour worked in the ICT sector is 1.5 higher in the EU and the US. However, while in the US the gap is larger in the ICT manufacturing sectors, in the EU it is larger in the ICT services sectors.

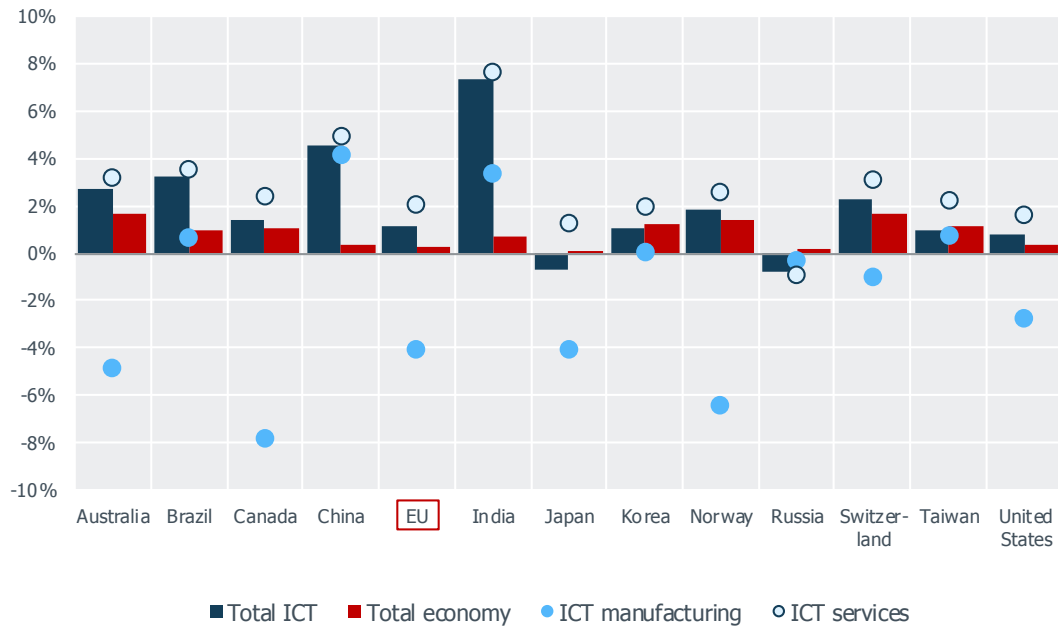
Figure 20: Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2015)

a) Value added



Note: 2006-2014 for Canada.

b) Employment

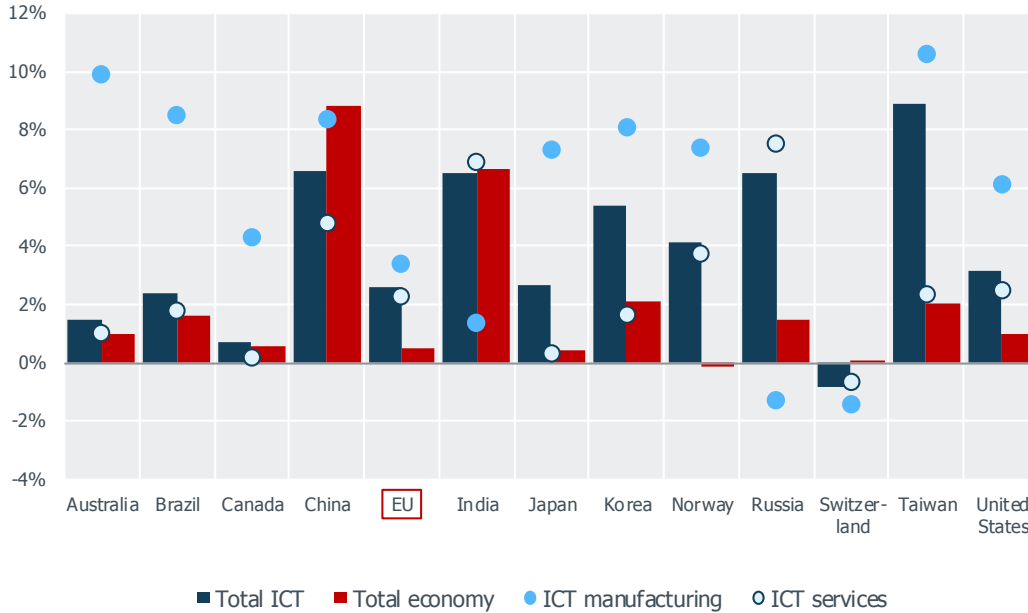


Note: Monetary variables are expressed in real terms.

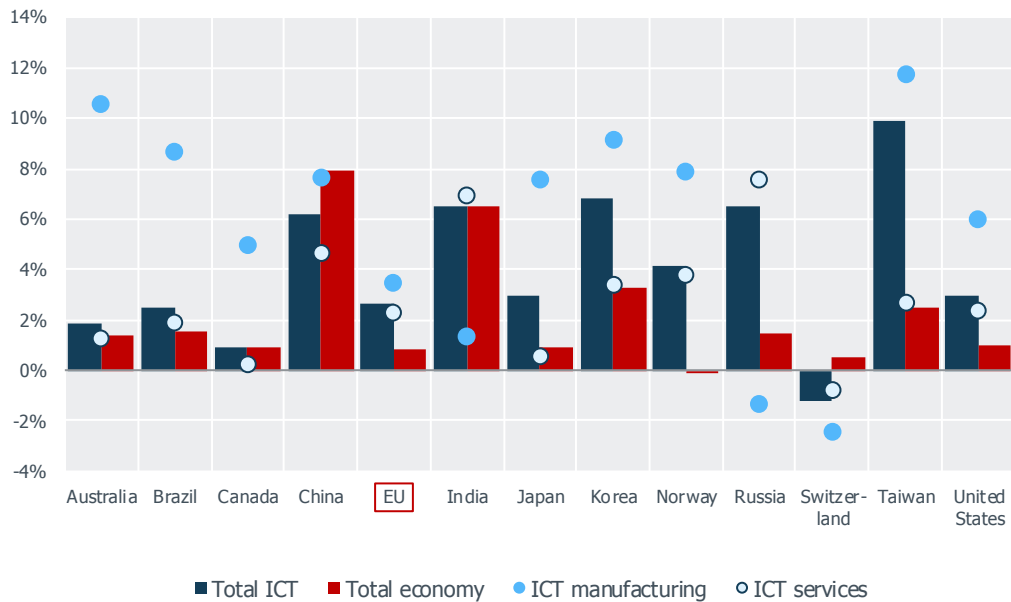
Source: 2018 PREDICT Dataset.

Figure 20 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2015)

c) Productivity per person employed



d) Productivity per hour worked

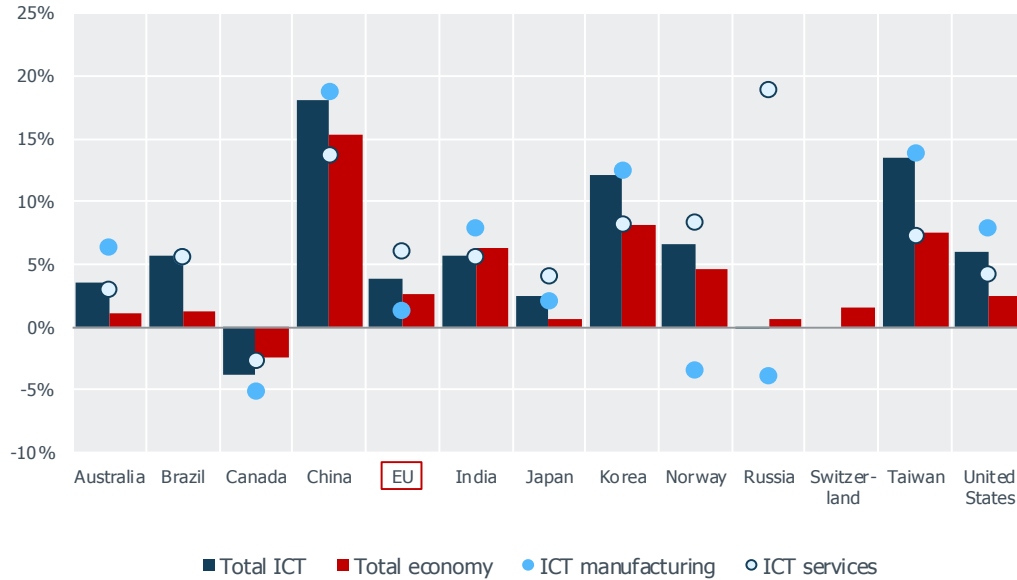


Note: Monetary variables are expressed in real terms. 2006-2014 for Canada.

Source: 2018 PREDICT Dataset.

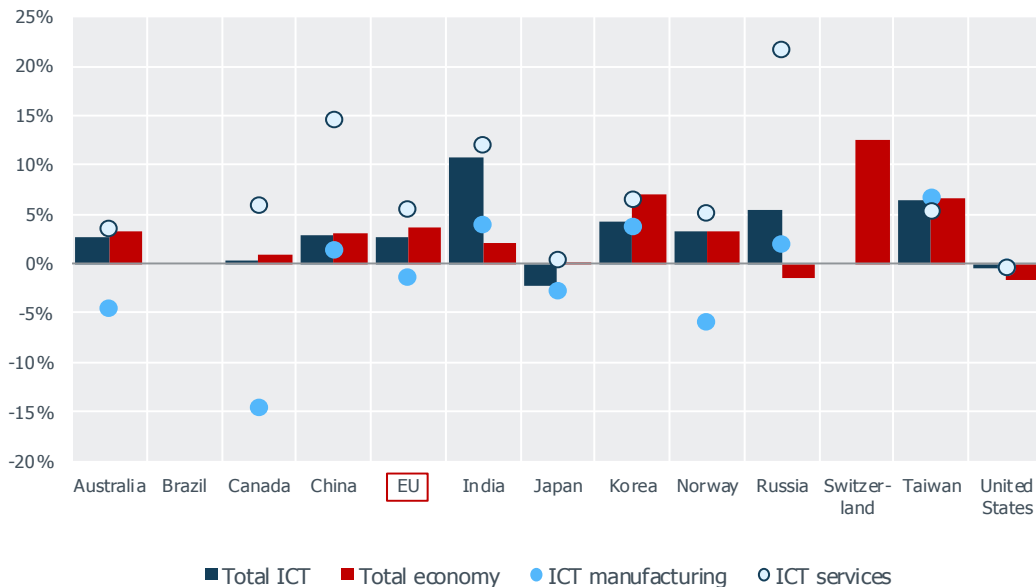
Figure 20 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2015)

e) BERD



Note: 2008-2011 for Brazil, 2006-2013 for India and 2006-2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing, the data is available but has been excluded due to high negative rate of growth (-56%) between 2008 and 2012, the only years available

f) RERD

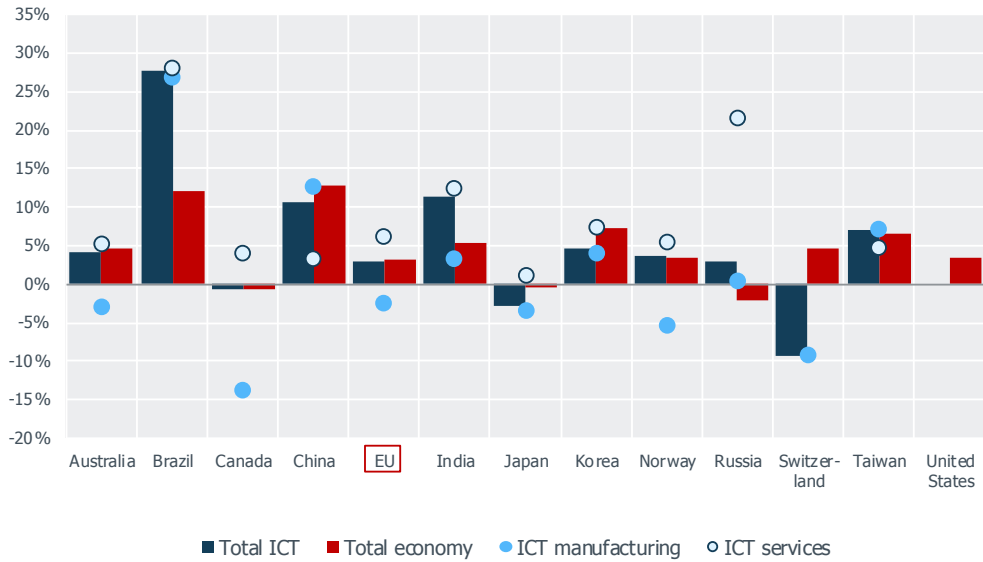


Note: Monetary variables are expressed in real terms. 2008-2012 for Switzerland, 2006-2013 for India and 2006-2014 for Canada. Data not available for Brazil. ICT sector for Switzerland includes only ICT manufacturing, the data is available but has been excluded due to high growth rate (231%).

Source: 2018 PREDICT Dataset.

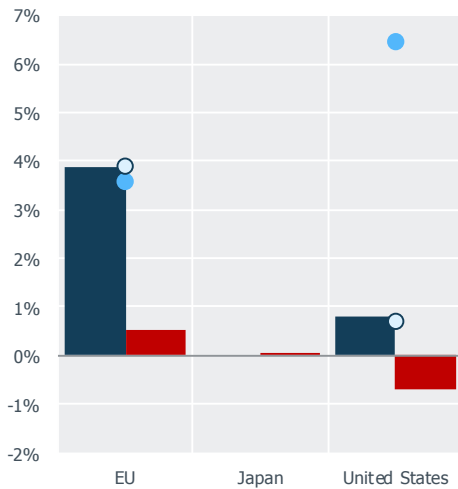
Figure 20 (cont.): Total economy, ICT sector, ICT manufacturing and ICT services in the international context. Mean annual growth rates (%) (2006-2015)

g) PERD

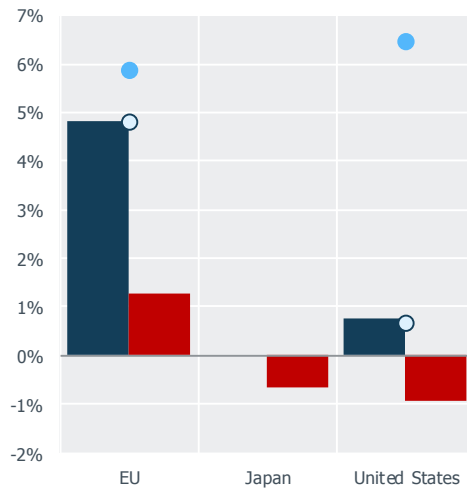


Note: 2008-2012 for Switzerland, 2006-2013 for India and 2006-2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing. ICT PERD for United States not included because of lack of homogeneous data.

h) GBARD



i) ICT GBARD

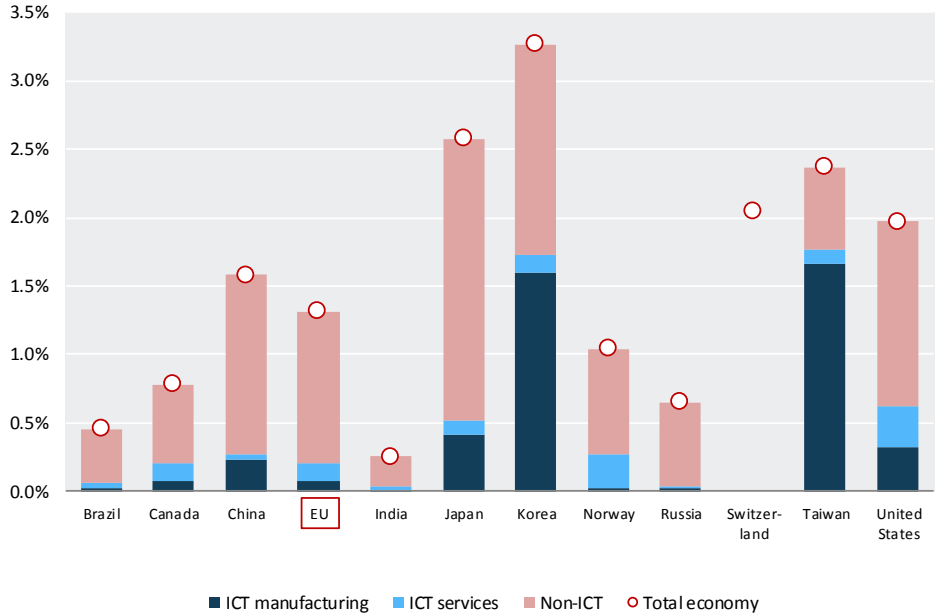


Note: Monetary variables are expressed in real terms. 2006-2016 for GBARD and ICT GBARD. ICT manufacturing for United States includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media). Source: 2018 PREDICT Dataset.

India and China presented the highest growth rates between 2006 and 2015 for VA and employment, both in the ICT sector and the total economy (Figure 20, a ,b). In India the ICT service sector was more dynamic while for China it was ICT manufacturing. In the EU the annual growth rate of VA in the ICT sector (3.8%) was similar to that of the US (4.0%), while employment grew at a slightly higher rate in the EU (1.2%) than in the US (0.8%). The Asian countries Taiwan (9.9%), Korea (6.8%), India (6.5%), together with Russia, and China (6.2%) presented the highest annual labour productivity growth per hour worked in the ICT sector (Figure 20, d), more than doubling those of the EU (2.6%) and the US (3.0%). China showed the most dynamic behaviour in BERD (18.0%) (Figure 20, e), India (10.7%) in R&D researchers (Figure 20,f), and Brazil (27.6%) in R&D personnel (Figure 20,g). Compared to those countries, the ICT sector in the EU and also in the US was much less dynamic. However, the EU presented a higher growth rate in GBARD and ICT GBARD in the ICT sector than the US and Japan (Figure 20, h,i).

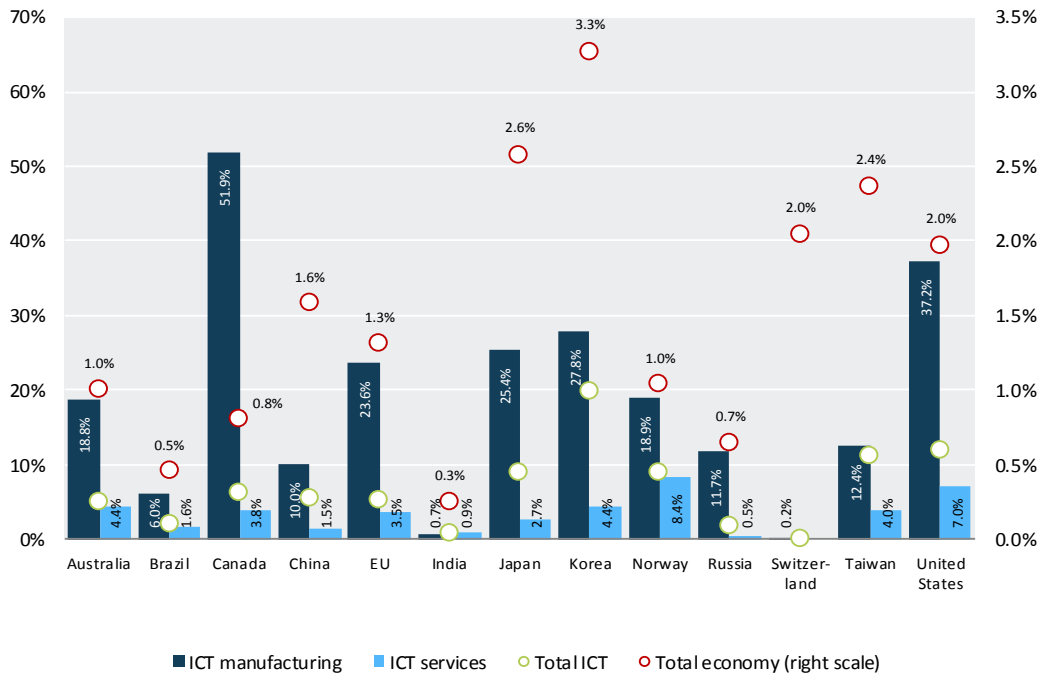
Figure 21: BERD intensity in the international context (2015)

a) BERD/GDP



Note: 2011 for Brazil, 2013 for India and 2012 for Switzerland. ICT manufacturing for Switzerland is available but has been excluded due to low value. In the case of ICT services the value is zero.
Source: 2018 PREDICT Dataset.

b) ICT sector BERD/ICT sector VA

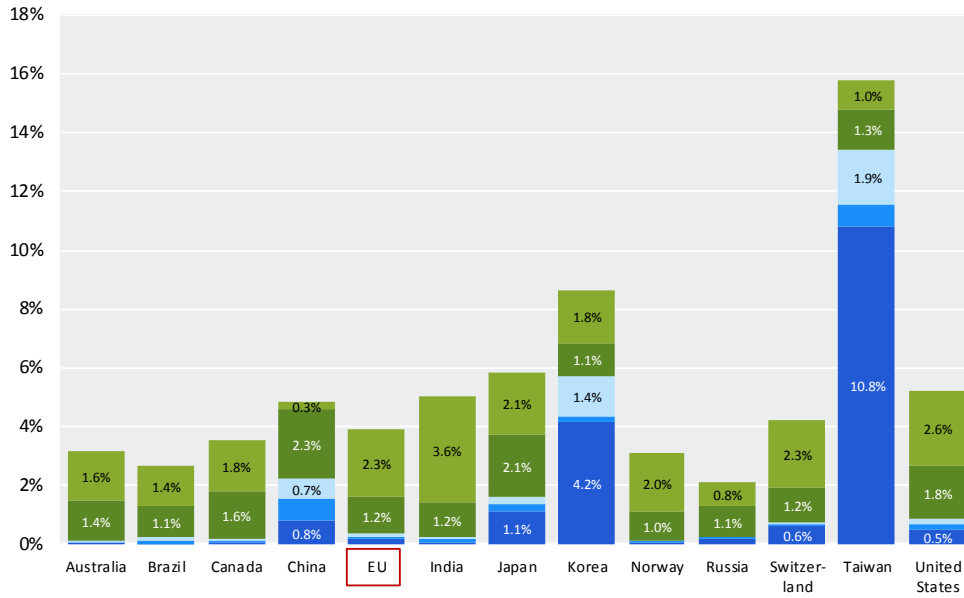


Note: 2011 for Brazil, 2014 for Canada, 2013 for India and 2012 for Switzerland.
Source: 2018 PREDICT Dataset.

South Korea (3.3%) has the highest BERD intensity (BERD/GDP) (Figure 21,a) of all the countries considered, followed by Japan (2.6%), Taiwan (2.4%) and the US (2.0%). In 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. In the EU (1.3%) BERD intensity is lower than in China (1.6%). BERD intensity in the ICT sector (measured as ICT sector BERD/ ICT sector VA) is very high in Korea, both for the total economy (3.3%) and also for the ICT sector (19.9%) (Figure 21,b). For ICT manufacturing, the highest ratio corresponds to Canada (51.9%) followed by the US (37.2%). In the ICT service sector, Norway (8.4%) takes the lead followed by the US (7.0%). The EU occupies the seventh position for the total economy (1.3%), the eighth for the ICT sector (5.2%), the seventh for ICT services (3.5%) and the fifth for ICT manufacturing (23.6%) of the thirteen countries considered.

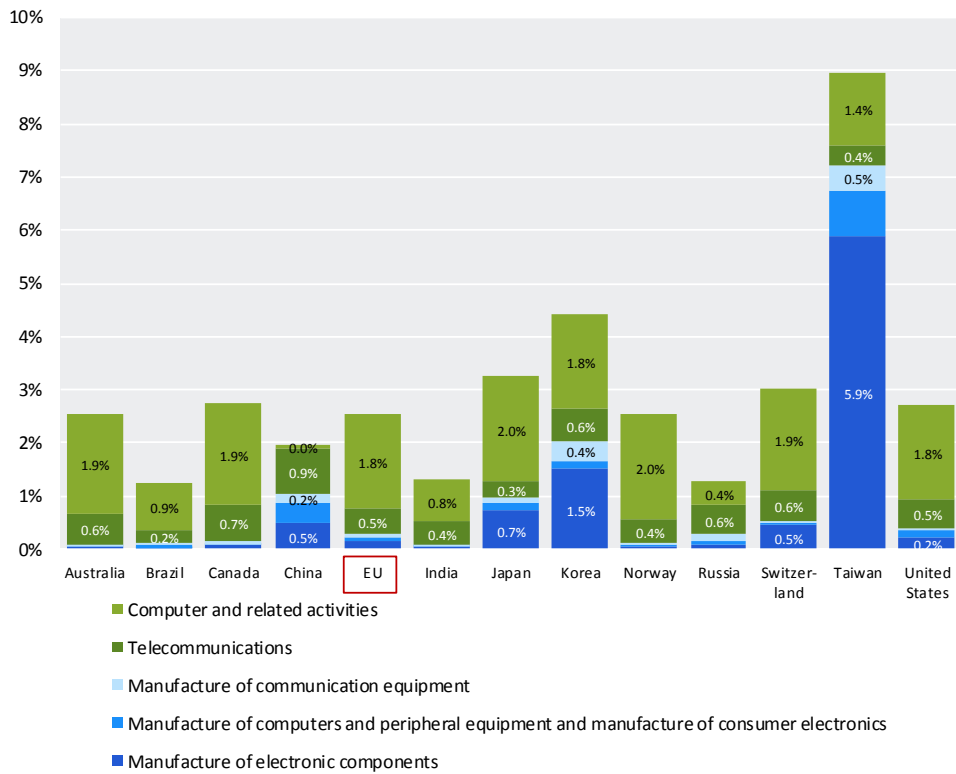
Figure 22: ICT sector by sub-sectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

a) VA share of GDP



Note: 2014 for Canada.

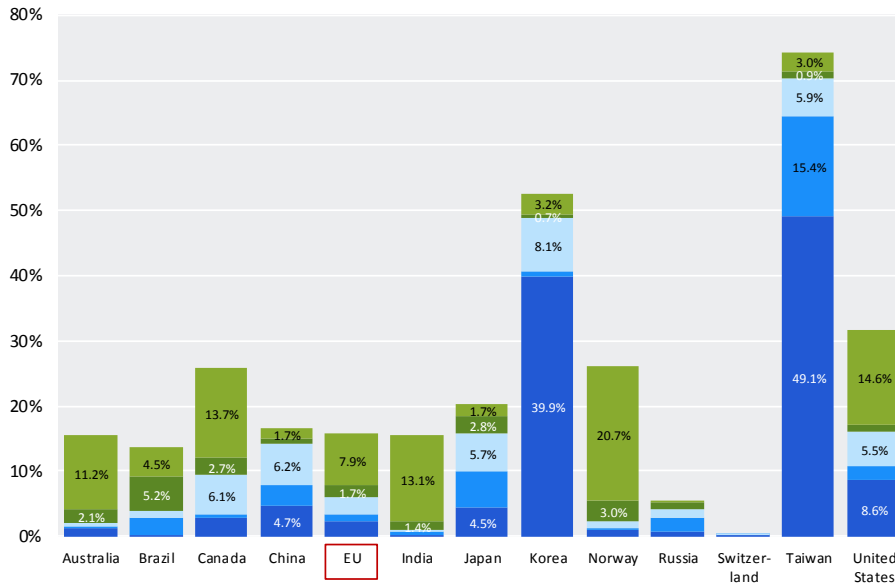
b) ICT sector employment share of total employment



Source: 2018 PREDICT Dataset.

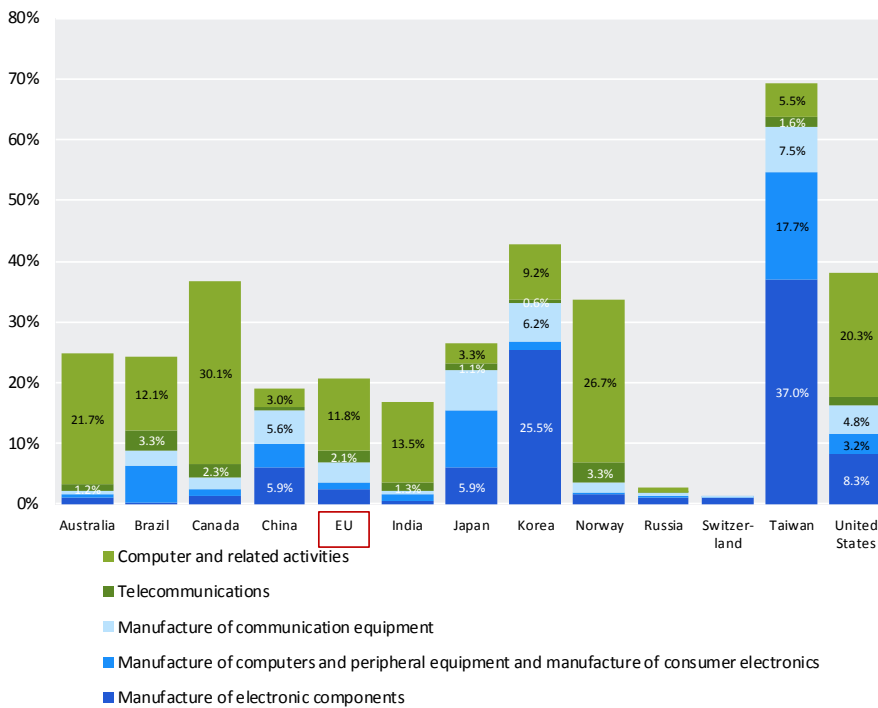
Figure 22 (cont.): ICT sector by sub-sectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

c) ICT sector BERD share of total BERD



Note: 2011 for Brazil, 2012 for Switzerland and 2013 for India.

d) ICT sector RERD share of total RERD

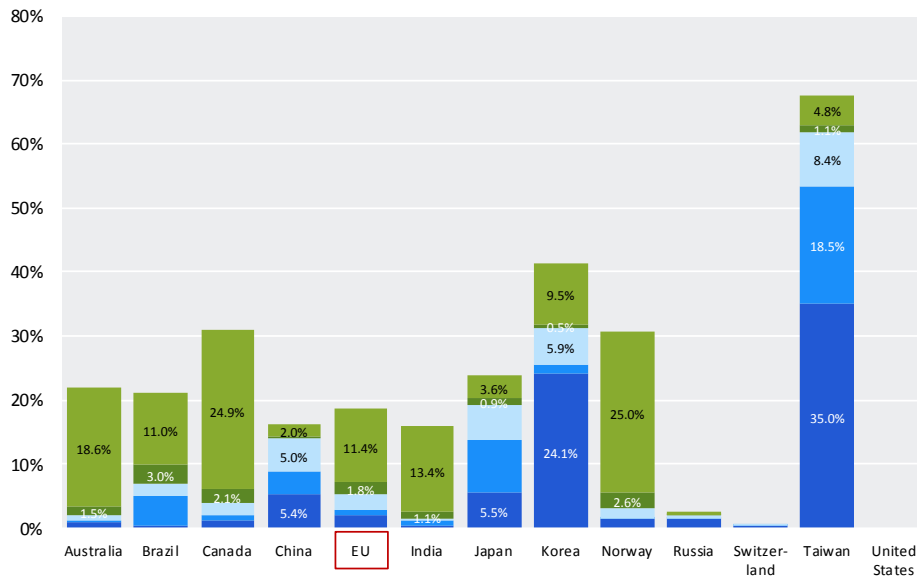


Note: 2011 for Brazil, 2012 for Switzerland, 2013 for India and 2014 for Canada.

Source: 2018 PREDICT Dataset.

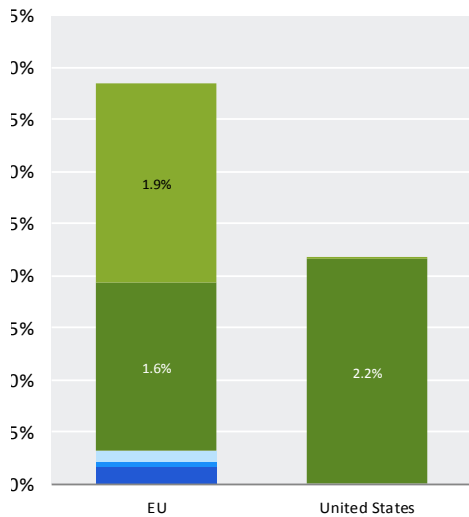
Figure 22 (cont.): ICT sector by sub-sectors in the international context: VA, employment, BERD, RERD, PERD, GBARD and ICT GBARD (2015)

e) ICT sector PERD share of total PERD

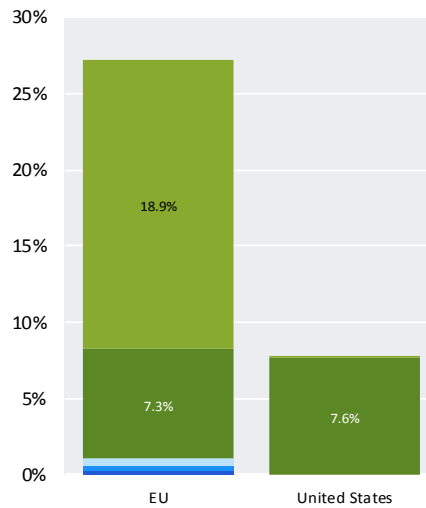


Note: 2011 for Brazil, 2012 for Switzerland, 2013 for India and 2014 for Canada.

f) ICT sector GBARD share of total GBARD



g) ICT sector ICT GBARD share of total ICT GBARD



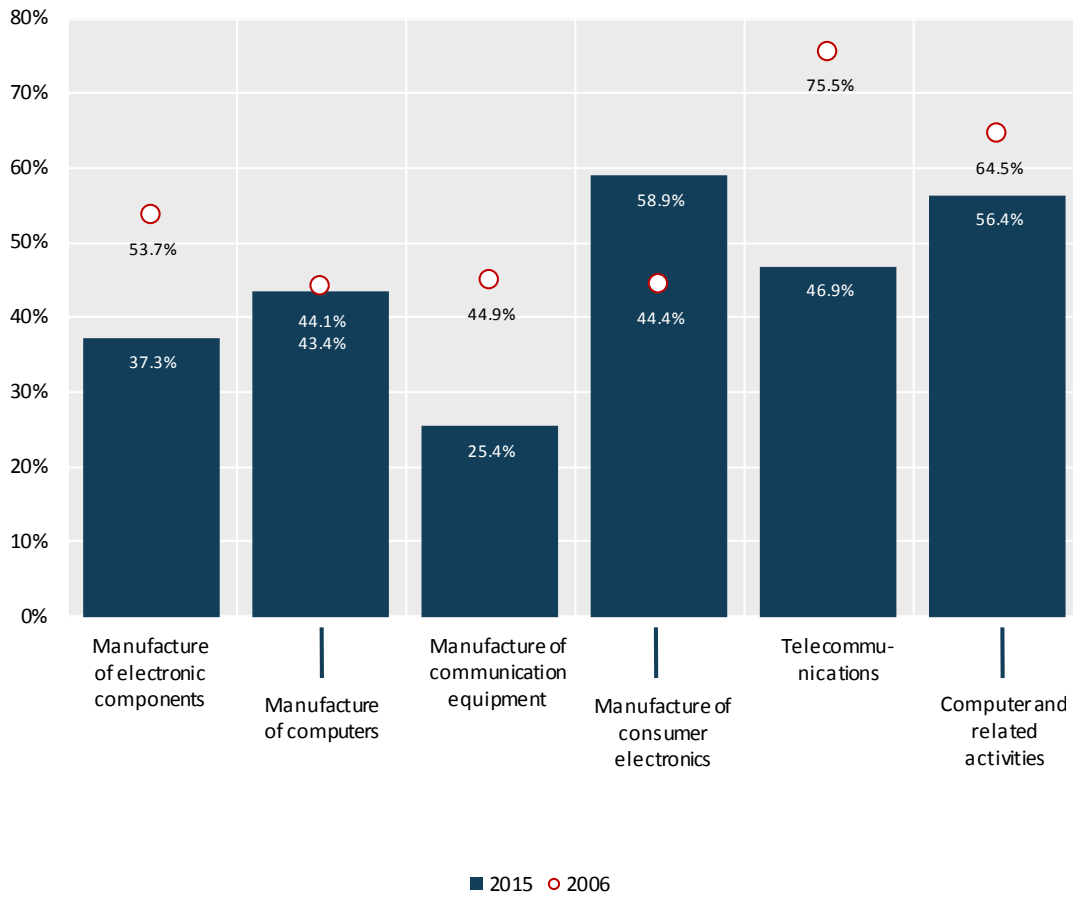
- Computer and related activities
- Telecommunications
- Manufacture of communication equipment
- Manufacture of computers and peripheral equipment and manufacture of consumer electronics
- Manufacture of electronic components

Note: 2016 for GBARD and ICT GBARD.

Source: 2018 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 10.8% of total GDP (Figure 22,a), 5.9% of total employment (Figure 22,b), 49.1% of BERD (Figure 22,c), 37.0% of R&D researchers and 35.0% of R&D personnel. In China, the sector with the highest share in terms of VA is *Telecommunications* (2.3%), while in India it is *Computer and related activities* (3.6%). In the EU 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 23: ICT sub-sector productivity per person employed, EU over United States (2006, 2015)

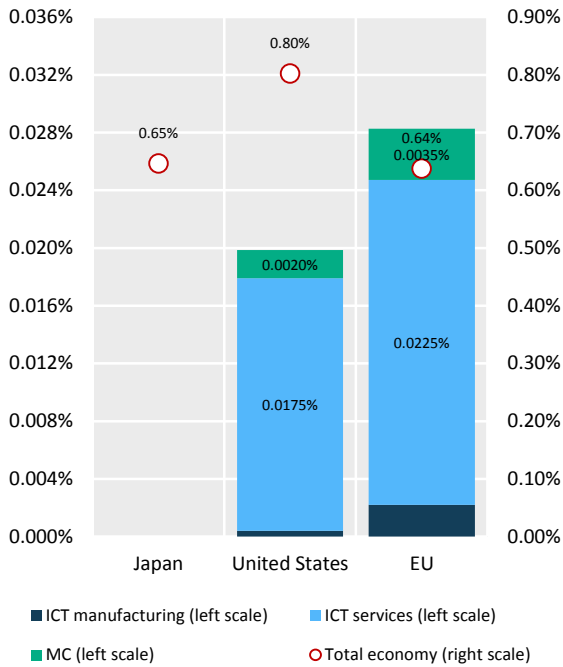


Source: 2018 PREDICT Dataset.

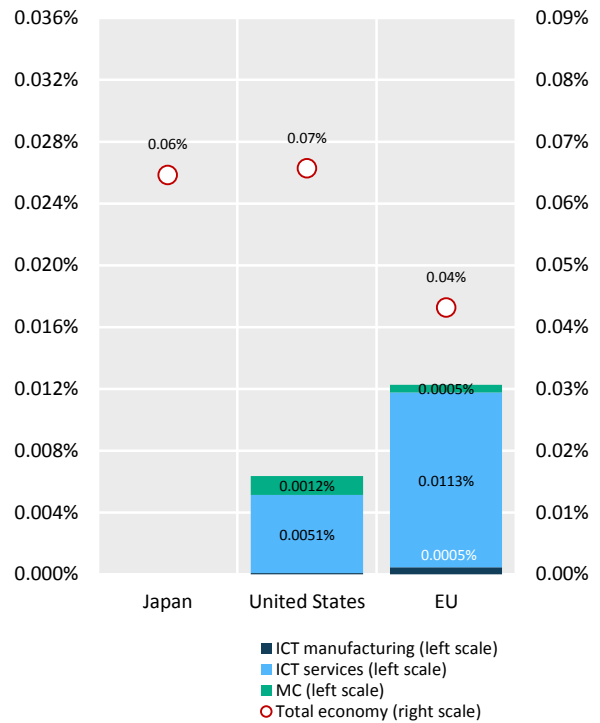
The US is the incontestable leader in many aspects but especially in labour productivity. It has a higher labour productivity per person employed than the EU in all ICT sub-sectors. *Manufacture of communication equipment* is the sub-sector in which the gap is wider (EU only represents 25.4% of the total of the US), followed by *Manufacture of electronic components* (37.3%), *Manufacture of computers* (43.4%) and *Telecommunications* (46.9%) (Figure 23). For the remaining two ICT sub-sectors, the US advantage is below 50%. In addition, the gap has widened since 2006 in four of the six sub-sectors considered. For *Manufacture of consumer electronics* the gap has narrowed and for *Manufacture of computers* it has remained the same.

Figure 24: GBARD and ICT GBARD by non-EU economies (2016)

a) GBARD intensity (GBARD/GDP)



b) ICT GBARD intensity (ICT GBARD/GDP)

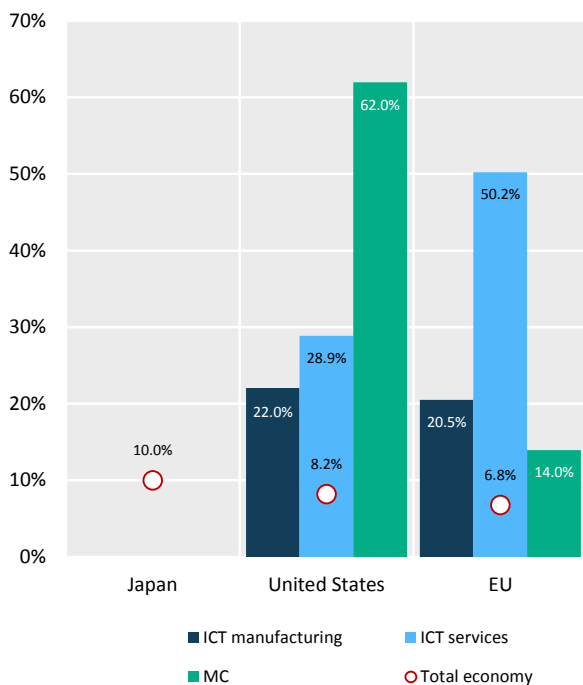


Note: Figures for Japan not fully homogeneous with EU and the United States (see methodology). ICT sector ICT GBARD for United States includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media). GDP nowcasted for 2016.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure 24 (cont.): GBARD and ICT GBARD by non-EU economies (2016)

c) ICT GBARD/GBARD

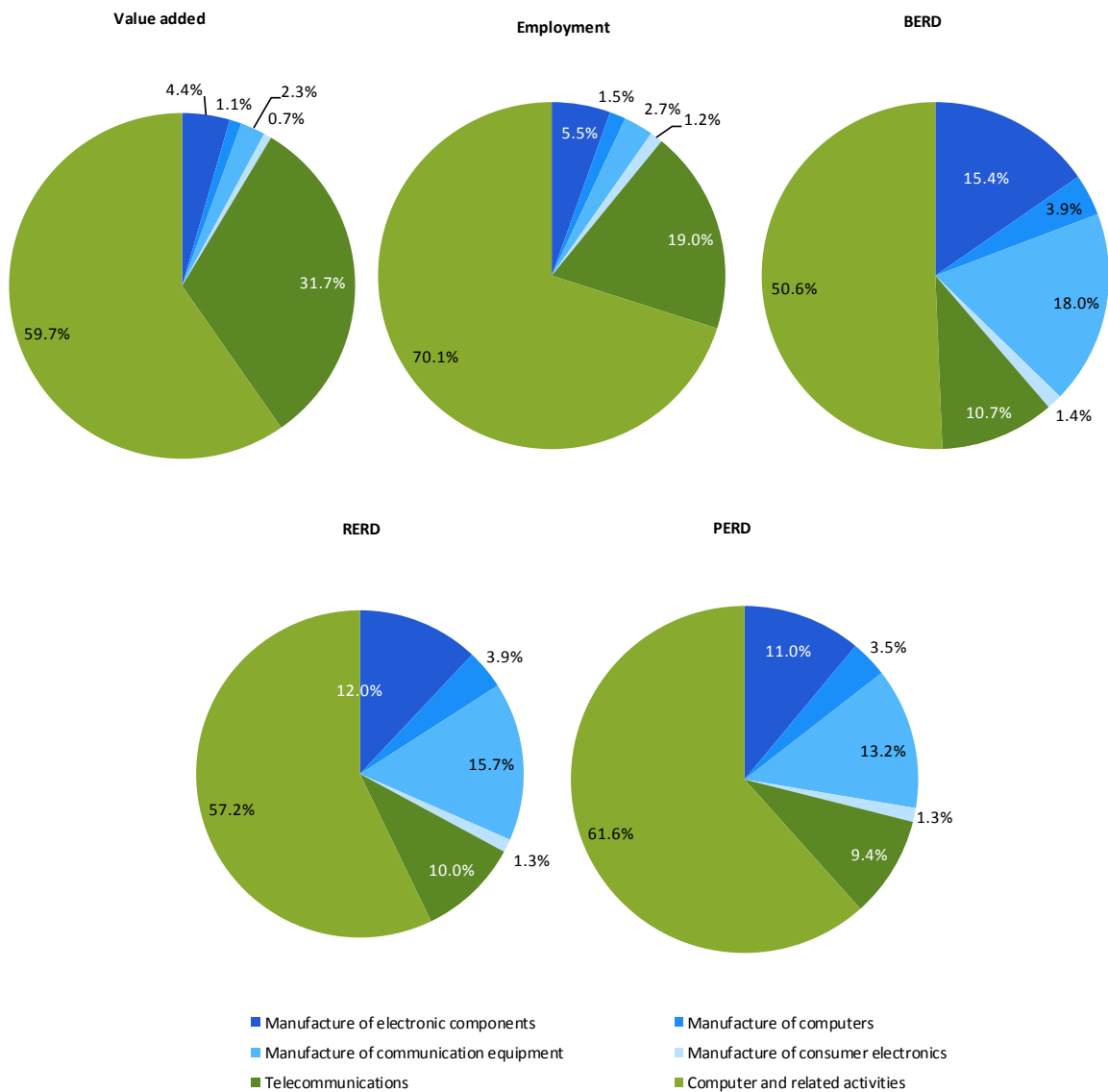


Note: Figures for Japan not fully homogeneous with EU and the United States (see methodology). ICT sector for United States (GBARD and ICT GBARD) includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media).

Source: 2018 PREDICT Dataset and European Economic Forecast Autumn 2017.

Public funding of R&D (GBARD) intensity (defined as GBARD/GDP) for the total economy is larger in the US (0.80%) than in Japan (0.65%) and the EU (0.64%)(Figure 24,a). However, it is larger in the EU for the ICT sector, ICT manufacturing, ICT services and MC sectors. The same results apply to the ICT GBARD variable. The only difference is that it is higher in the US than in the EU in the MC sector. The weight of ICT GBARD over total GBARD is especially high for the MC sector in the US (62.0%) as compared with the EU (14.0%). On the contrary, for the ICT services it is higher in the EU (50.2%) than in the US (28.9%), while the shares for the ICT manufacturing sector are similar (Figure 24,c).

Figure 25: Overview of PREDICT variables: value added, employment, BERD, RERD, PERD, GBARD, ICT GBARD and labour productivity by ICT sub-sector (2015)

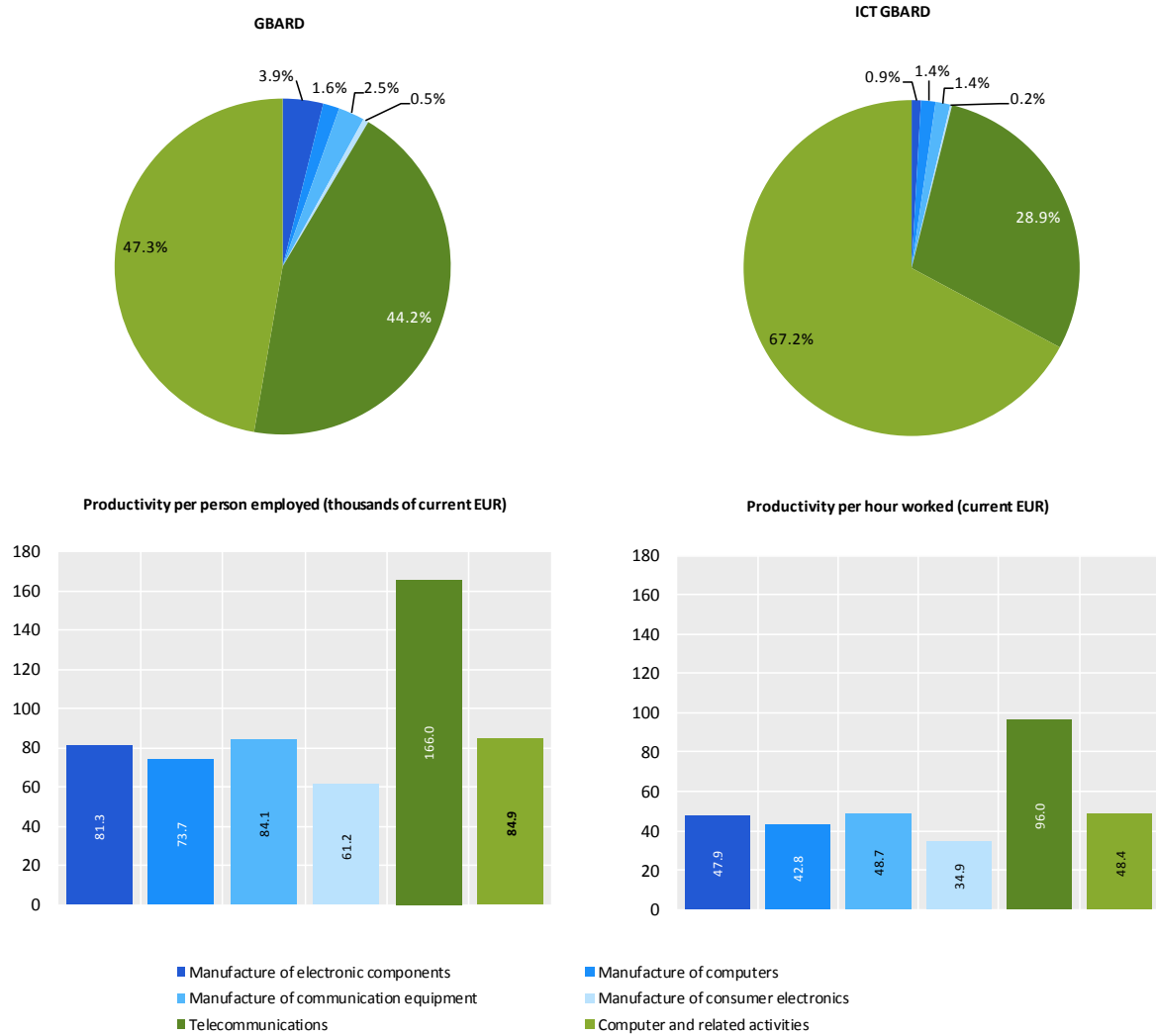


Source: 2018 PREDICT Dataset.

The *Computer and related activities* sub-sector consistently scored the highest in the seven indicators, with shares between 47.3% (GBARD) and 70.1% (Employment) in 2015 (Figure 25).

The *Telecommunications* sub-sector led labour productivity, both productivity per person employed and productivity per hour worked.

Figure 25 (cont.): Overview of PREDICT variables value added, employment, BERD, RERD, PERD, GBARD, ICT GBARD and labour productivity by ICT sub-sector (2015)



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).

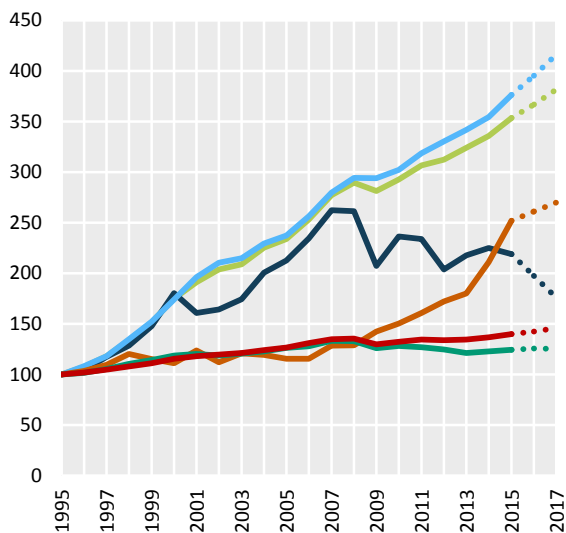
Source: 2018 PREDICT Dataset.

4 Annex

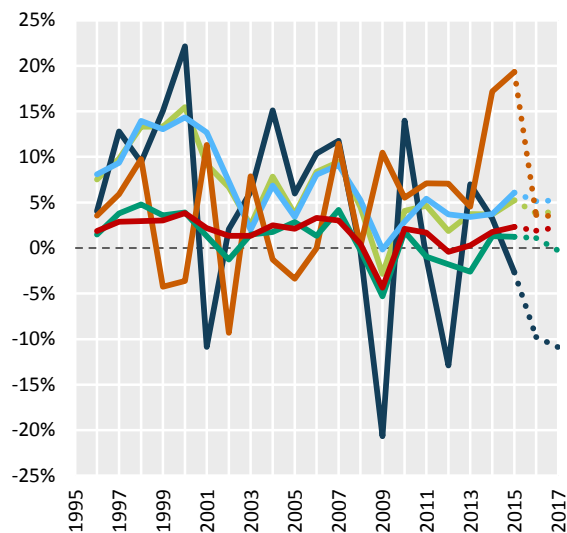
4.1 ICT sector and its R&D in the EU

Figure A 1: ICT sector VA in the EU (1995-2017)

a) Index 1995=100



b) Annual real growth rates



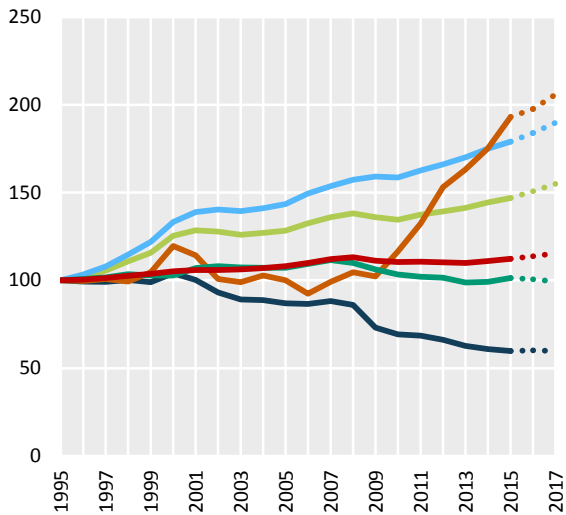
— Total ICT — ICT manufacturing — ICT services — RS — MC — GDP

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

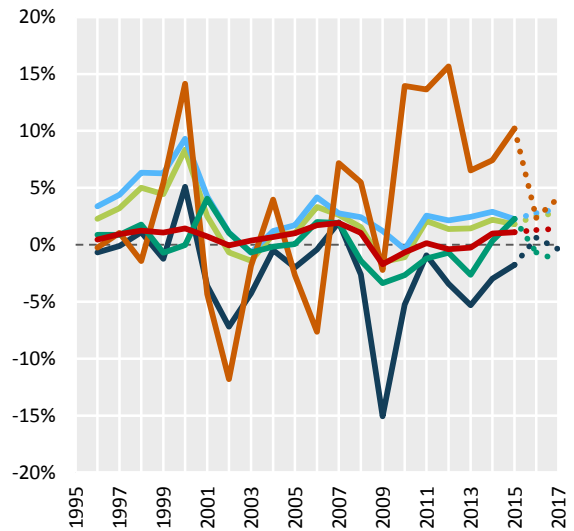
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 2: ICT sector employment in the EU (1995-2017)

a) Index 1995=100



b) Annual growth rates



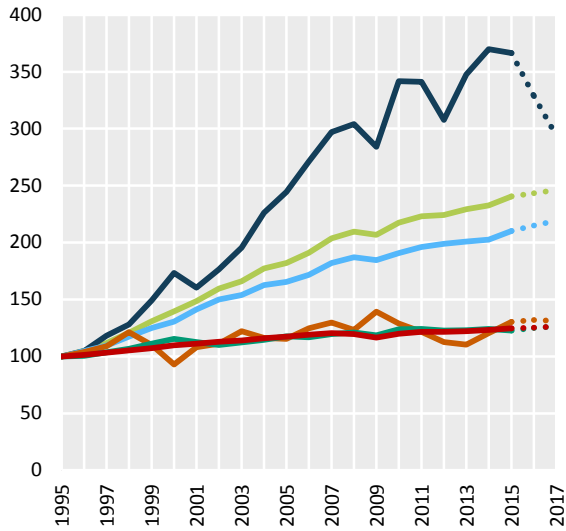
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total employment

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

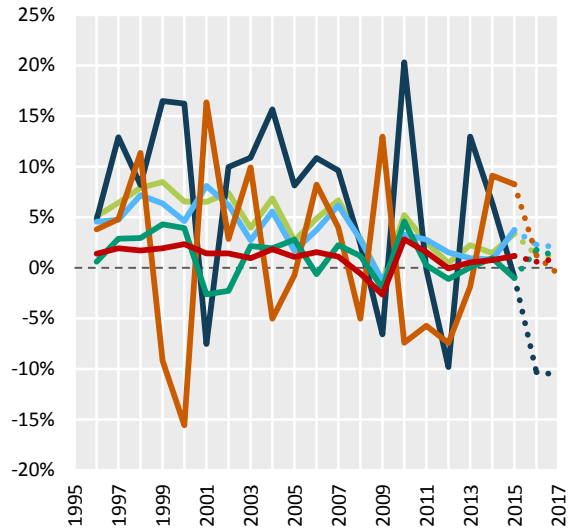
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 3: ICT sector productivity per person employed in the EU (1995-2017)

a) Index 1995=100



b) Annual real growth rates



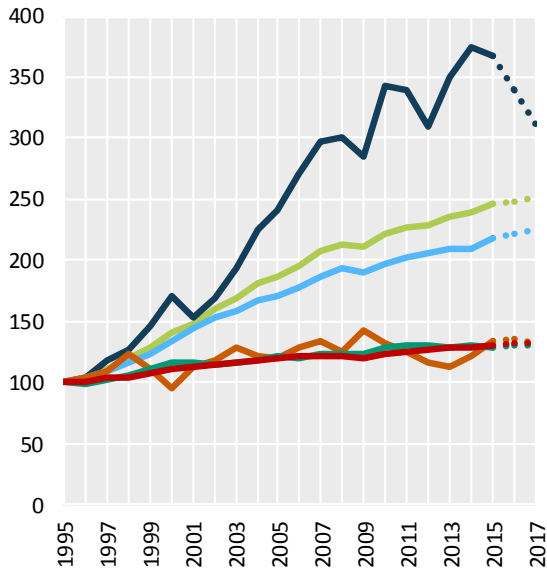
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total economy

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

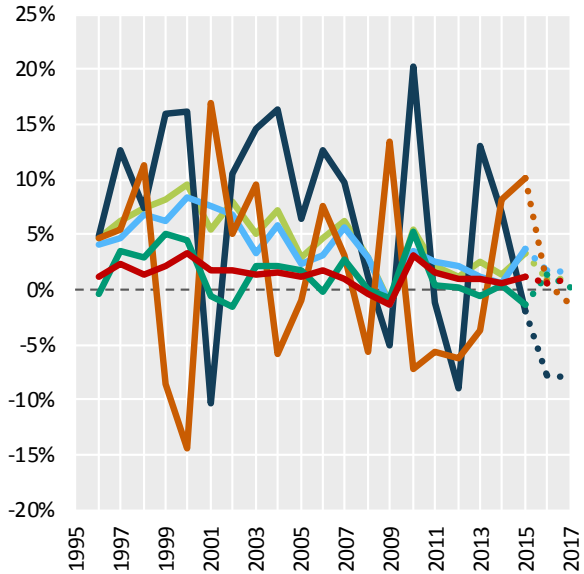
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 4: ICT sector productivity per hour worked in the EU (1995-2017)

a) Index 1995=100



b) Annual real growth rates



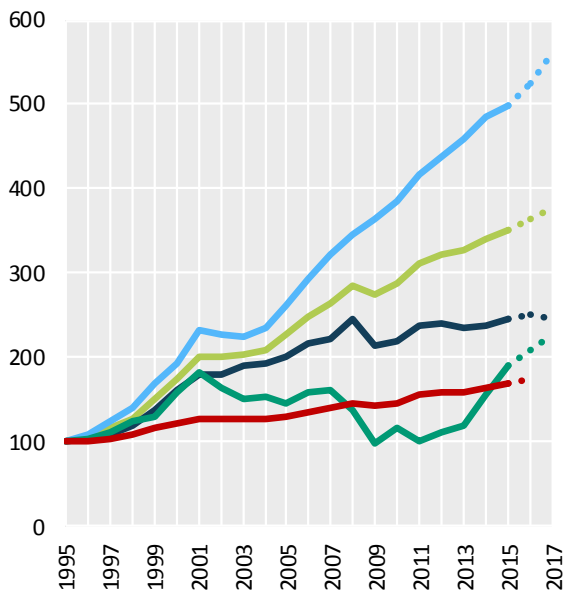
Legend: Total ICT (light green), ICT manufacturing (dark blue), ICT services (light blue), RS (orange), MC (teal), Total economy (red)

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

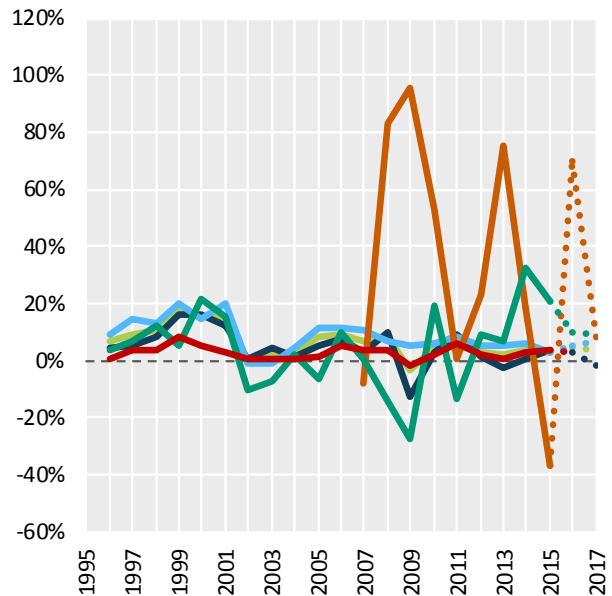
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 5: ICT sector BERD in the EU (1995-2017)

a) Index 1995=100



b) Annual real growth rates



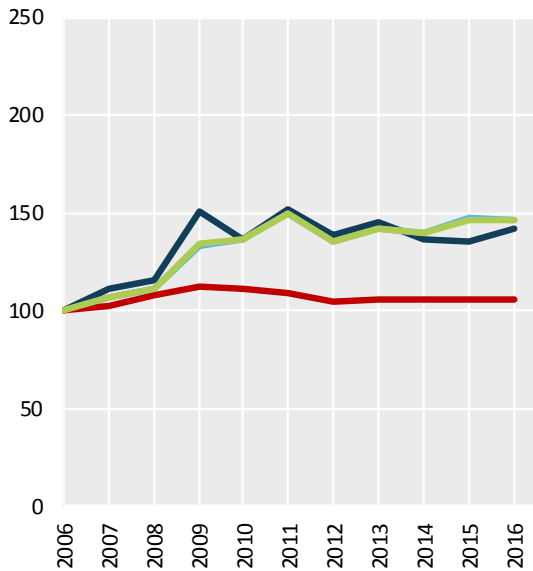
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total BERD

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

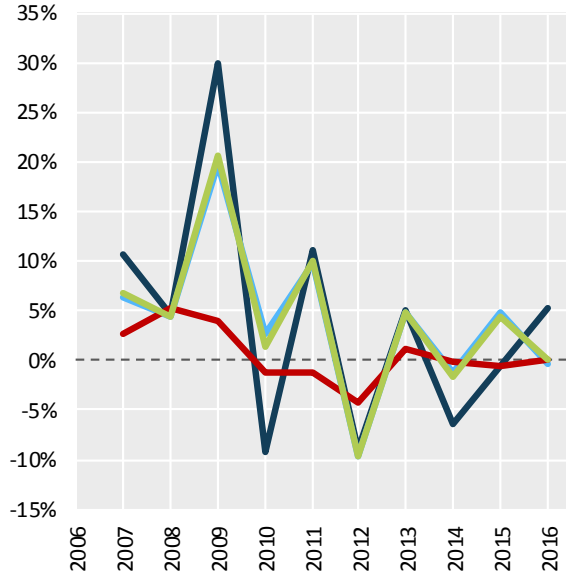
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 6: GBARD and ICT GBARD in the EU (2006-2016)

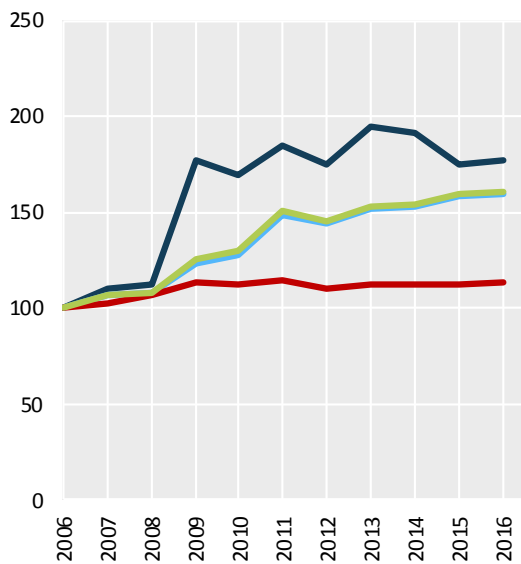
a) GBARD. Index 2006=100



b) GBARD. Annual real growth rates



c) ICT GBARD. Index 2006=100



d) ICT GBARD. Annual real growth rates

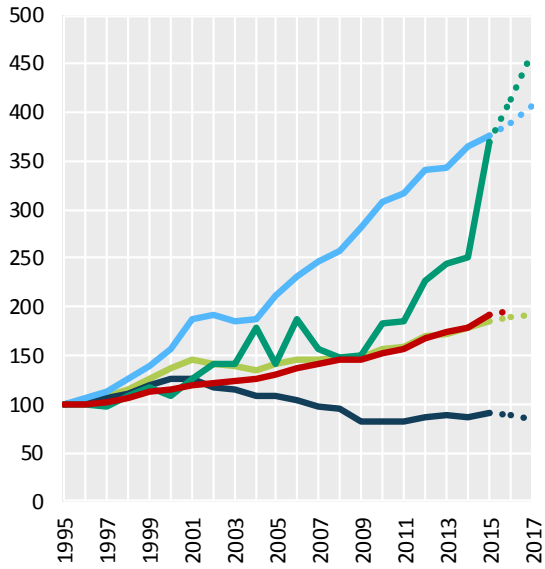


— ICT manufacturing — ICT services — Total ICT GBARD — Total ICT

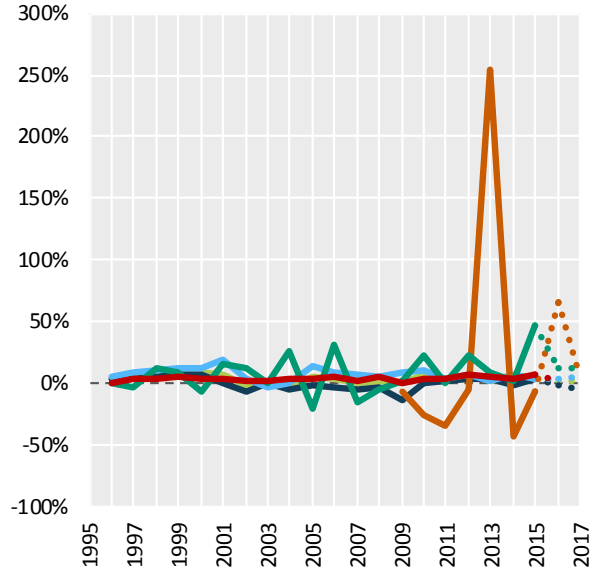
Source: 2018 PREDICT Dataset.

Figure A 7: ICT sector RERD in the EU (1995-2017)

a) Index 1995=100



b) Annual growth rates



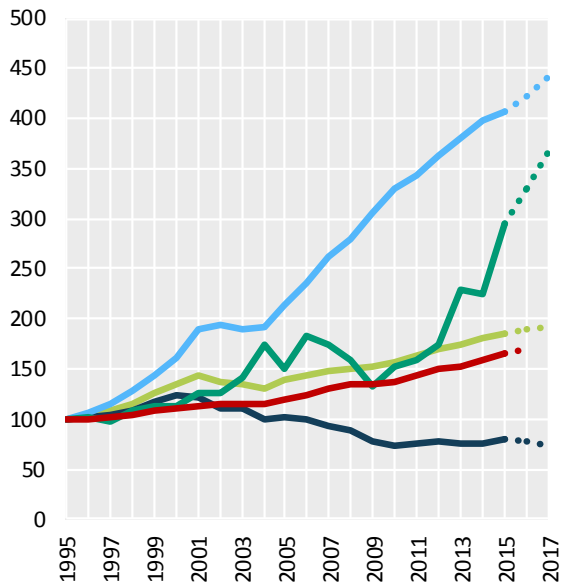
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total RERD

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

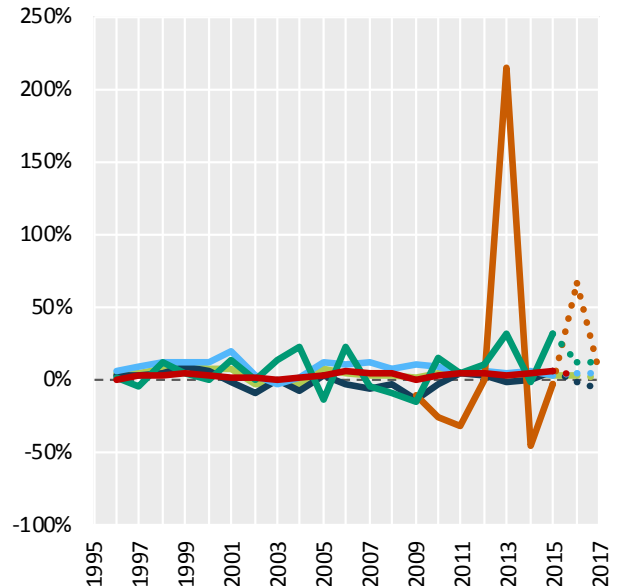
Source: 2018 PREDICT Dataset.

Figure A 8: ICT sector PERD in the EU (1995-2017)

a) Index 1995=100



b) Annual growth rates



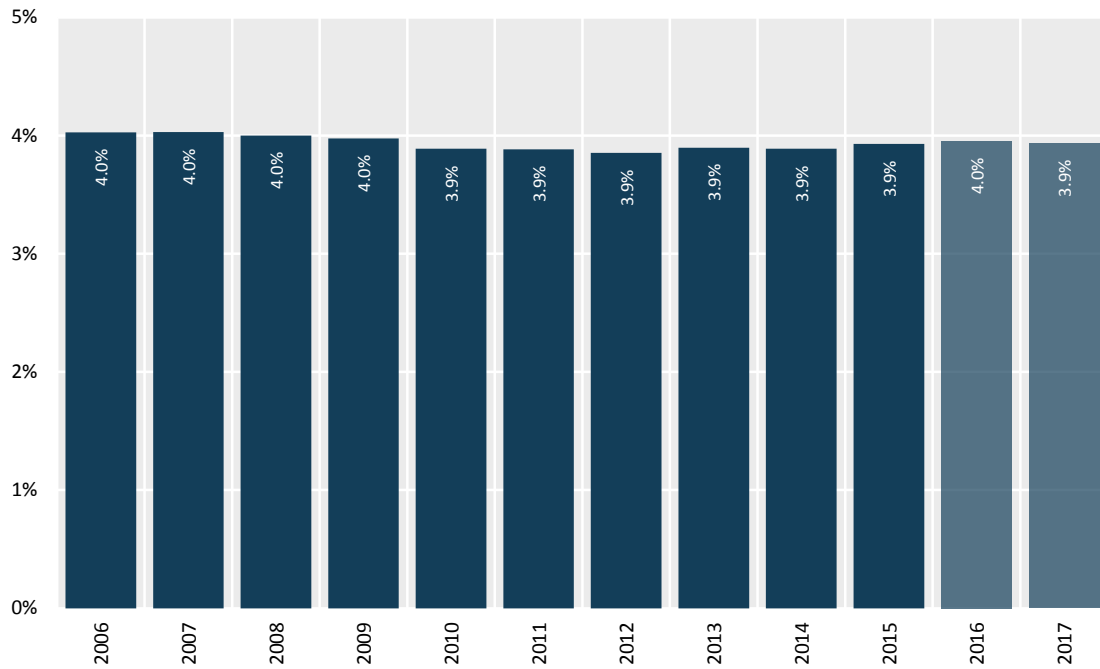
— Total ICT — ICT manufacturing — ICT services — RS — MC — Total PERD

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

Source: 2018 PREDICT Dataset.

4.2 Analysis by sub-sectors in the EU

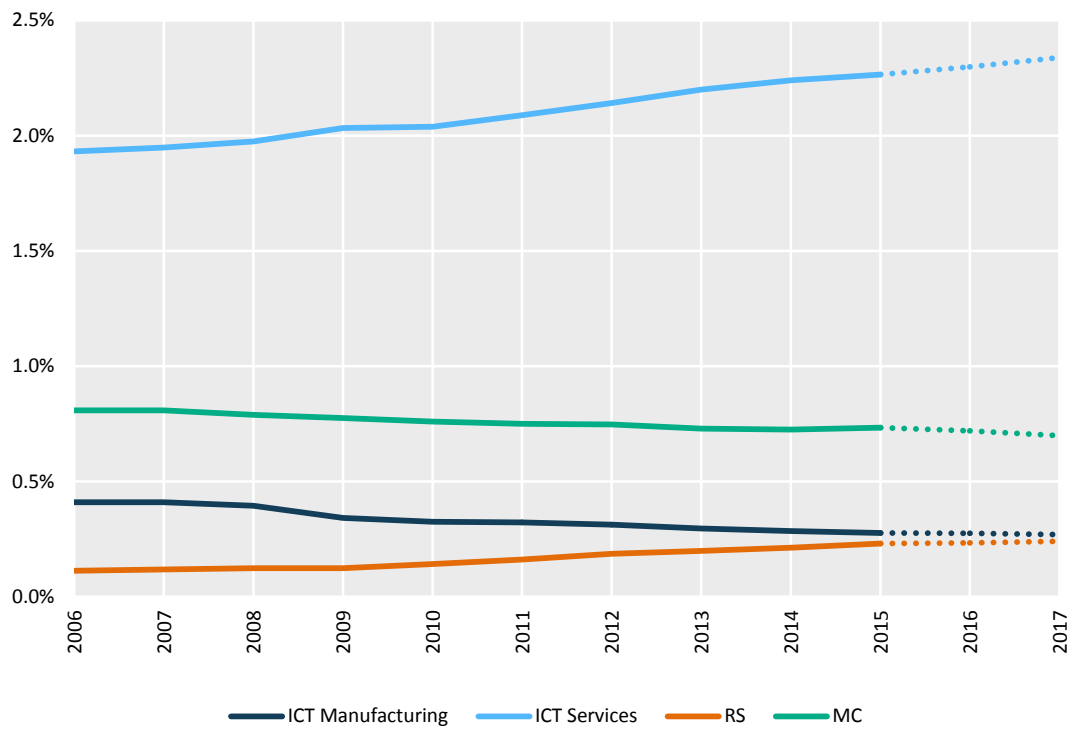
Figure A 9: ICT sector VA share of GDP in the EU (2006-2017)



Note: Light columns indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

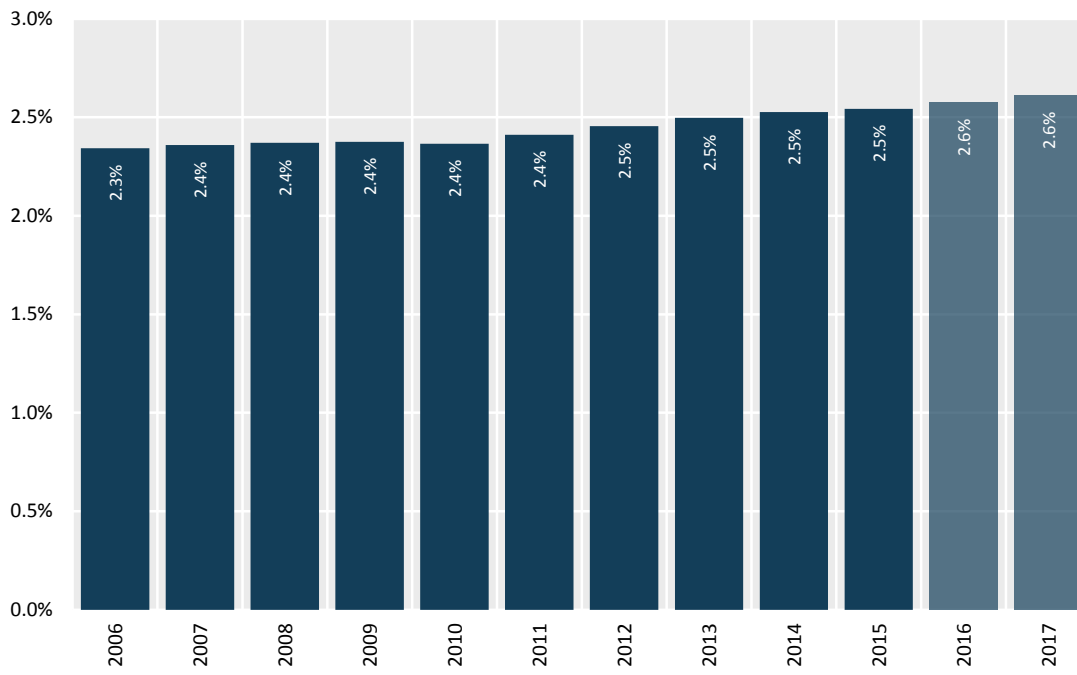
Figure A 10: ICT manufacturing, ICT services, MC and RS sectors share of GDP in the EU (2006-2017)



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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

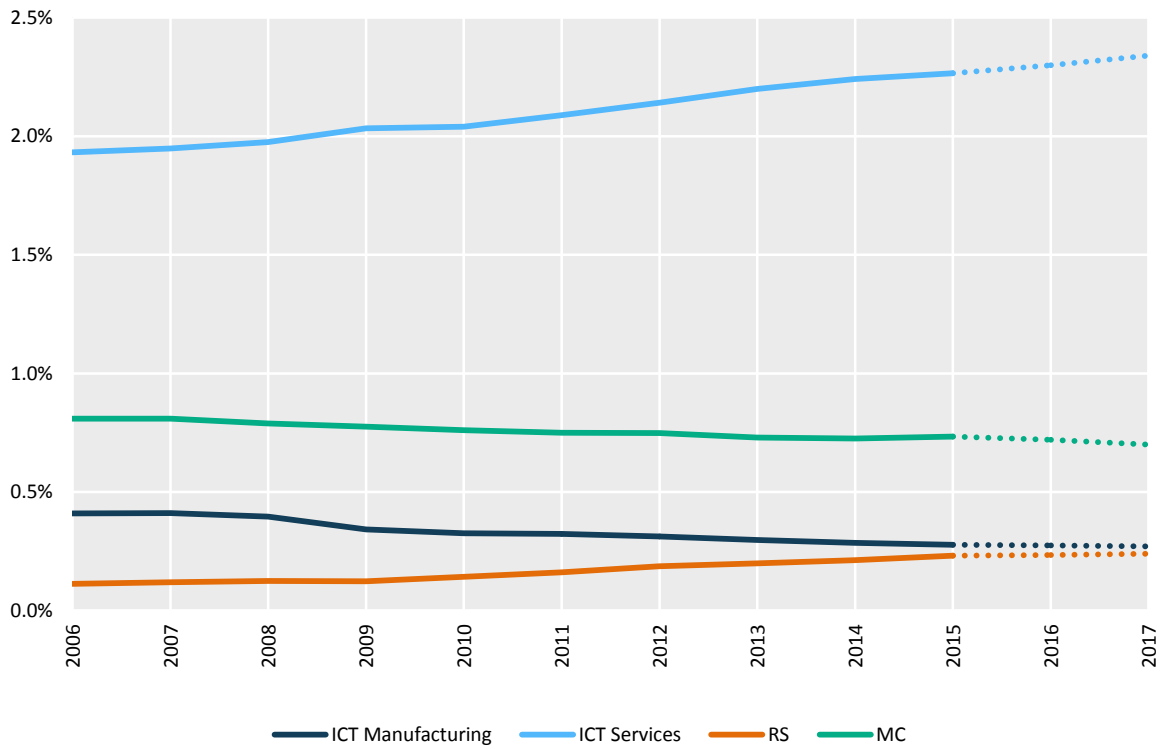
Figure A 11: ICT sector employment share of total employment in the EU (2006-2017)



Note: Light columns indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 12: ICT manufacturing, ICT services, MC and RS sectors share of the total employment in the EU (2006-2017)

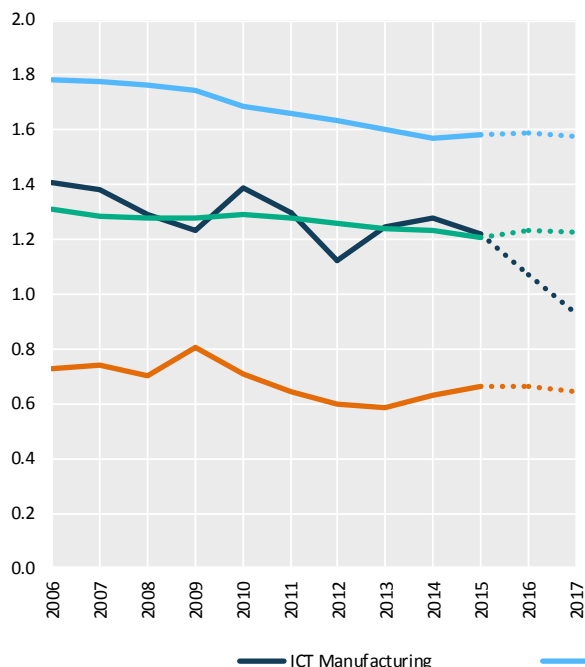


Note: MC: Media and Content. RS: Retail sale via mail order houses or via Internet. Dashed lines indicate nowcasted data.

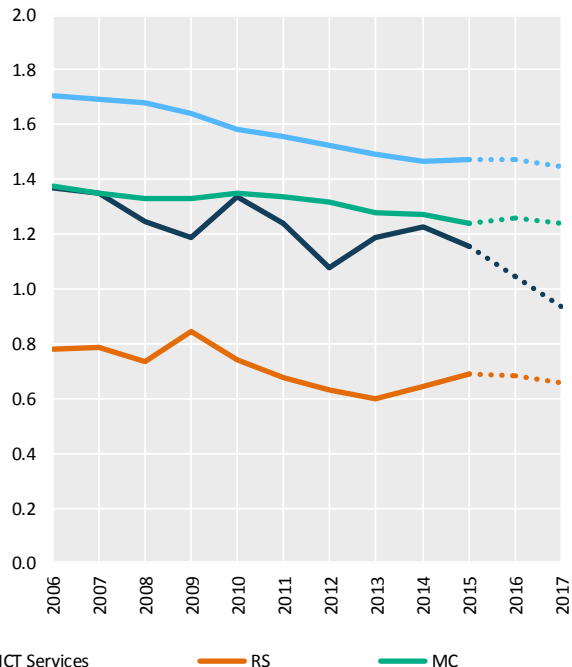
Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 13: Productivity in ICT manufacturing, ICT services, MC and RS sectors as a ratio of total economy productivity in the EU (2006-2017)

a) Productivity per person employed



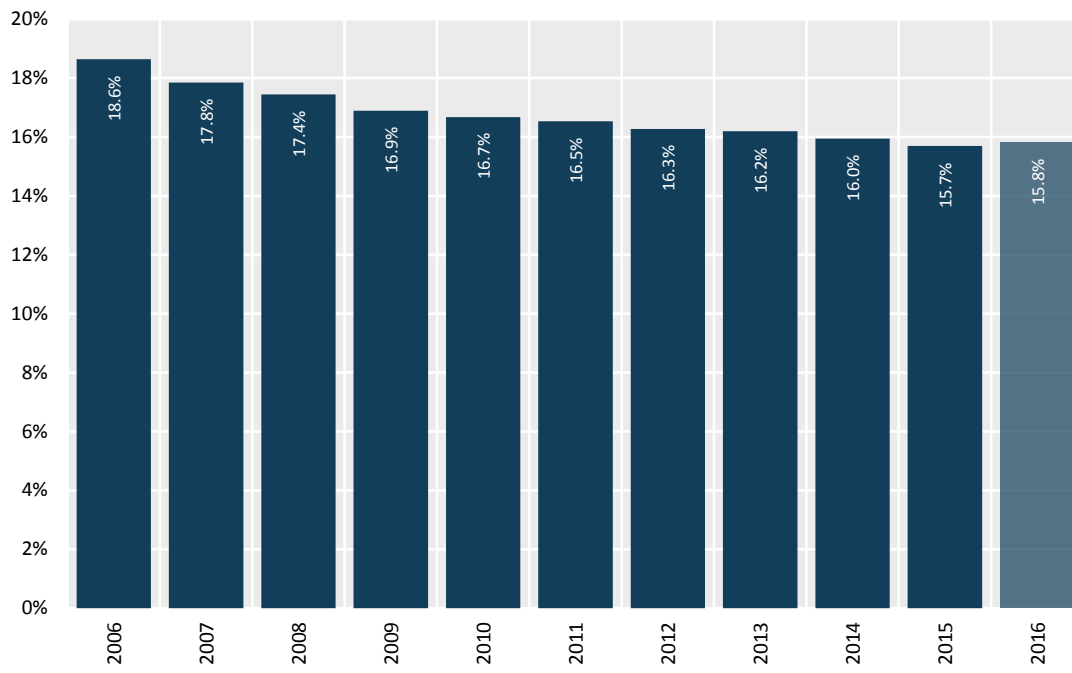
b) Productivity per hour worked



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

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 14: ICT sector BERD share of total BERD in the EU (2006-2016)

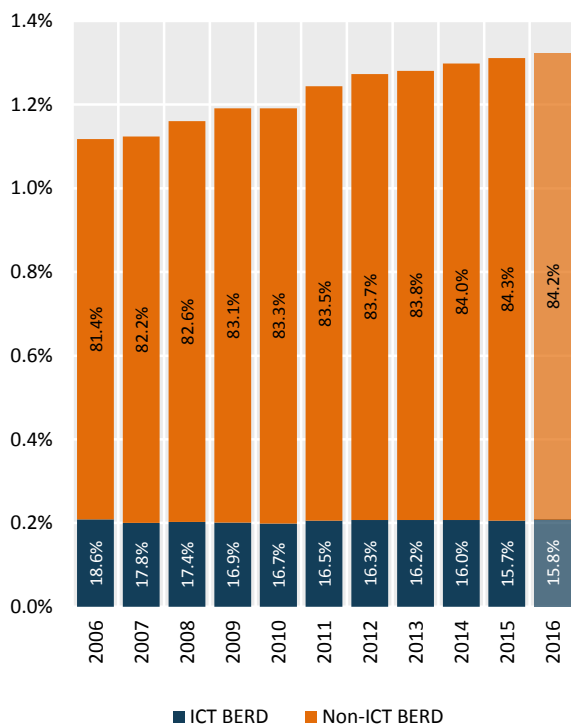


Note: Light columns indicate nowcasted data.

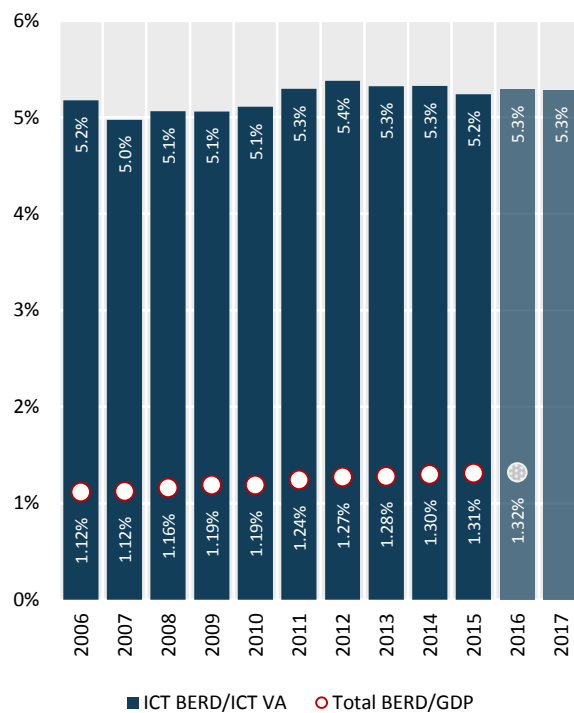
Source: 2018 PREDICT Dataset.

Figure A 15: ICT BERD intensity and total BERD intensity in the EU (2006-2017)

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



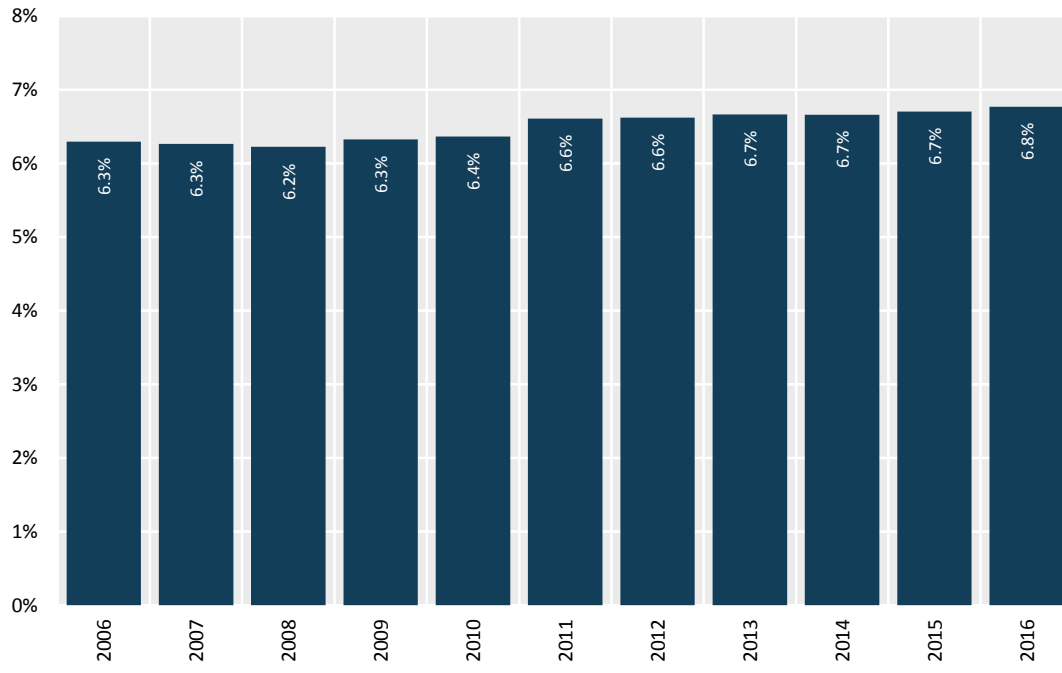
b) ICT BERD intensity and total BERD intensity



Note: Column and circle patterns indicate nowcasted data.

Source: 2018 PREDICT Dataset, AMECO and Eurostat.

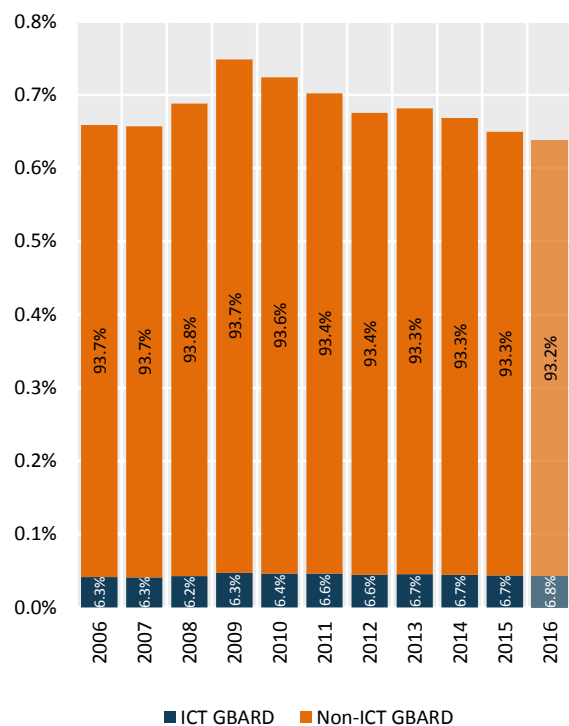
Figure A 16: ICT GBARD share of total GBARD in the EU (2006-2016)



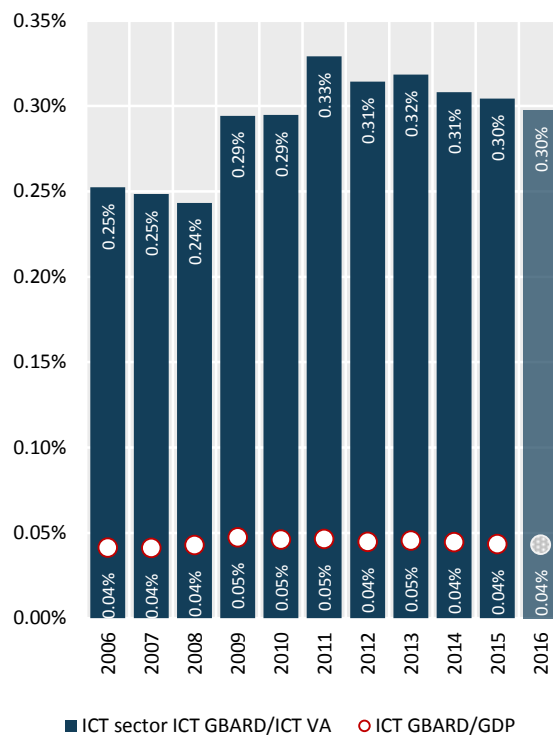
Source: 2018 PREDICT Dataset.

Figure A 17: ICT GBARD intensity in ICT sector and total economy in the EU Union (2006-2016)

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



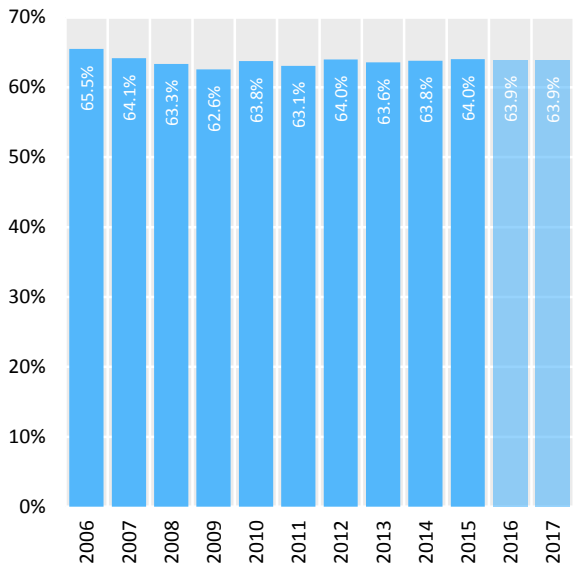
b) ICT GBARD intensity



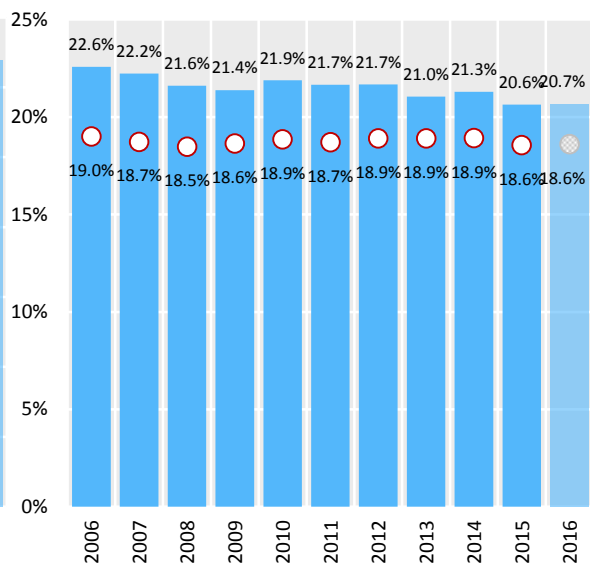
Note: Column and circle patterns indicate nowcasted data.
 Source: 2018 PREDICT Dataset, AMECO and Eurostat.

Figure A 18: ICT sector RERD and ICT sector PERD in the EU (2006-2017)

a) ICT RERD over ICT PERD



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



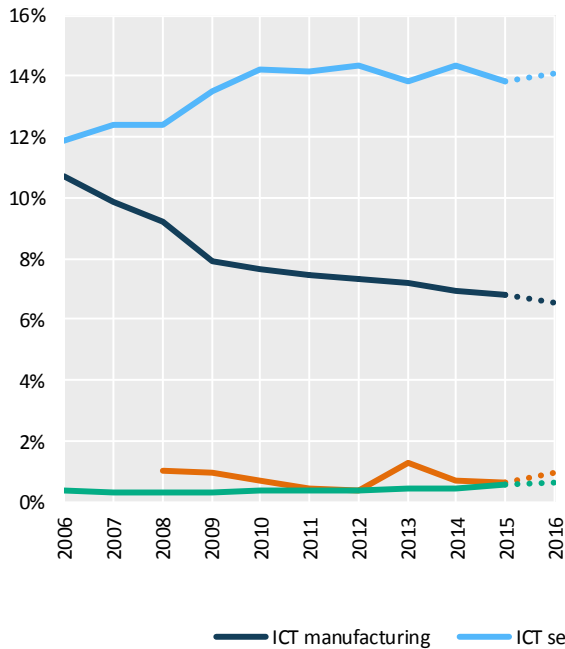
■ ICT RERD over total RERD ○ ICT PERD over total PERD

Note: Light columns and circle patterns indicate nowcasted data.

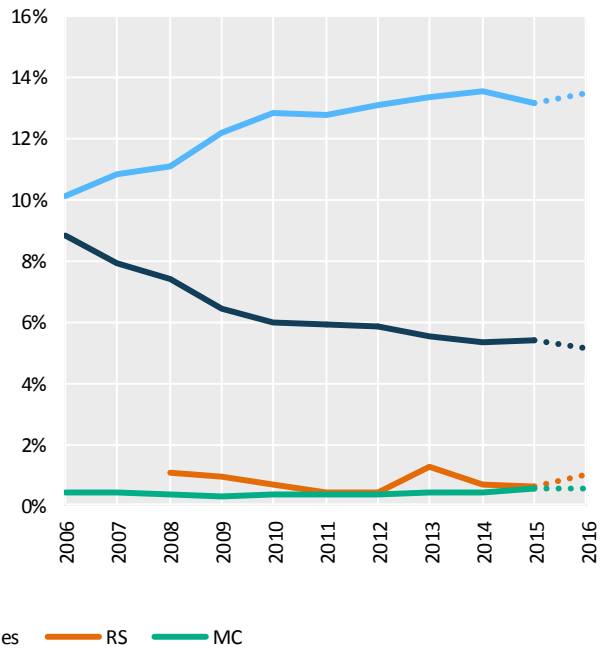
Source: 2018 PREDICT Dataset.

Figure A 19: ICT manufacturing, ICT services, MC and RS sector share of total in the EU (2006-2016)

a) RERD



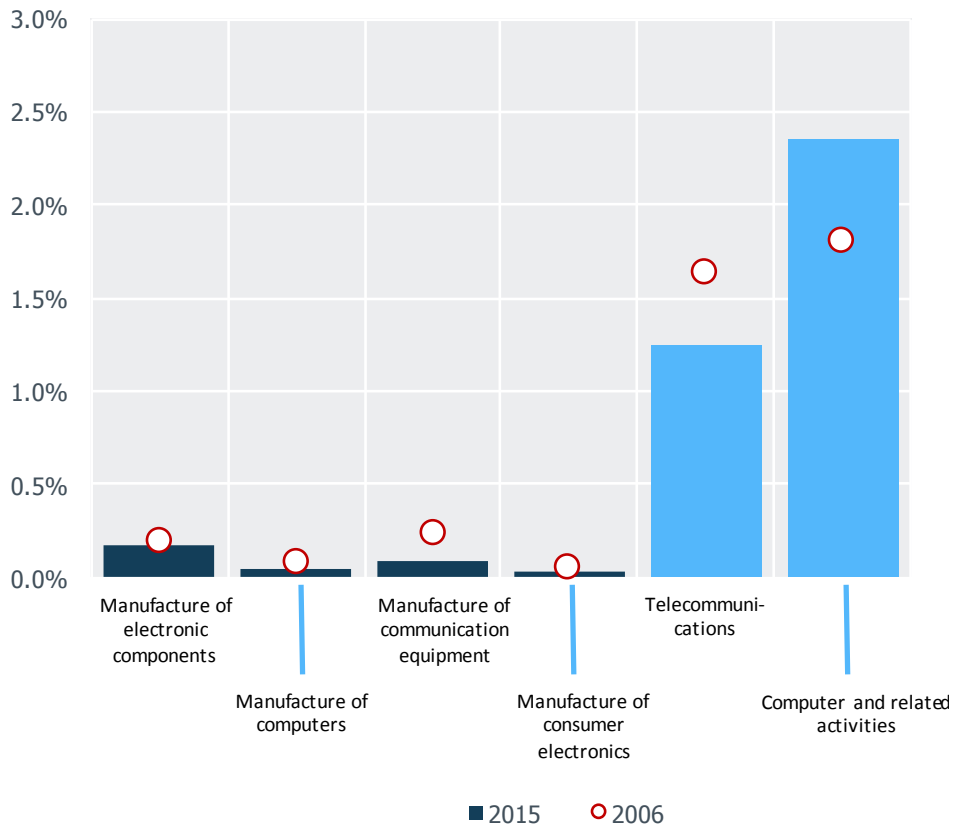
b) PERD



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

Source: 2018 PREDICT Dataset.

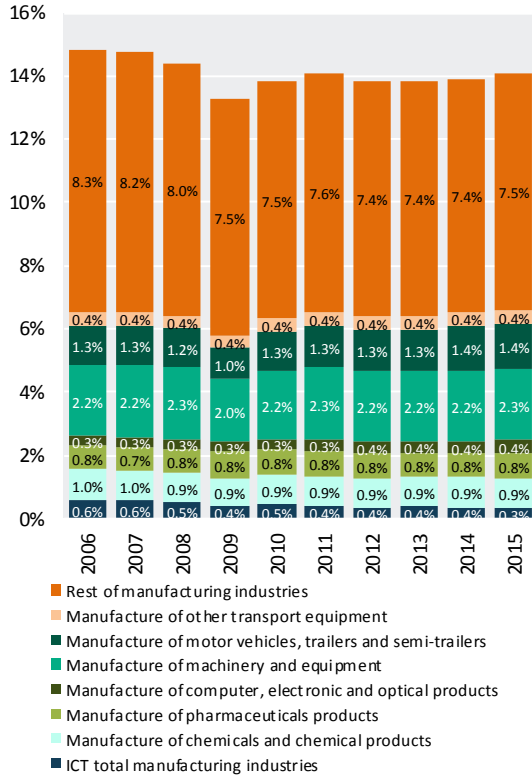
Figure A 20: ICT sector VA share of GDP by sub-sector in the EU (2006, 2015)



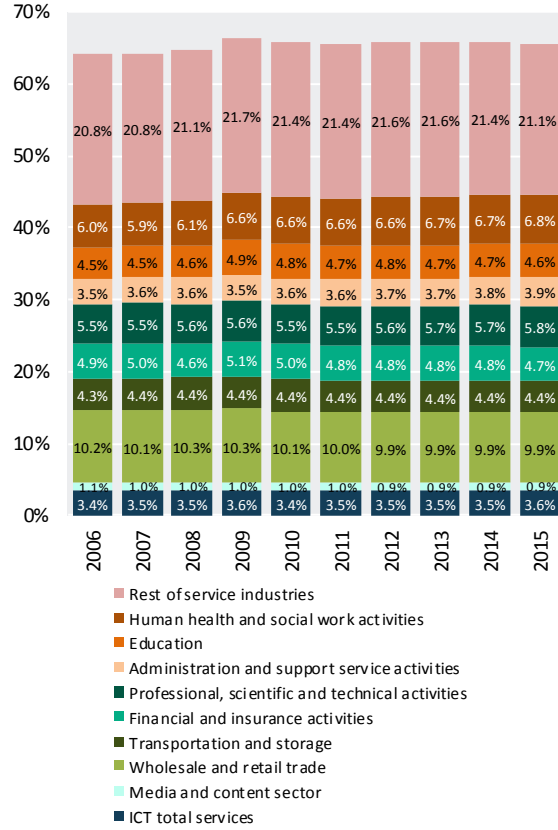
Source: 2018 PREDICT Dataset.

Figure A 21: ICT sector VA share of GDP and comparison with non-ICT economic activities in the EU (2006-2015)

a) Manufacturing



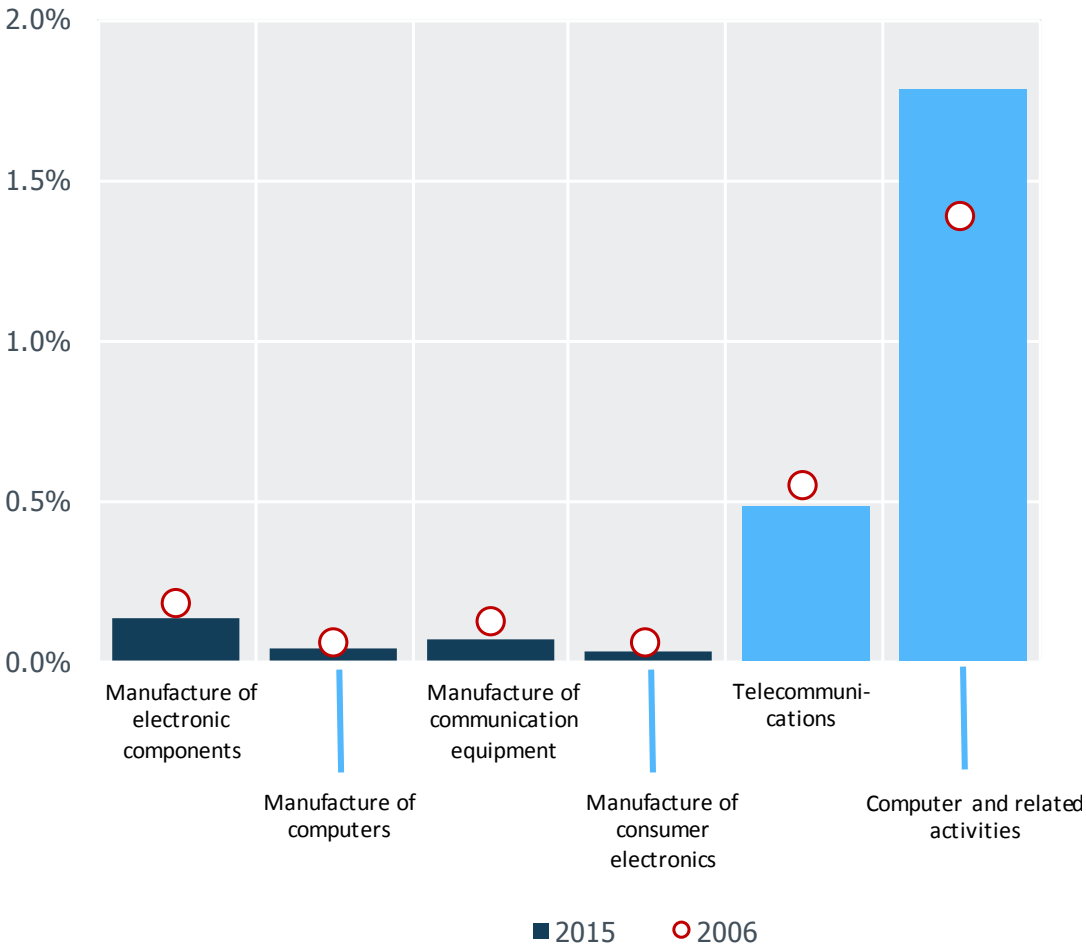
b) Services



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: 2018 PREDICT Dataset.

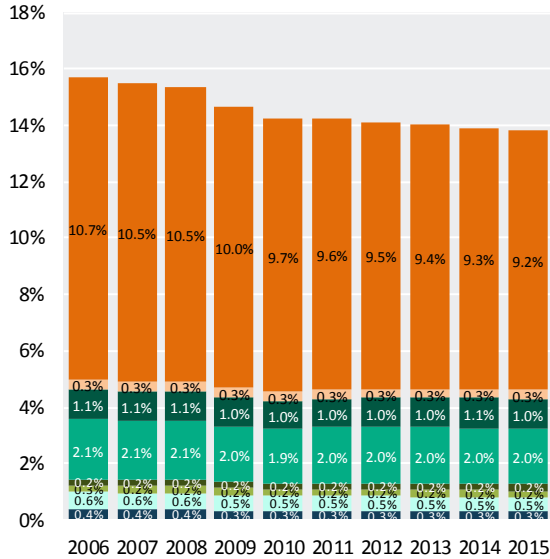
Figure A 22: ICT sector employment share of total employment by sub-sector in the EU (2006, 2015)



Source: 2018 PREDICT Dataset.

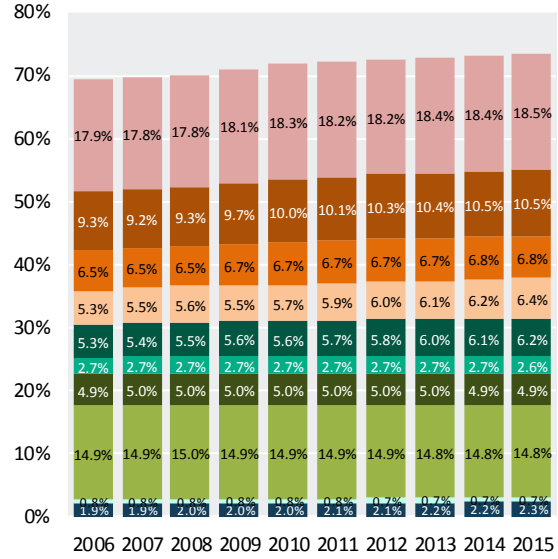
Figure A 23: ICT sector employment share on total employment and comparison with non-ICT economic activities in the EU (2006-2015)

a) Manufacturing



- 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 pharmaceutical products
- Manufacture of chemicals and chemical products
- ICT total manufacturing industries

b) Services



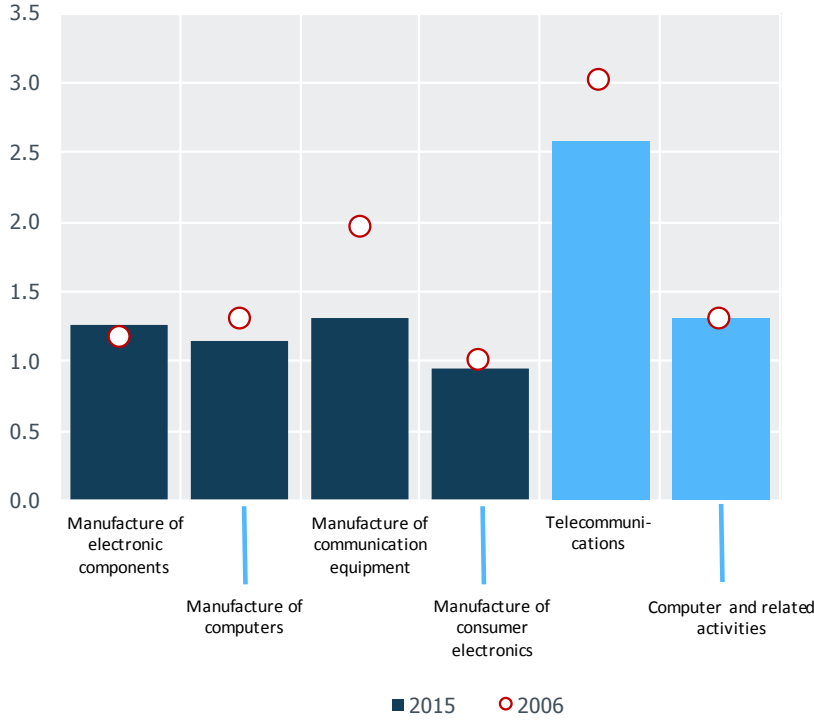
- Rest of service industries
- Human health and social work activities
- Education
- Administration and support service activities
- Professional, scientific and technical activities
- Financial and insurance activities
- Transportation and storage
- Wholesale and retail trade
- Media and content sector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

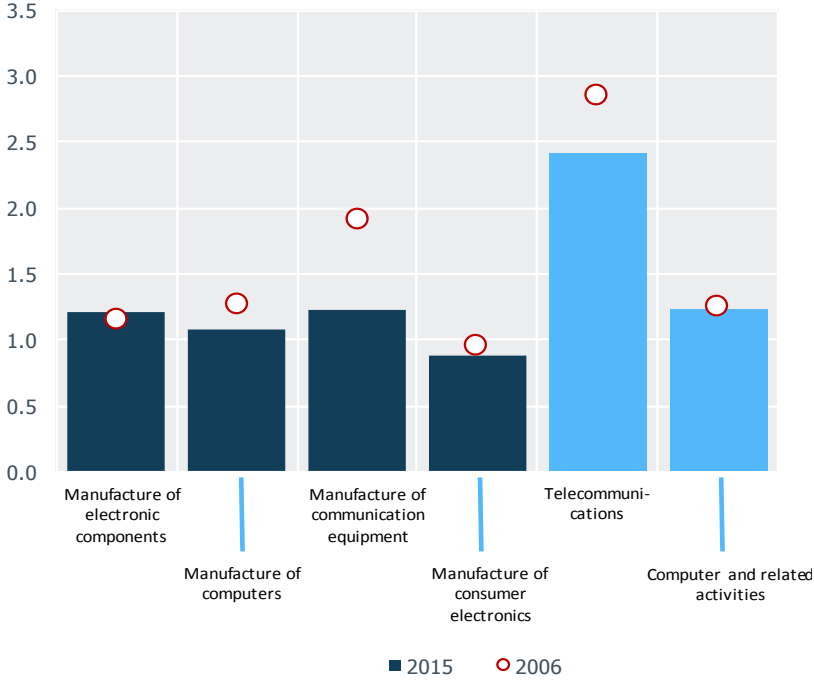
Source: 2018 PREDICT Dataset.

Figure A 24: ICT sector productivity ratio over productivity in total economy by sub-sector in the EU (2006, 2015)

a) Labour productivity per person employed



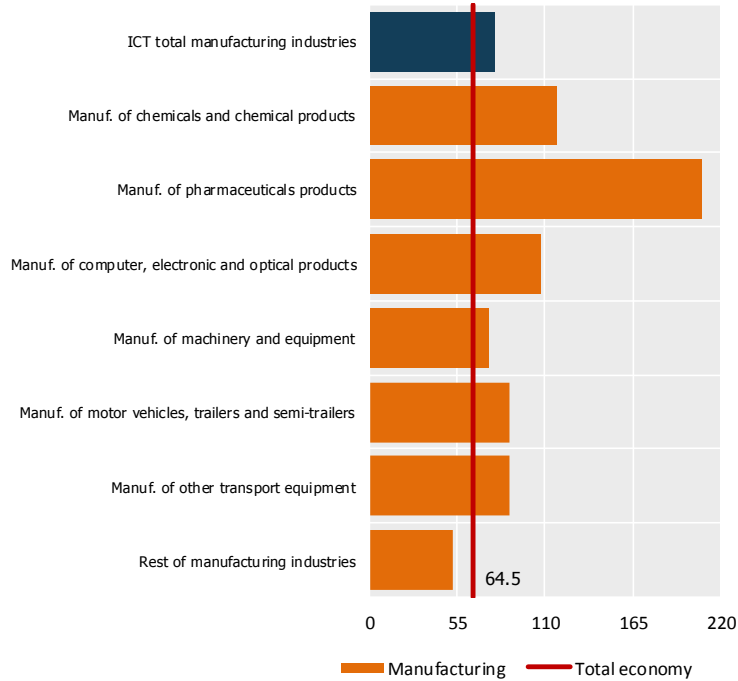
b) Labour productivity per hour worked



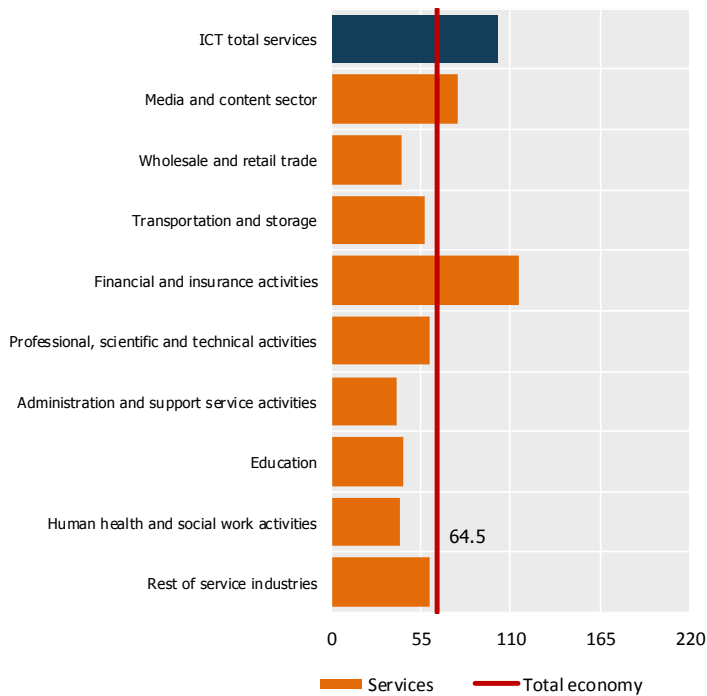
Source: 2018 PREDICT Dataset.

Figure A 25: ICT sector productivity per person employed and comparison with non-ICT economic activities in the EU (thousand current EUR per person; 2015)

a) Manufacturing



b) Services

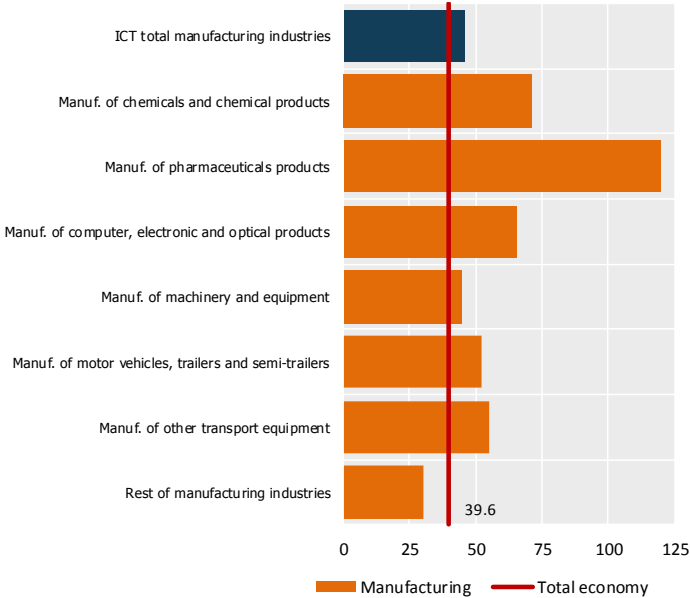


Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction not included neither in manufacturing nor in services industries.

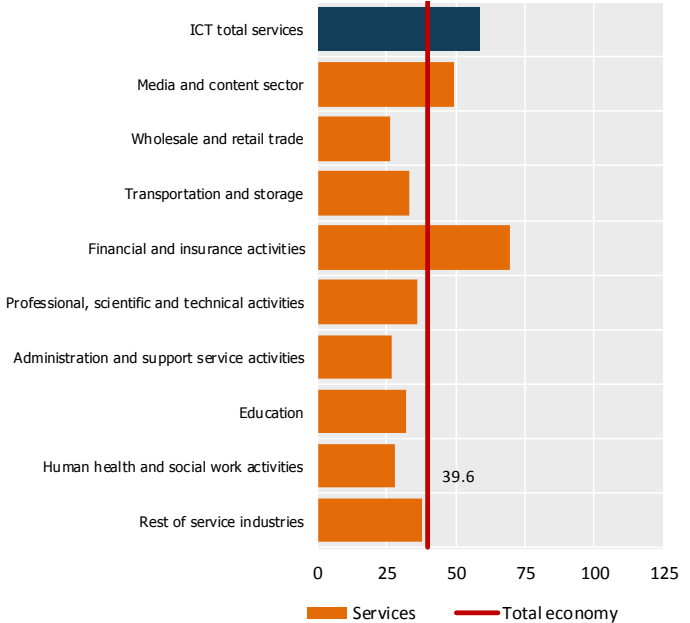
Source: 2018 PREDICT Dataset.

Figure A 26: ICT sector productivity per hour worked and comparison with non-ICT economic activities in the EU (current EUR per hour worked; 2015)

a) Manufacturing



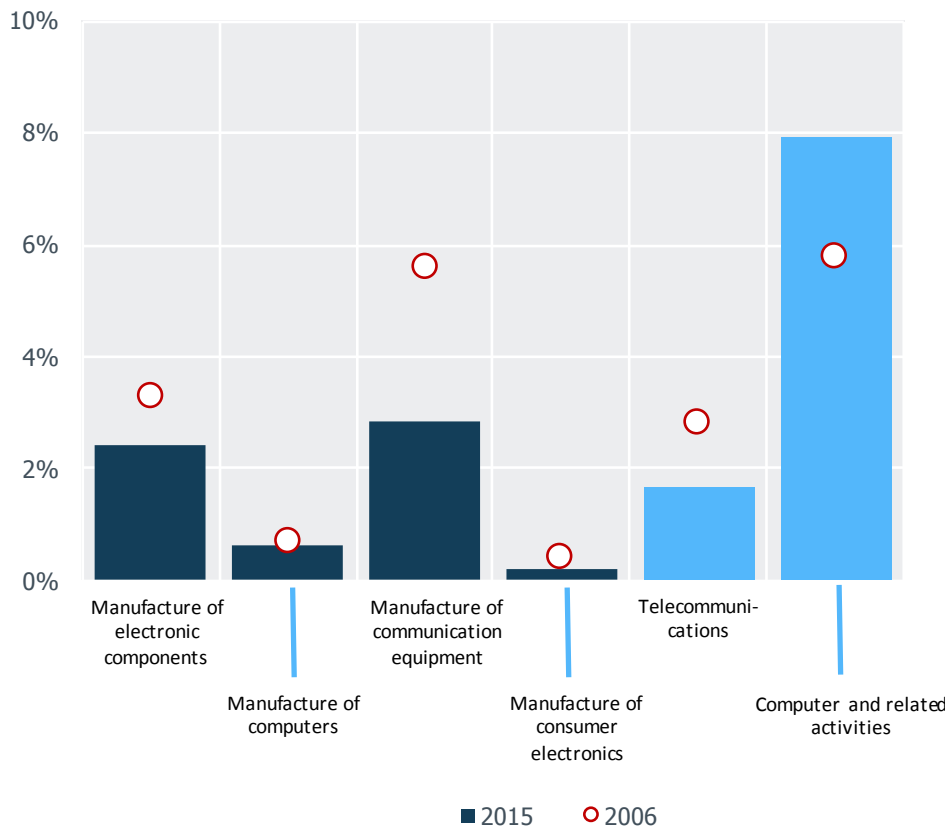
b) Services



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: 2018 PREDICT Dataset.

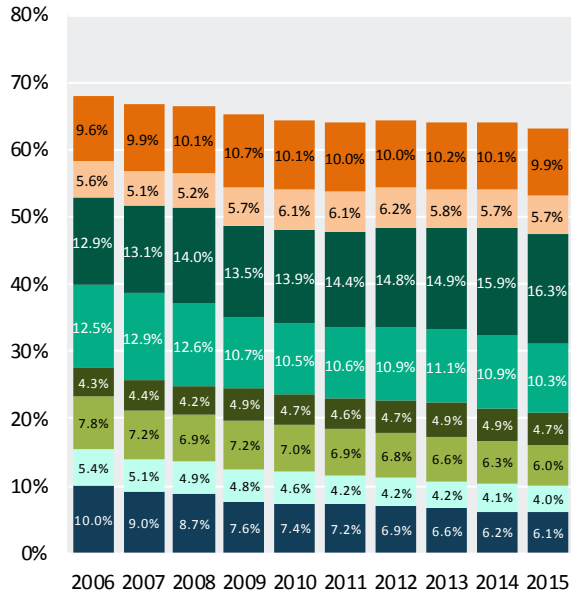
Figure A 27: ICT sector BERD share of total BERD by sub-sector in the EU (2006, 2015)



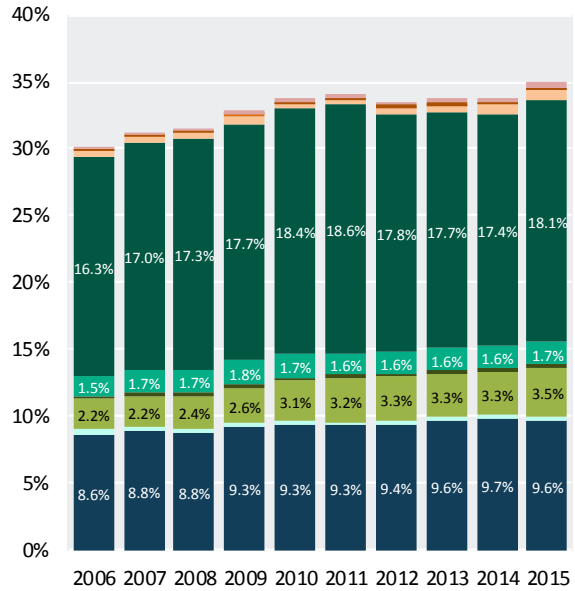
Source: 2018 PREDICT Dataset.

Figure A 28: ICT sector BERD share of total BERD and comparison with non-ICT economic activities in the EU (2006-2015)

a) Manufacturing



b) Services

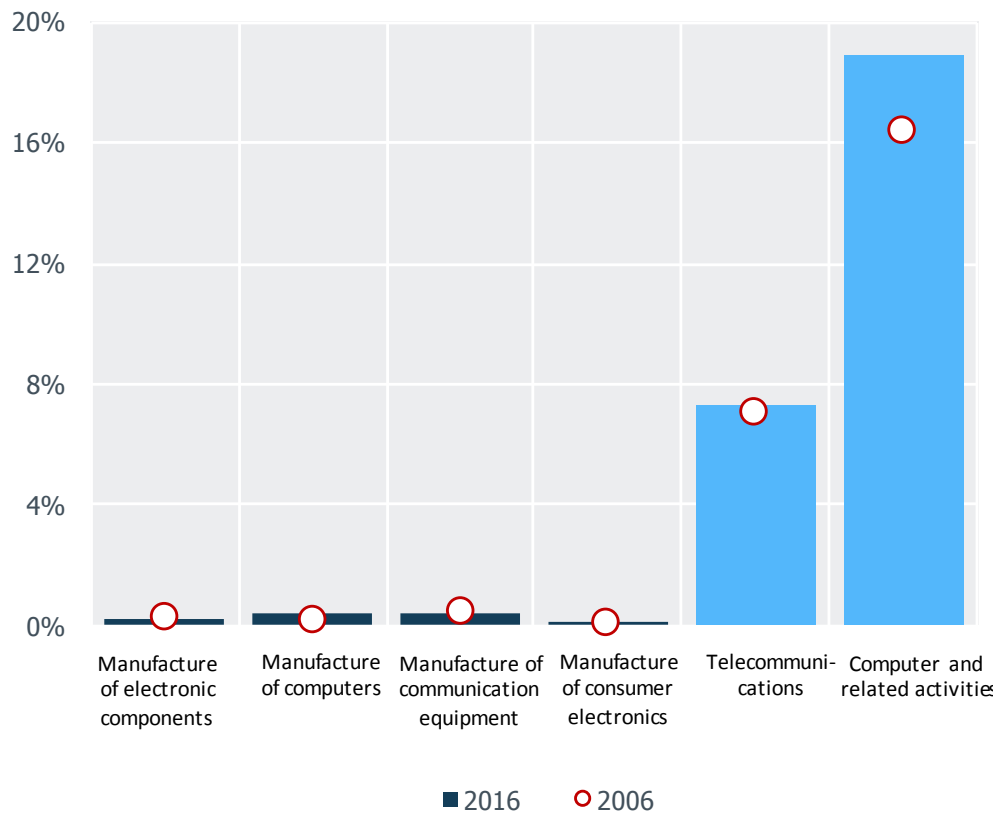


- Rest of manufacturing industries
 - Manufacture of other transport equipment
 - Manufacture of motor vehicles, trailers and semi-trailers
 - Manufacture of machinery and equipment
 - Manufacture of computer, electronic and optical products
 - Manufacture of pharmaceutical products
 - Manufacture of 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: 2018 PREDICT Dataset.

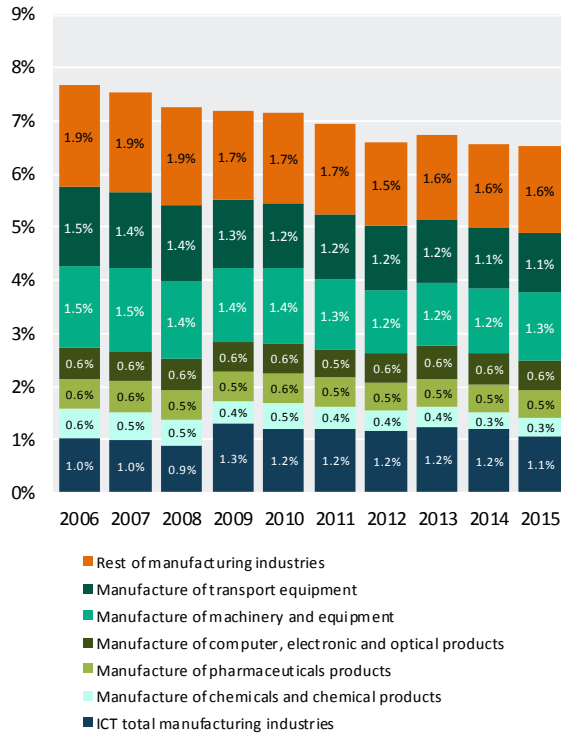
Figure A 29: ICT GBARD share of total ICT GBARD by sub-sector in the EU (2006, 2016)



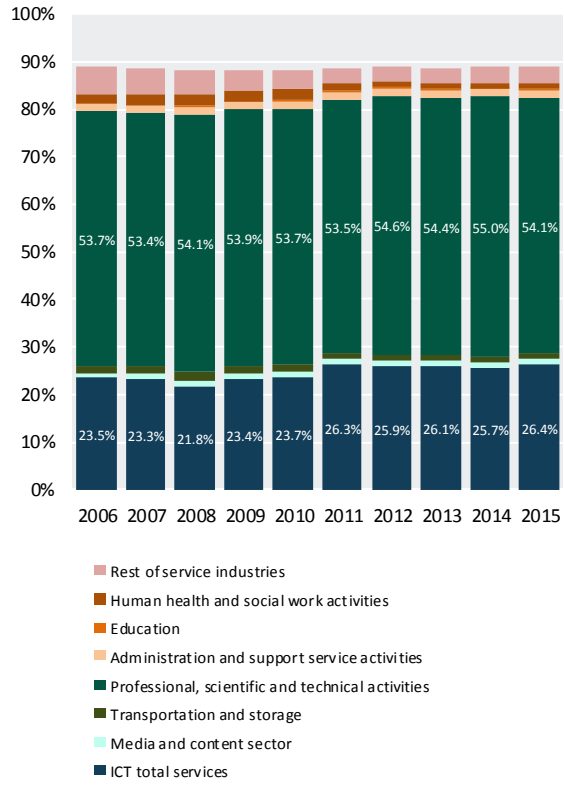
Source: 2018 PREDICT Dataset.

Figure A 30: ICT sector ICT GBARD share on total ICT GBARD and comparison with non-ICT economic activities in the EU (2006-2015)

a) Manufacturing



b) Services

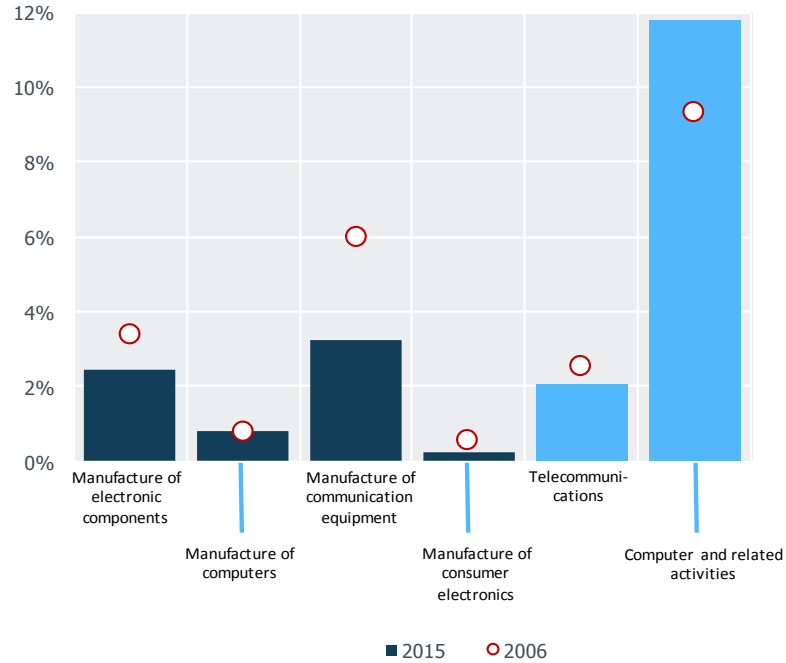


Note: Agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities; and construction not included neither in manufacturing nor in services industries.

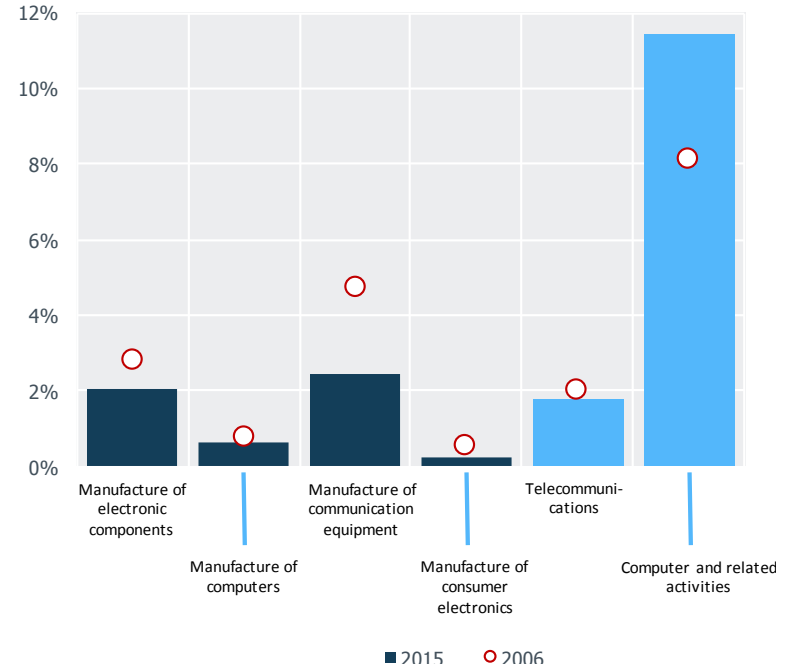
Source: 2018 PREDICT Dataset.

Figure A 31: ICT sector share of total by sub-sector, RERD and PERD in the EU (2006, 2015)

a) RERD



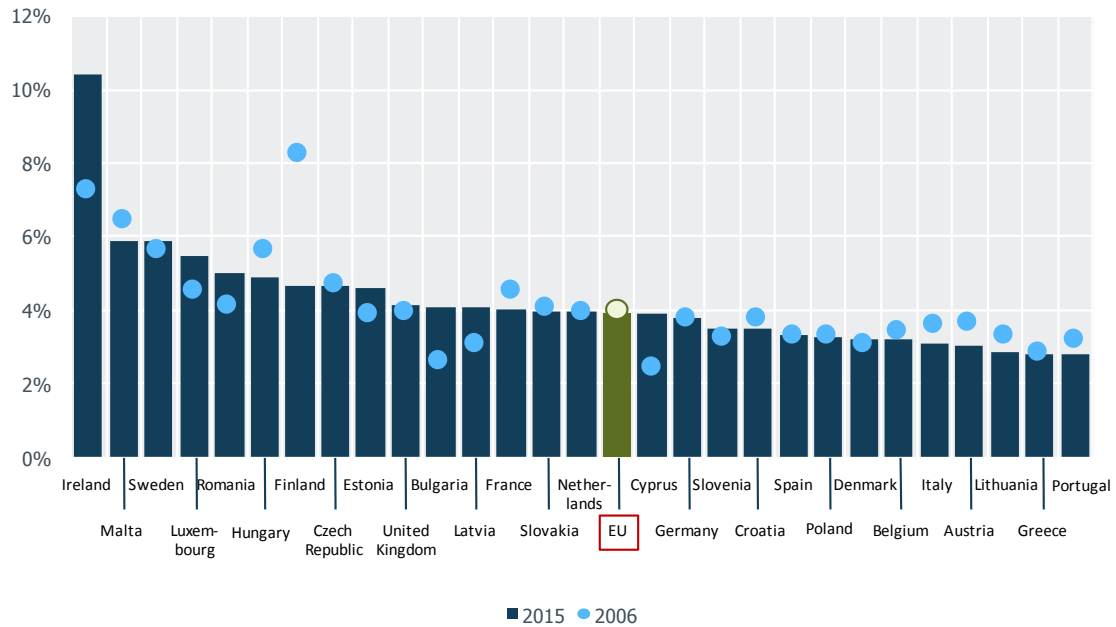
b) PERD



Source: 2018 PREDICT Dataset.

4.3 Analysis by EU Member state

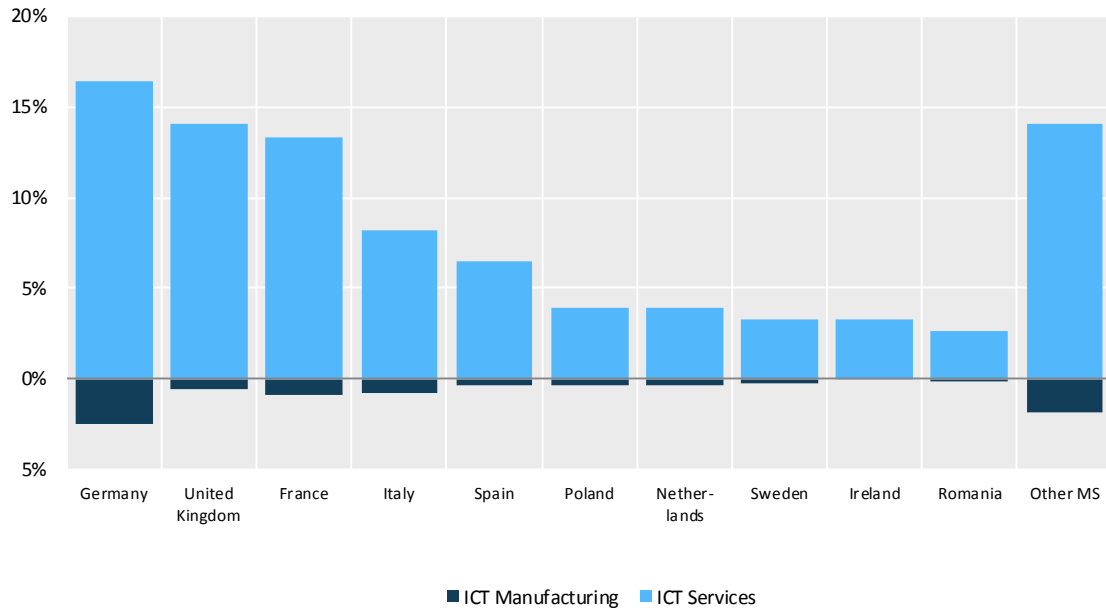
Figure A 32: ICT sector VA share of GDP. EU Member States (2006, 2015)



Note: 2014 for Ireland.

Source: 2018 PREDICT Dataset.

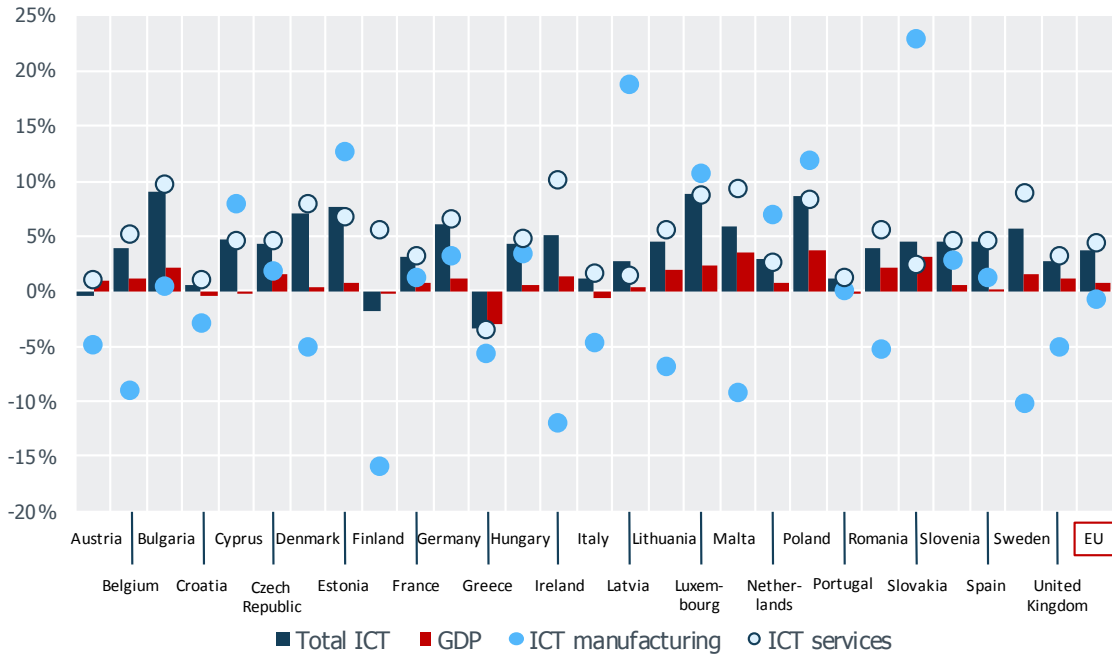
Figure A 33: ICT manufacturing and ICT services VA in the ten largest EU Member States' contributors (percentages, 2015)



Note: ICT manufacturing is not available for Ireland in 2015 due to confidentiality reasons. In 2014, this sector accounts for around 0.4% of total ICT sector VA.

Source: 2018 PREDICT Dataset.

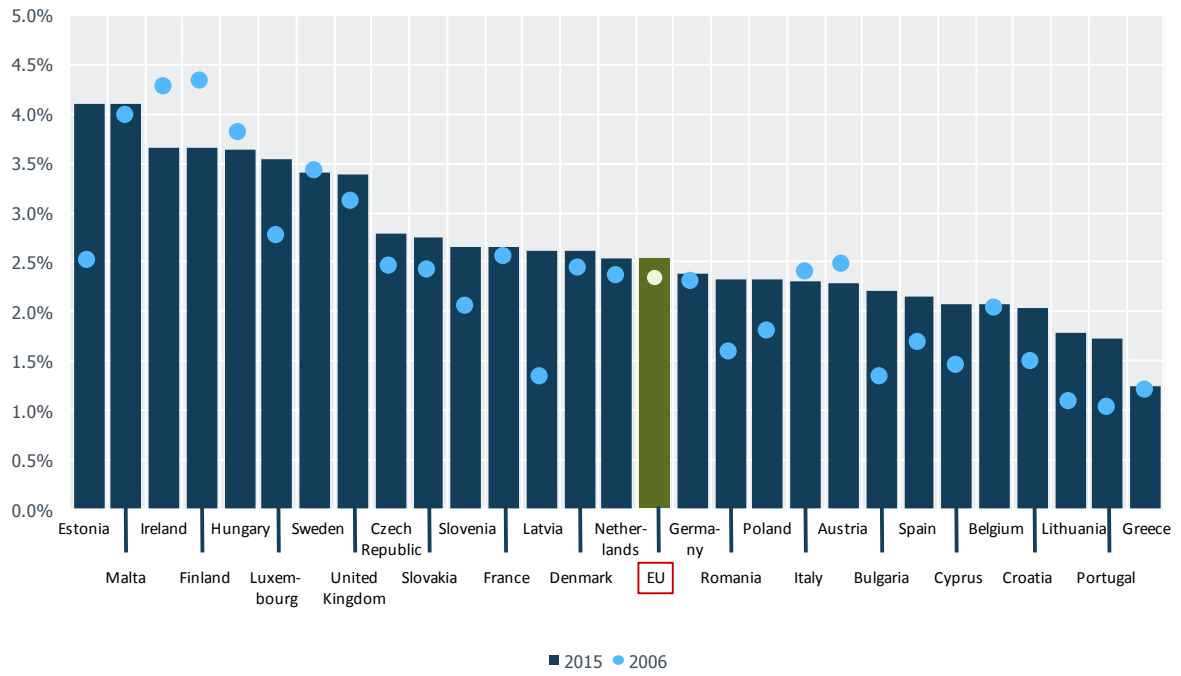
Figure A 34: Mean annual real growth rate of VA in ICT sector, ICT manufacturing, ICT services and GDP by EU Member state (2006-2015)



Note: 2006-2014 for Ireland.

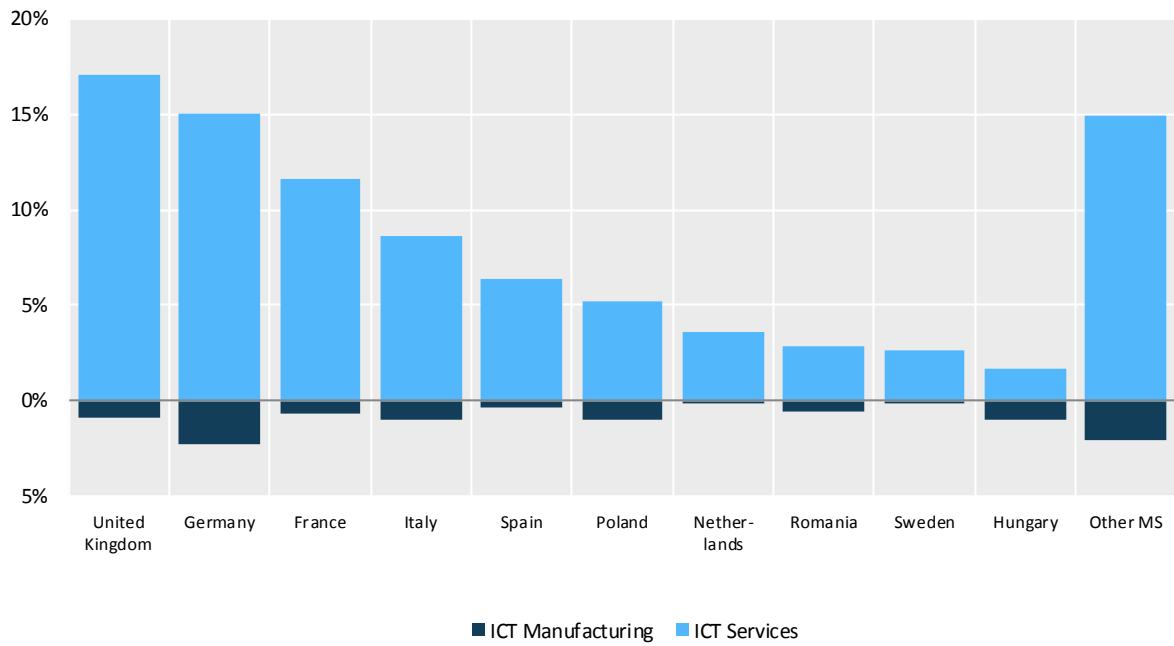
Source: 2018 PREDICT Dataset.

Figure A 35: ICT sector employment share of total employment by EU Member state (2006, 2015)



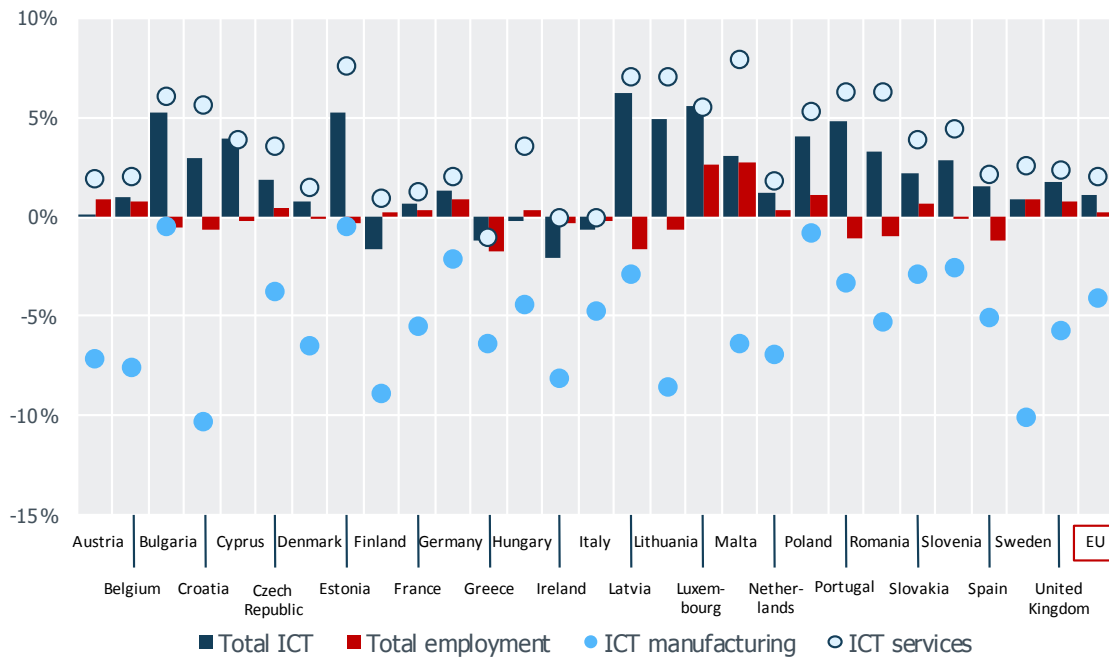
Source: 2018 PREDICT Dataset.

Figure A 36: ICT manufacturing and ICT services employment in the ten largest EU Member states' contributors (percentages, 2015)



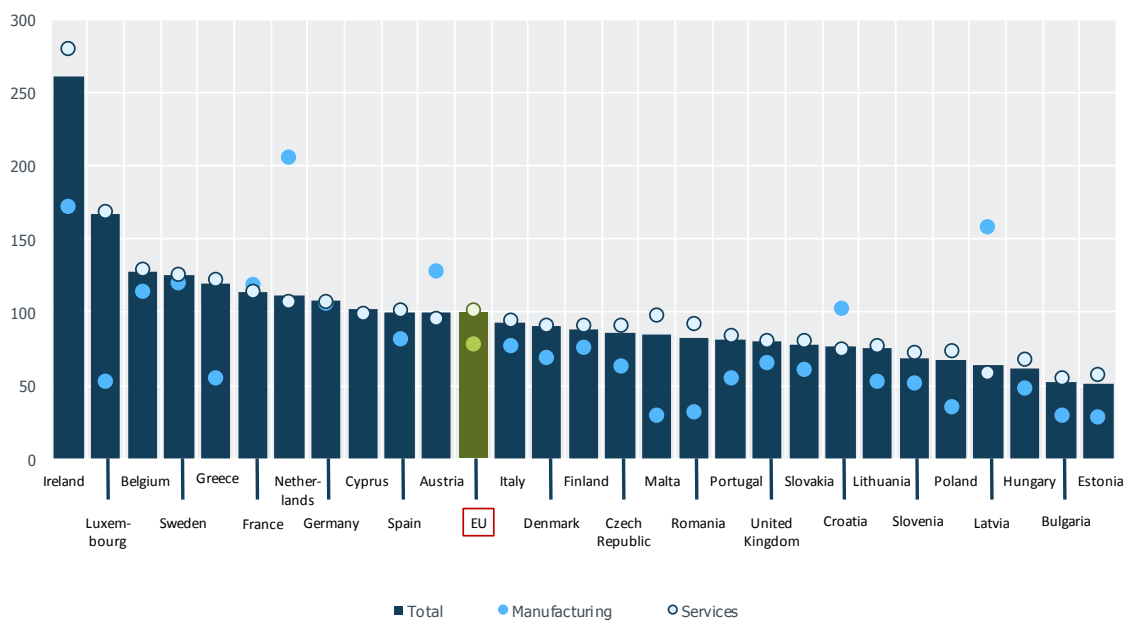
Source: 2018 PREDICT Dataset.

Figure A 37: Mean annual growth rate of employment in ICT sector, ICT manufacturing, ICT services and total employment by EU Member state (2006-2015)



Source: 2018 PREDICT Dataset.

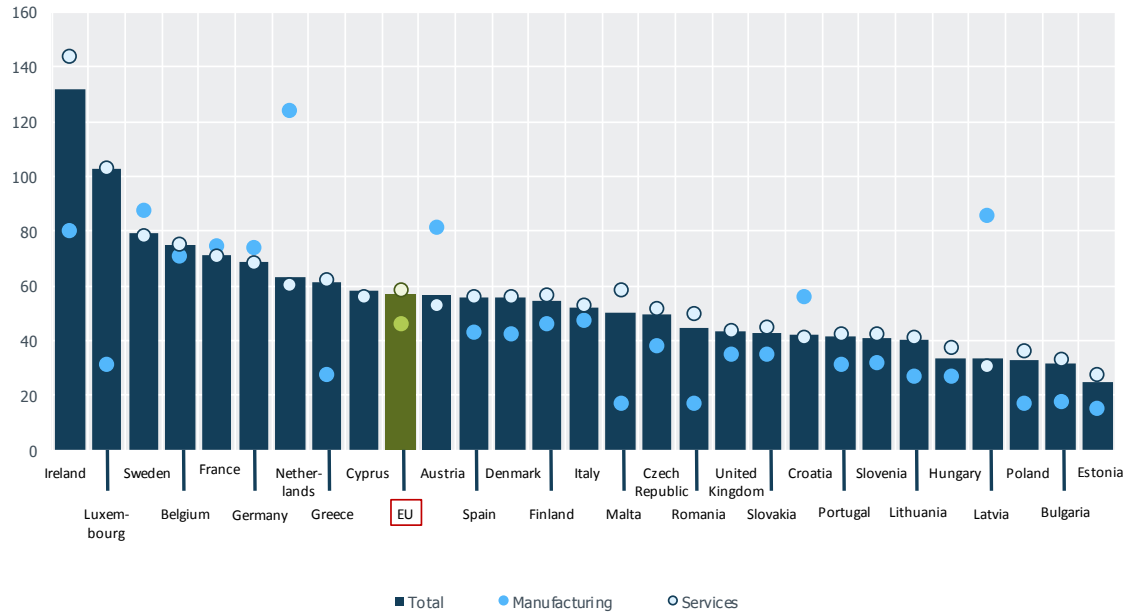
Figure A 38: ICT sector productivity per person employed by EU Member state (thousands of EUR PPS per person, 2015)



Note: 2014 for Ireland. Data for 2015 for Cyprus and ICT manufacturing is available but has been excluded due to high value (501.3).

Source: 2018 PREDICT Dataset.

Figure A 39: ICT sector productivity per hour worked by EU Member state (current EUR PPS per hour, 2015)

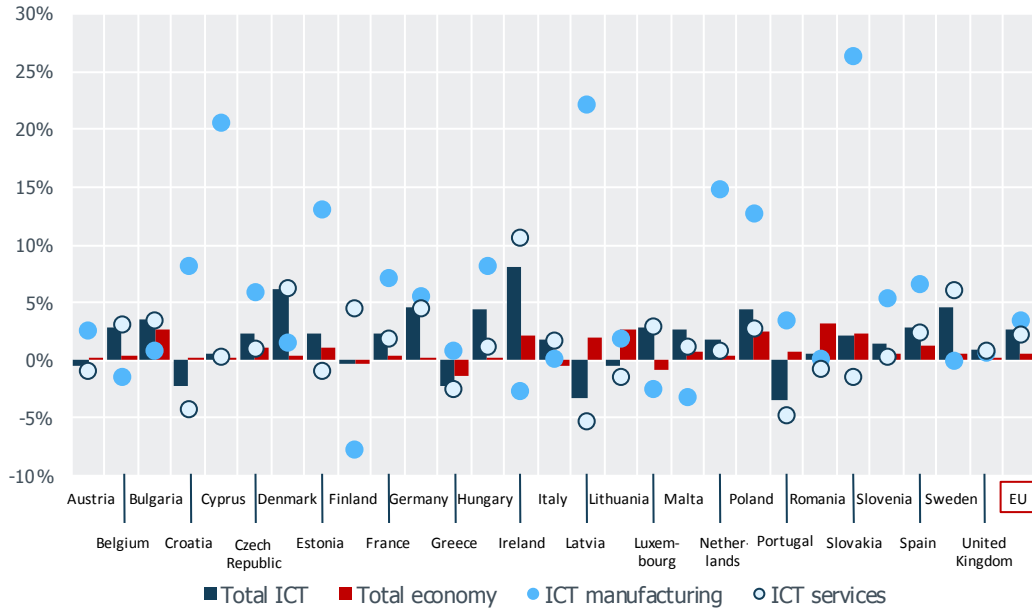


Note: 2014 for Ireland. Data for 2015 for Cyprus and ICT manufacturing is available but has been excluded due to high value (276.0).

Source: 2018 PREDICT Dataset.

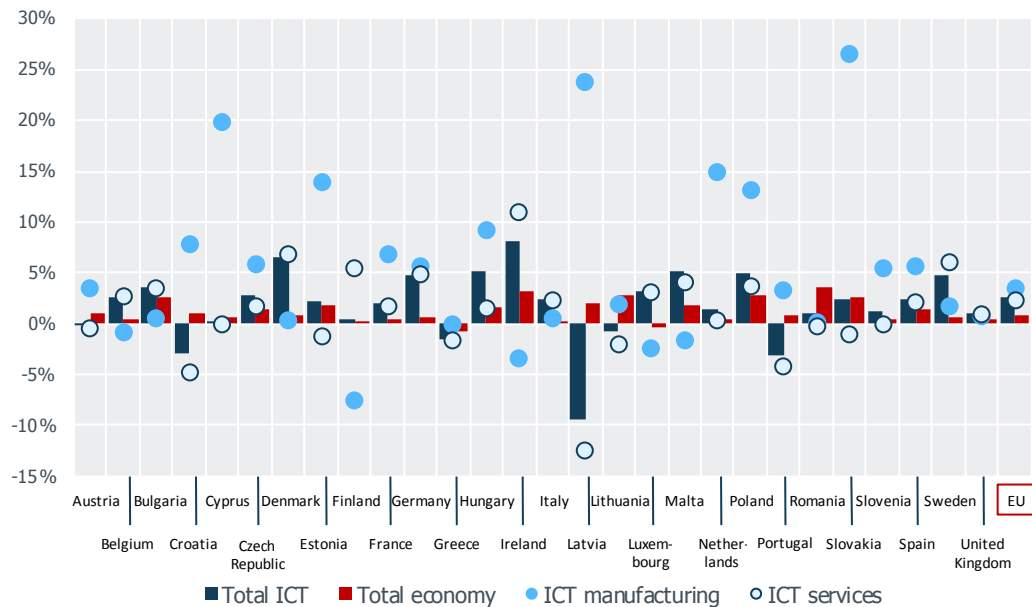
Figure A 40: Mean annual real growth rate of labour productivity in ICT sector, ICT manufacturing, ICT services and total economy by EU Member state (2006-2015)

a) Productivity per person employed



Note: 2006-2014 for Ireland.

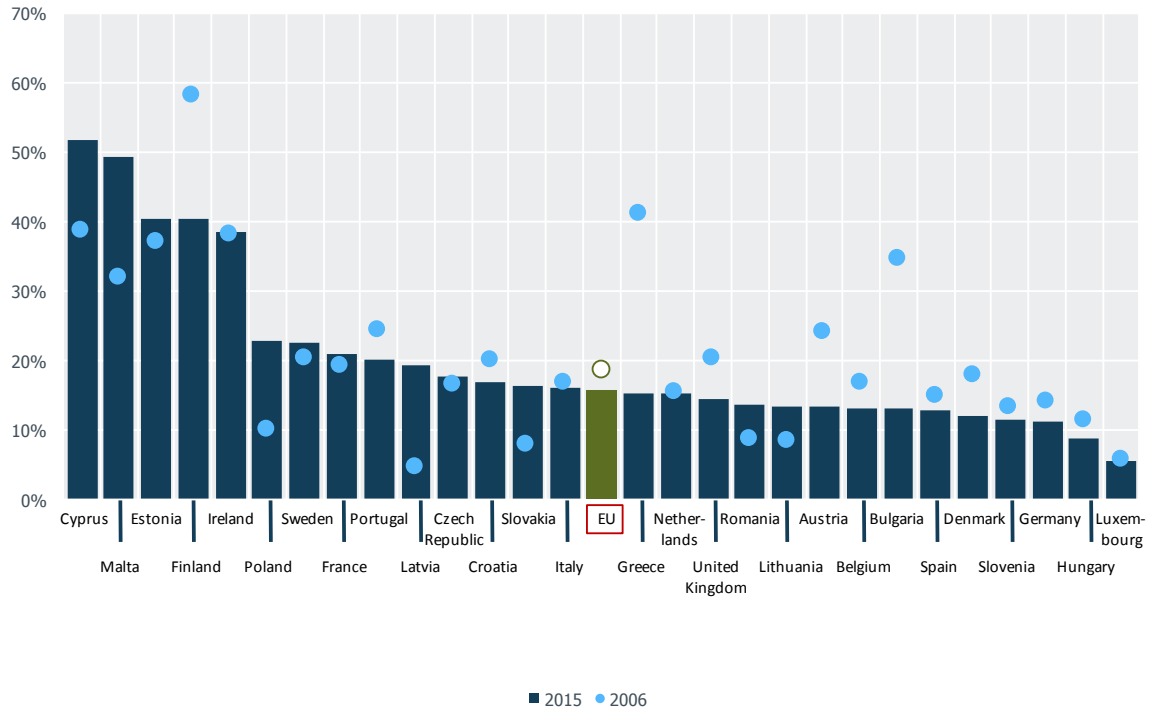
b) Productivity per hour worked



Note: 2006-2014 for Ireland.

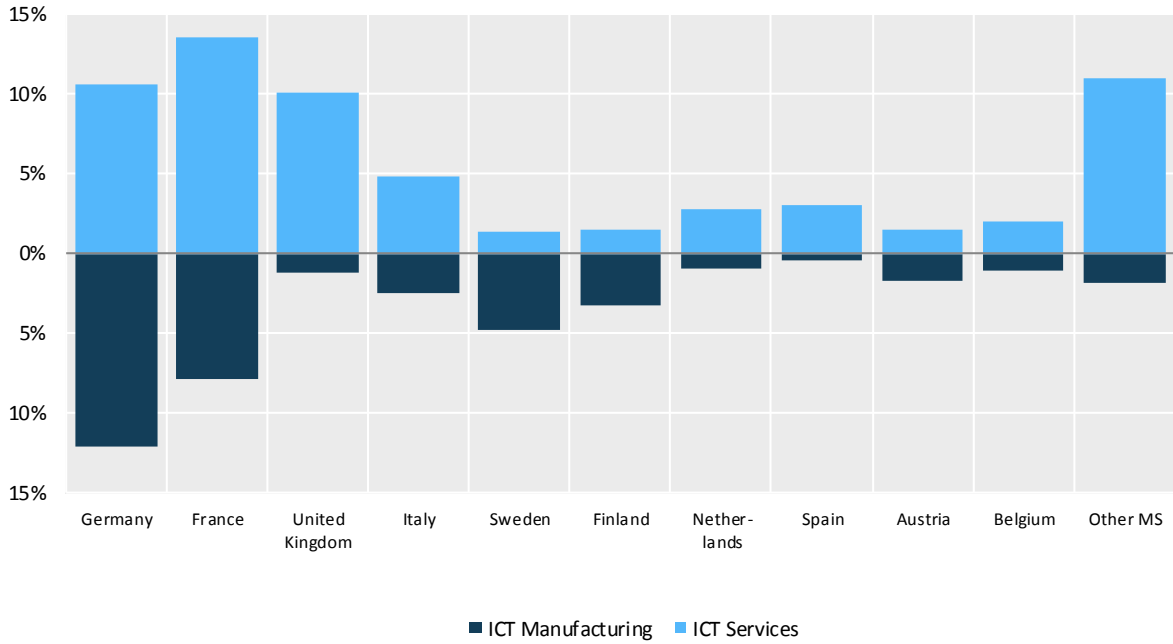
Source: 2018 PREDICT Dataset.

Figure A 41: ICT sector BERD share of total BERD by EU Member state (2006, 2015)



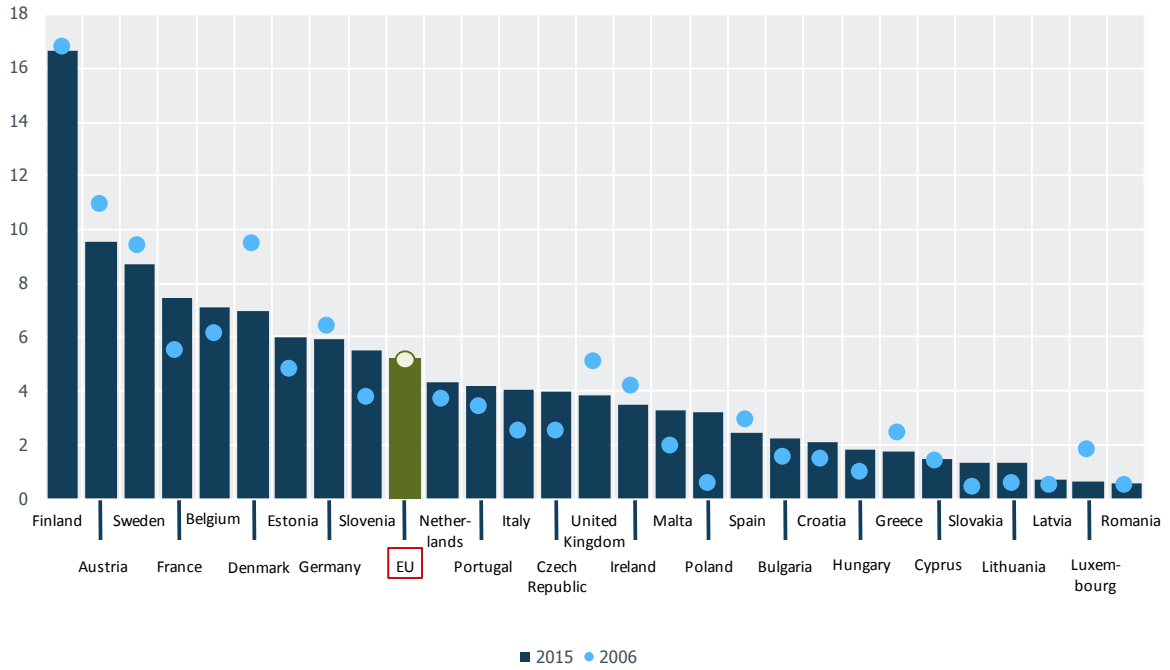
Source: 2018 PREDICT Dataset.

Figure A 42: ICT manufacturing and ICT services BERD in the ten largest EU Member states' contributors (percentages, 2015)



Source: 2018 PREDICT Dataset.

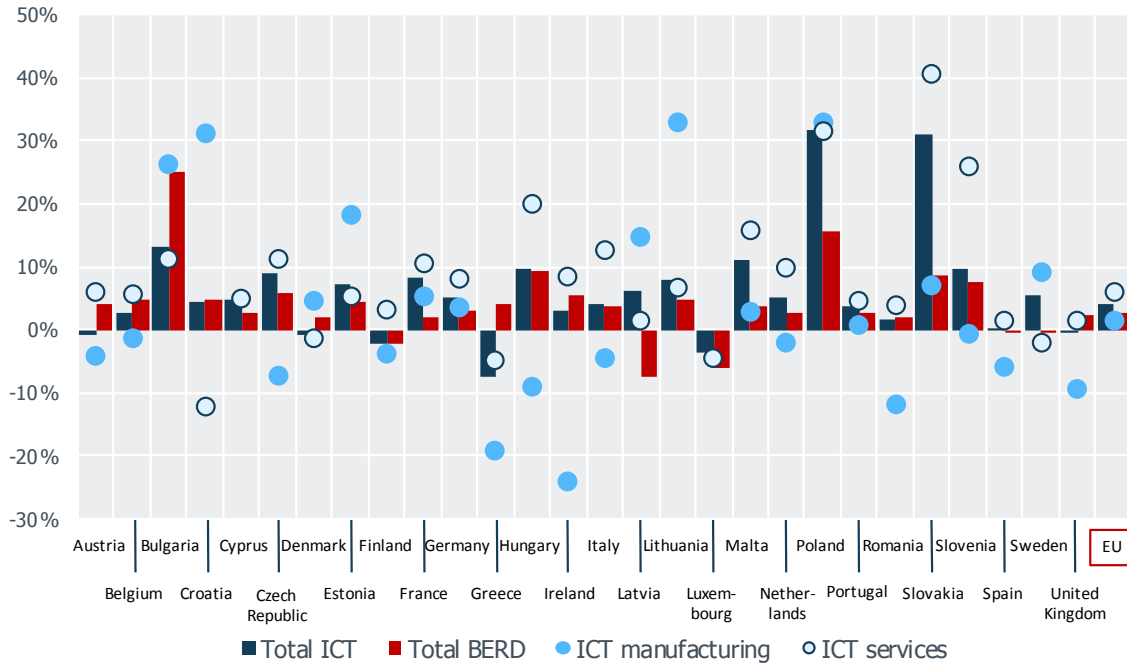
Figure A 43: ICT manufacturing and ICT services BERD in the ten largest EU Member states' contributors (percentages, 2015)



Note: 2014 for Ireland.

Source: 2018 PREDICT Dataset.

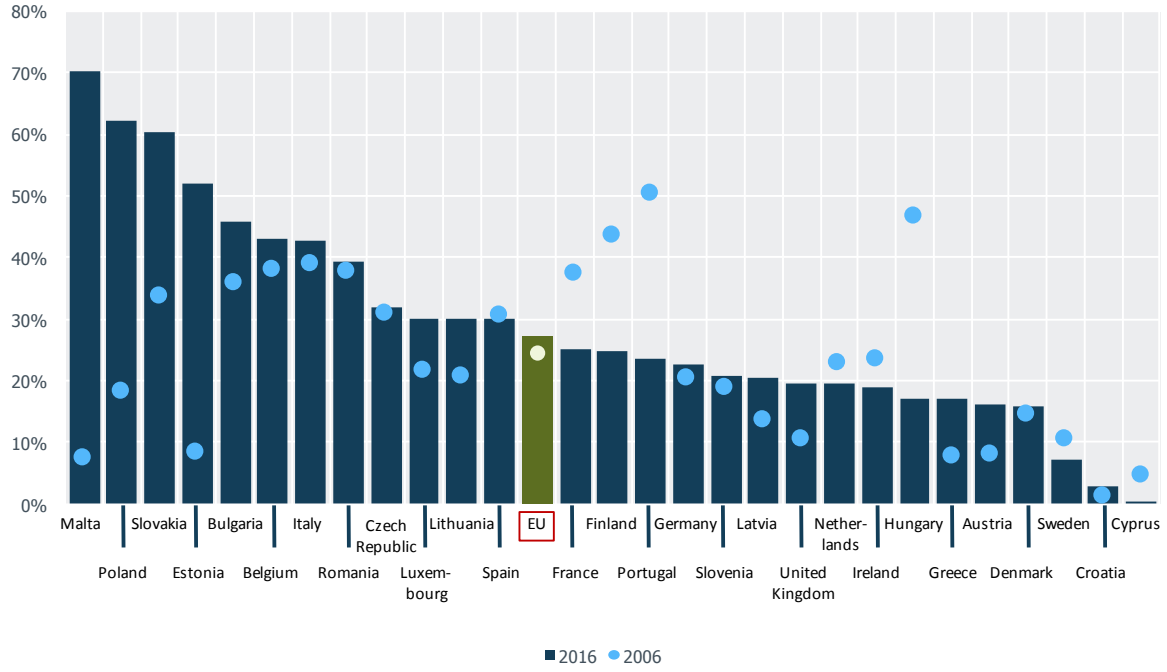
Figure A 44: Mean annual real growth rate of BERD in ICT sector, ICT manufacturing, ICT services and total BERD by EU Member state (2006-2015)



Note: 2006-2014 for Ireland.

Source: 2018 PREDICT Dataset.

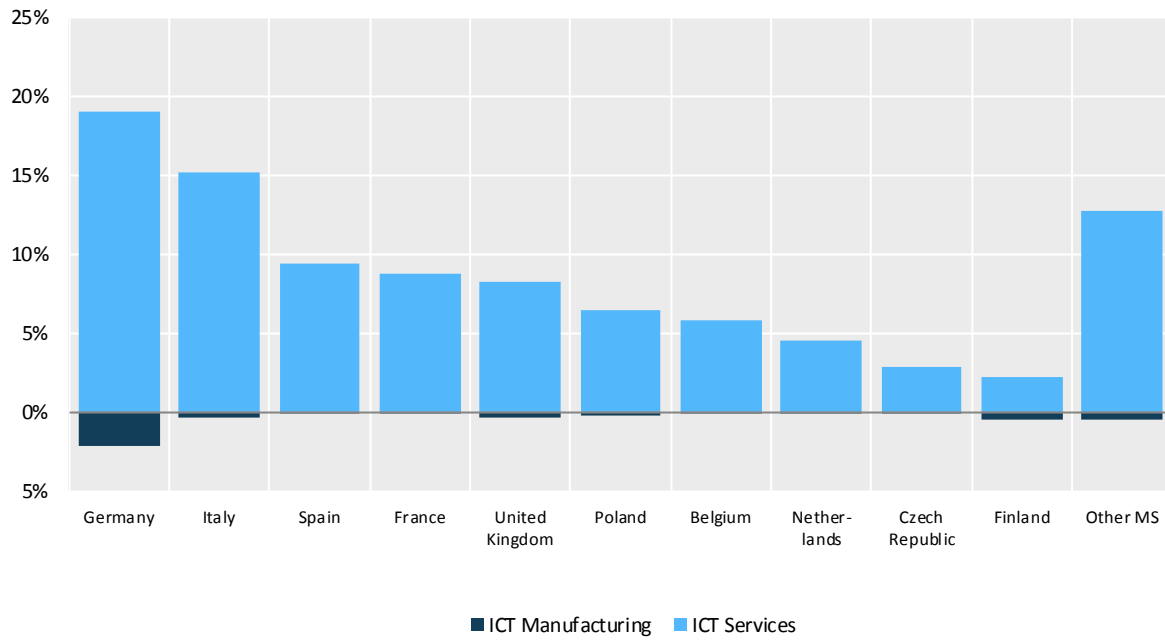
Figure A 45: ICT sector ICT GBARD share of total ICT GBARD by EU Member state (2006, 2016)



Note: 2008 is the first year available for Croatia.

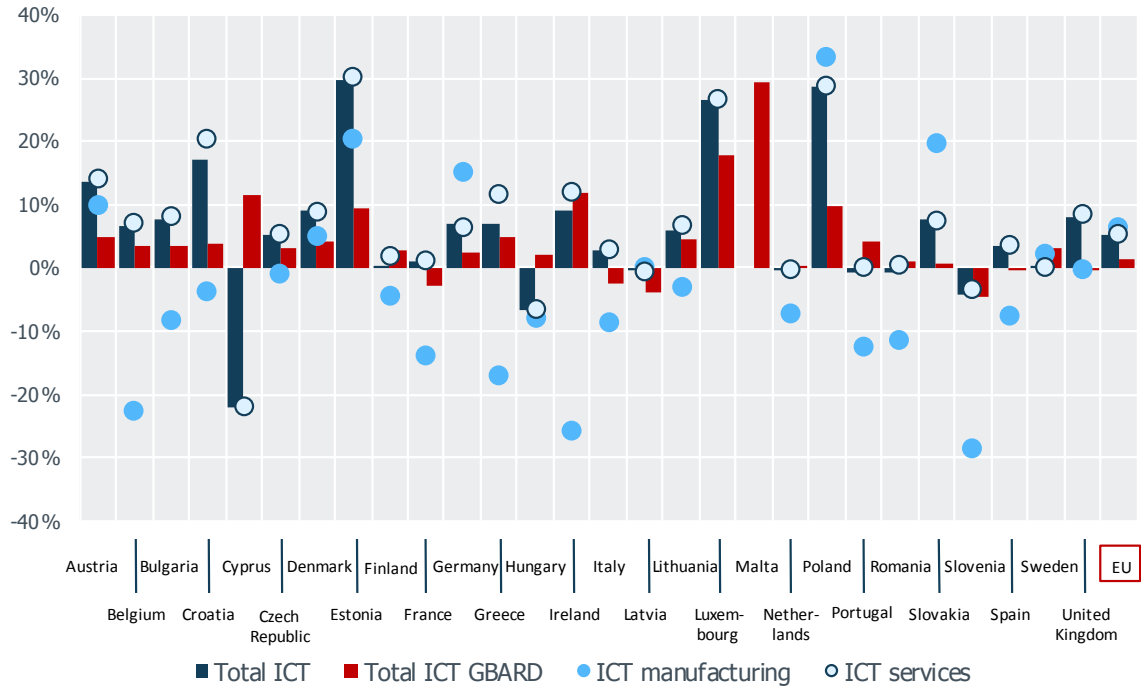
Source: 2018 PREDICT Dataset.

Figure A 46: ICT manufacturing and ICT services ICT GBARD in the ten largest Member State's contributors (percentages, 2016)



Source: 2018 PREDICT Dataset.

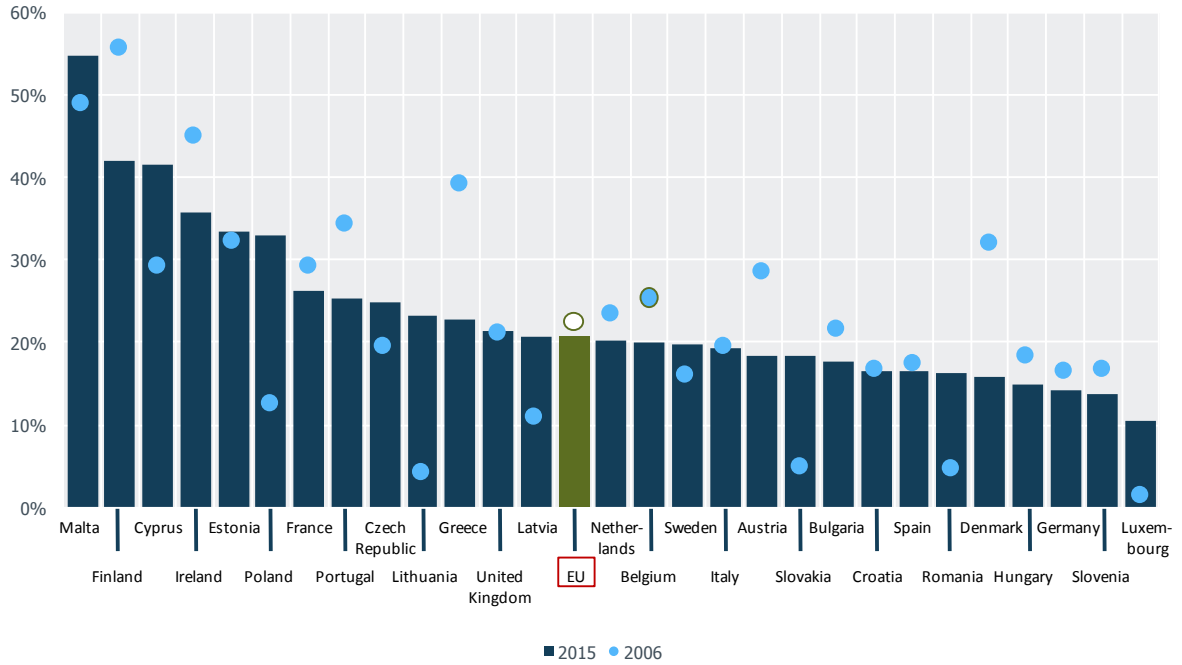
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Note: 2008-2015 for Croatia.

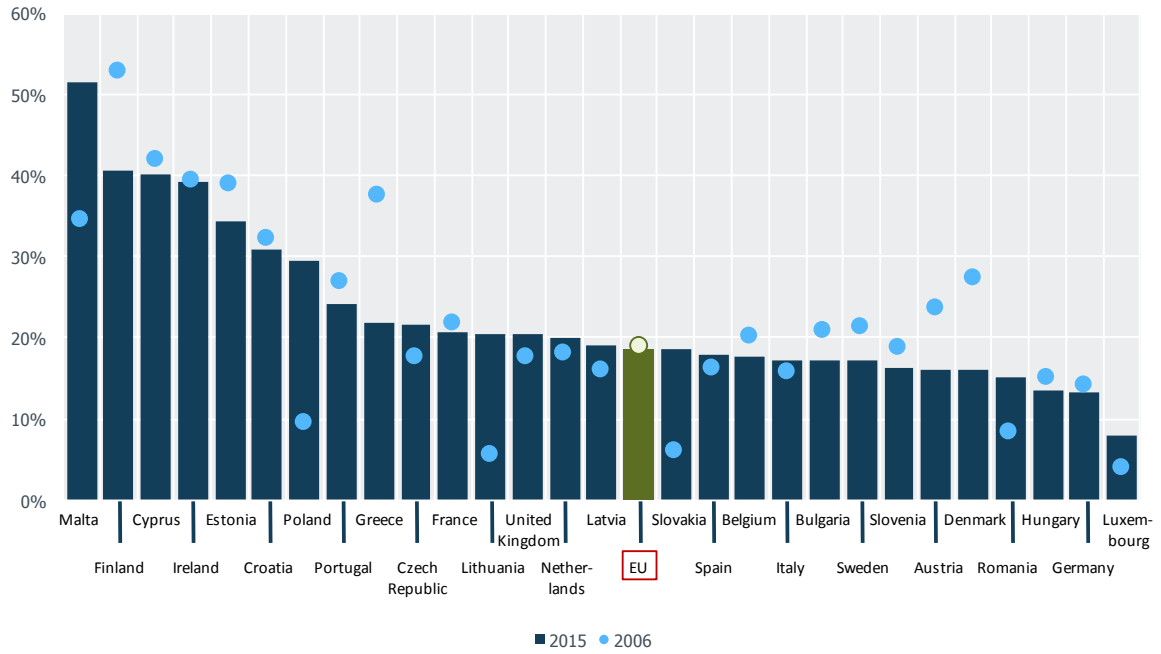
Source: 2018 PREDICT Dataset.

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Source: 2018 PREDICT Dataset.

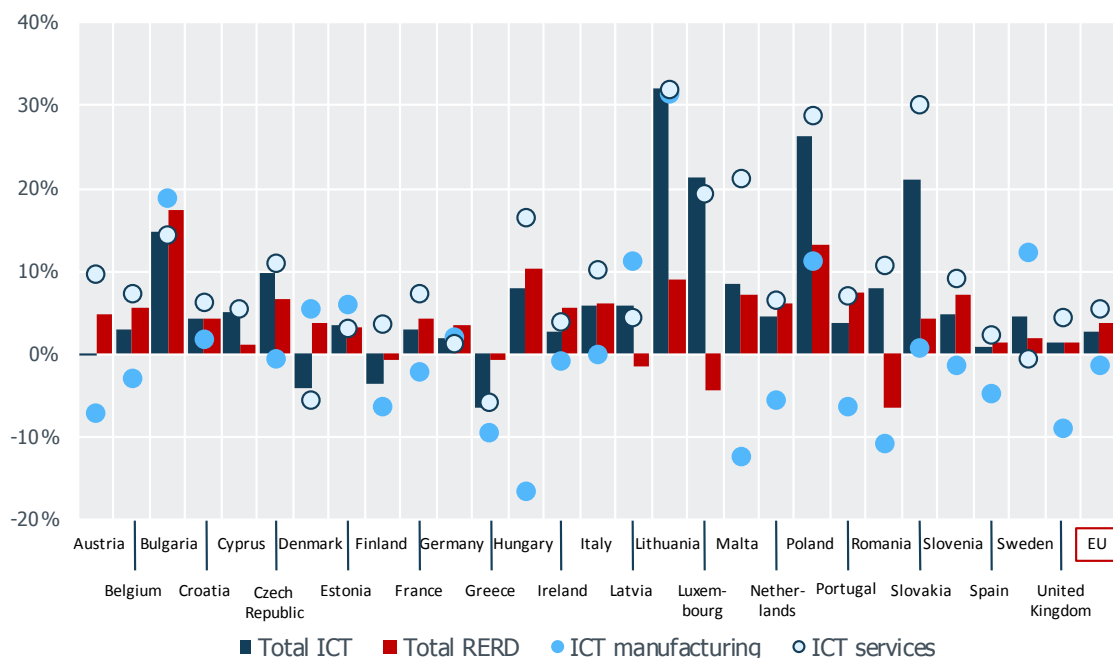
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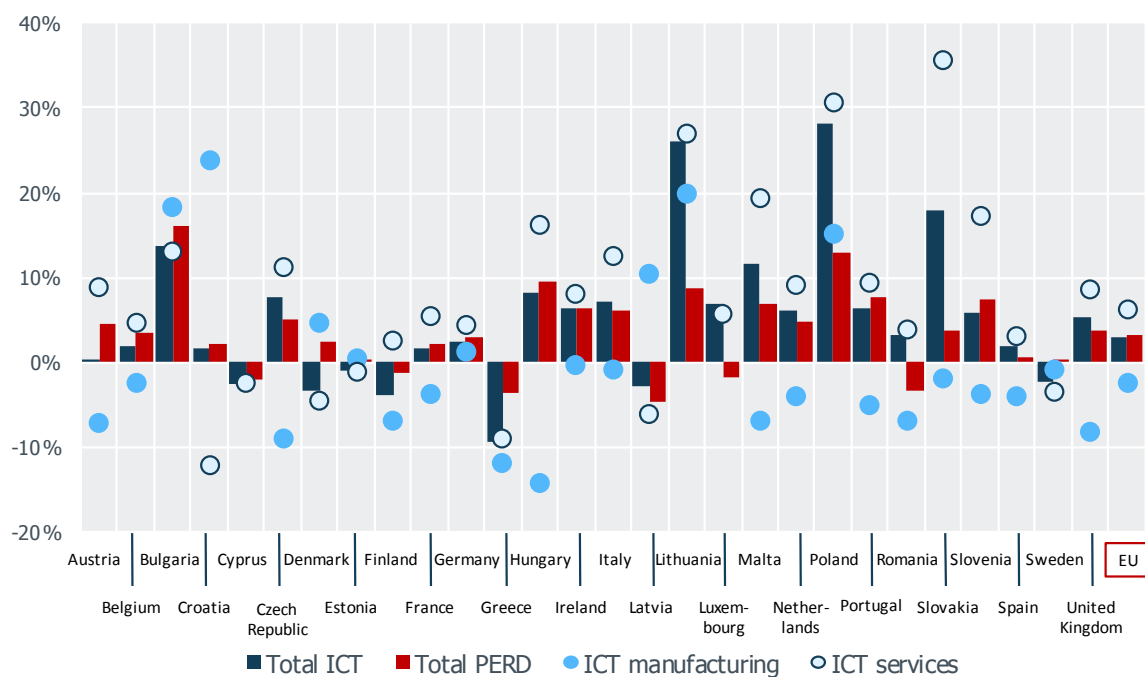
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a) RERD



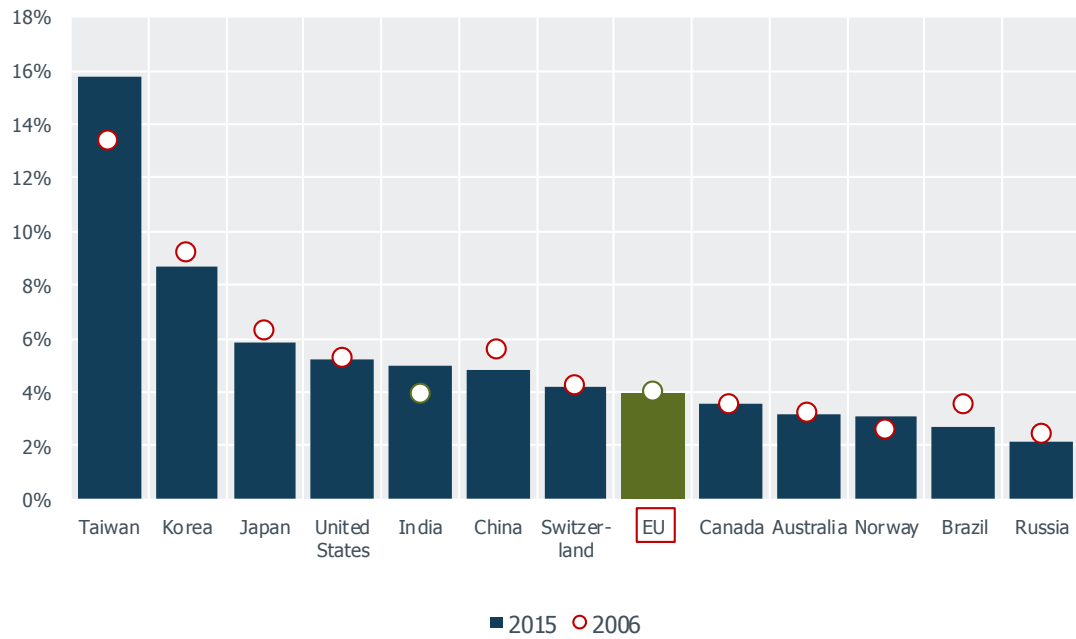
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Source: 2018 PREDICT Dataset.

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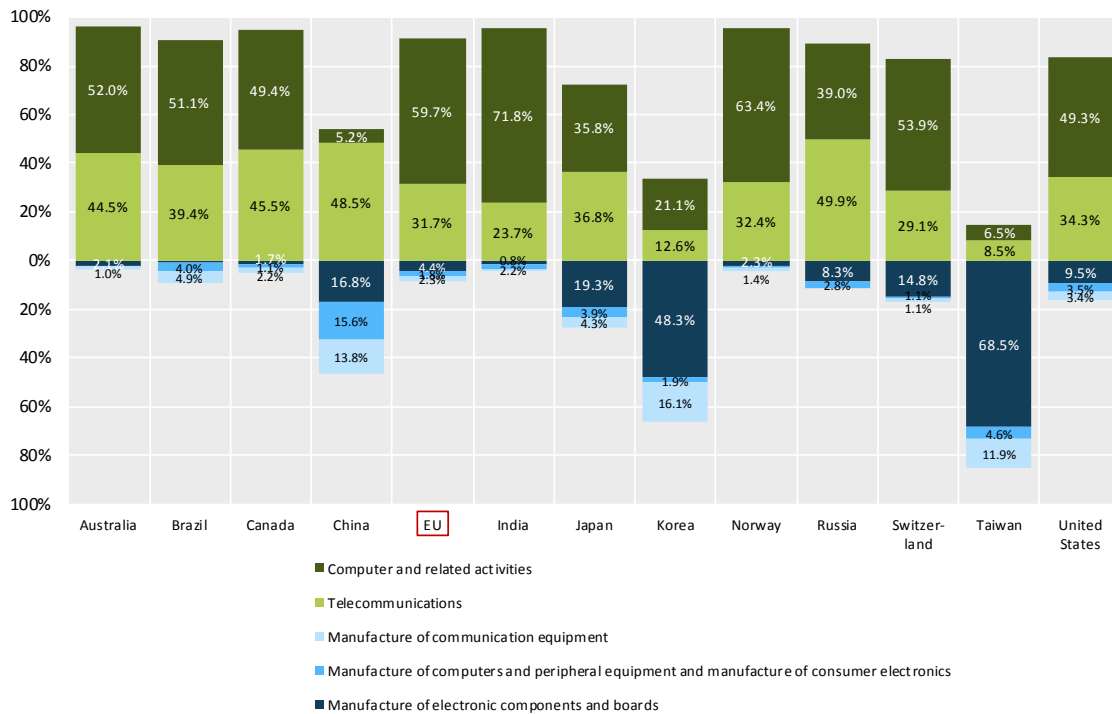


2014 for Canada

Source: 2018 PREDICT Dataset.

Note:

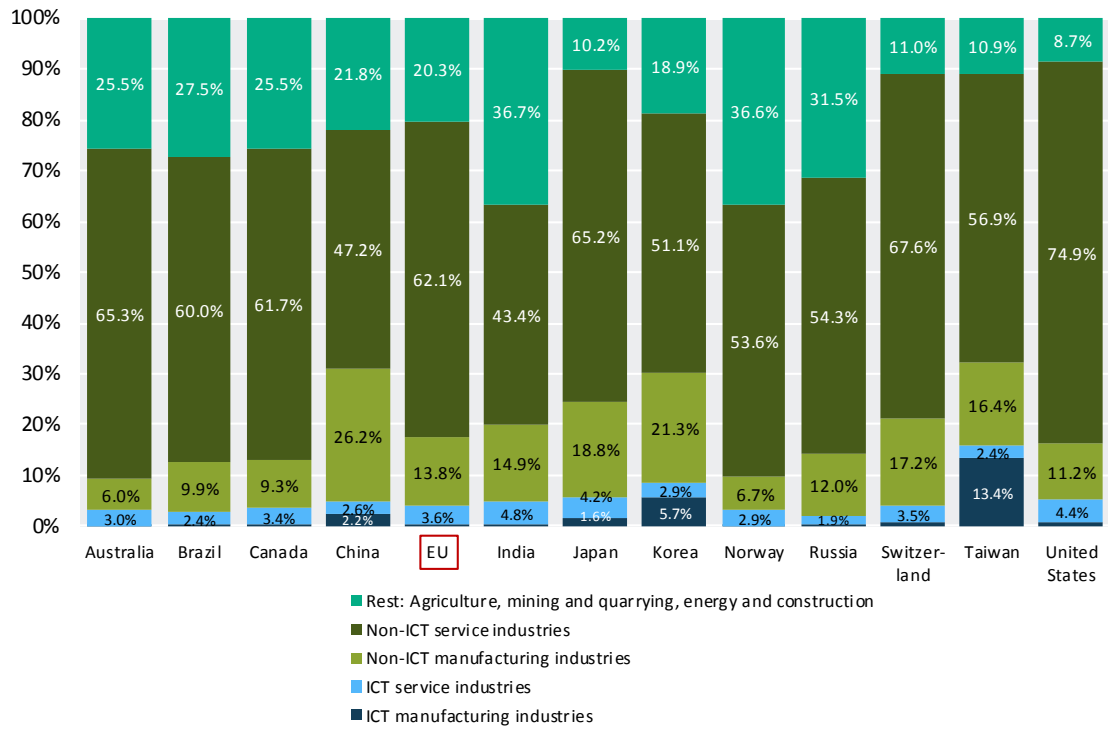
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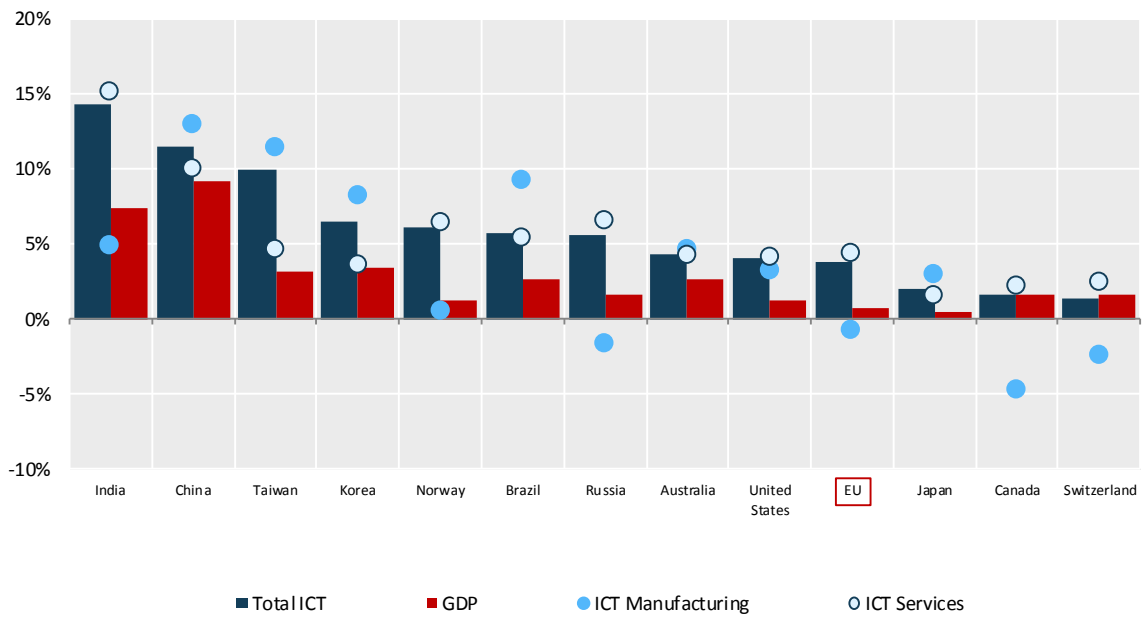
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 Source: 2018 PREDICT Dataset.

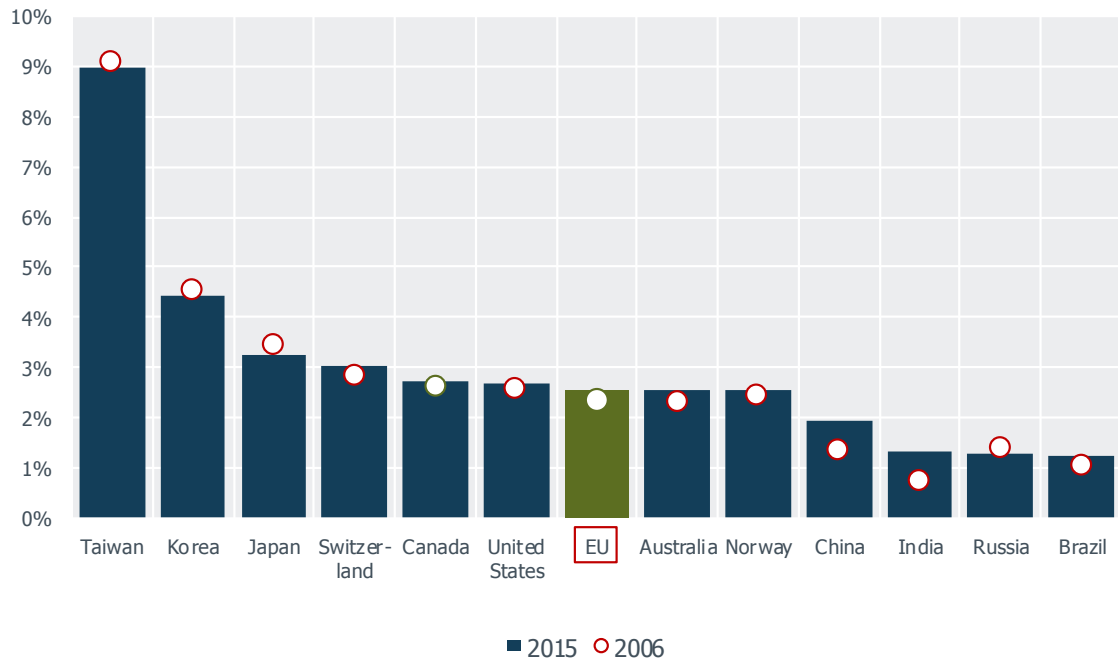
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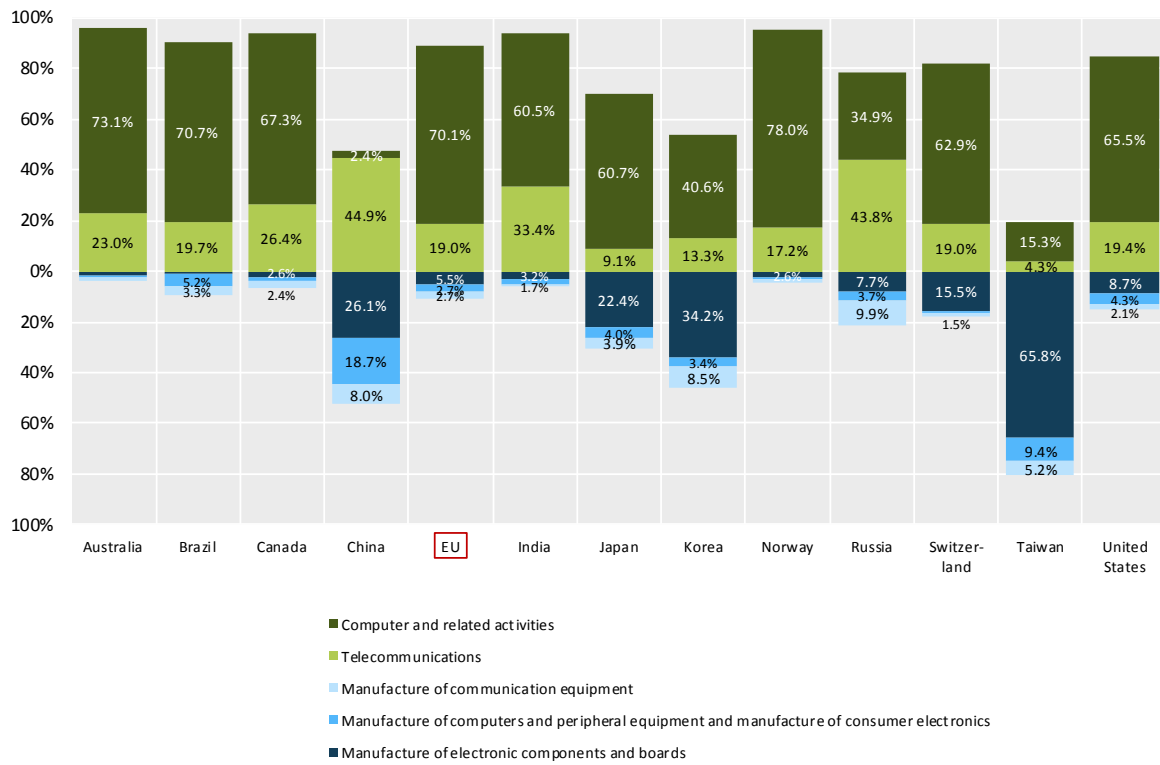
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Source: 2018 PREDICT Dataset.

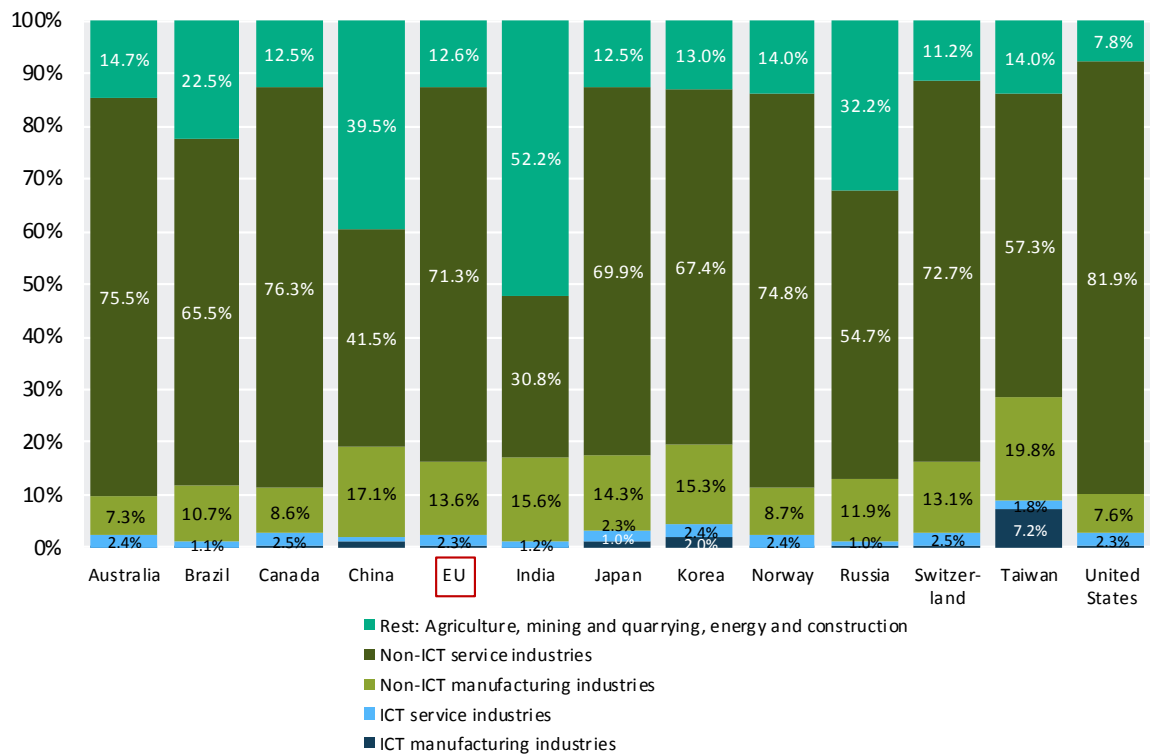
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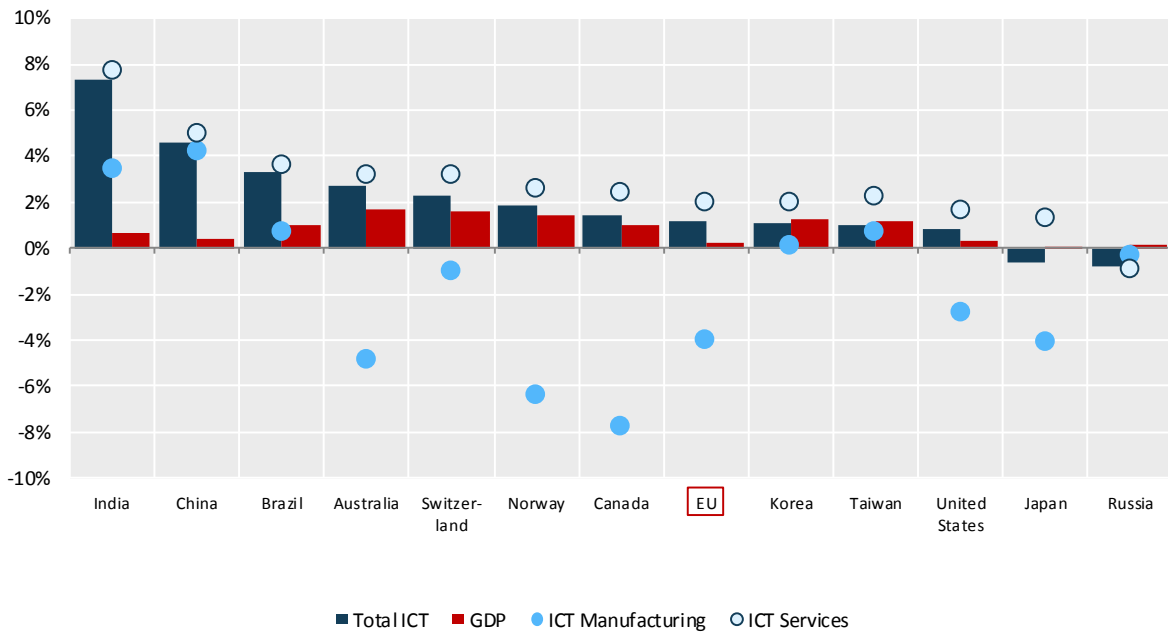
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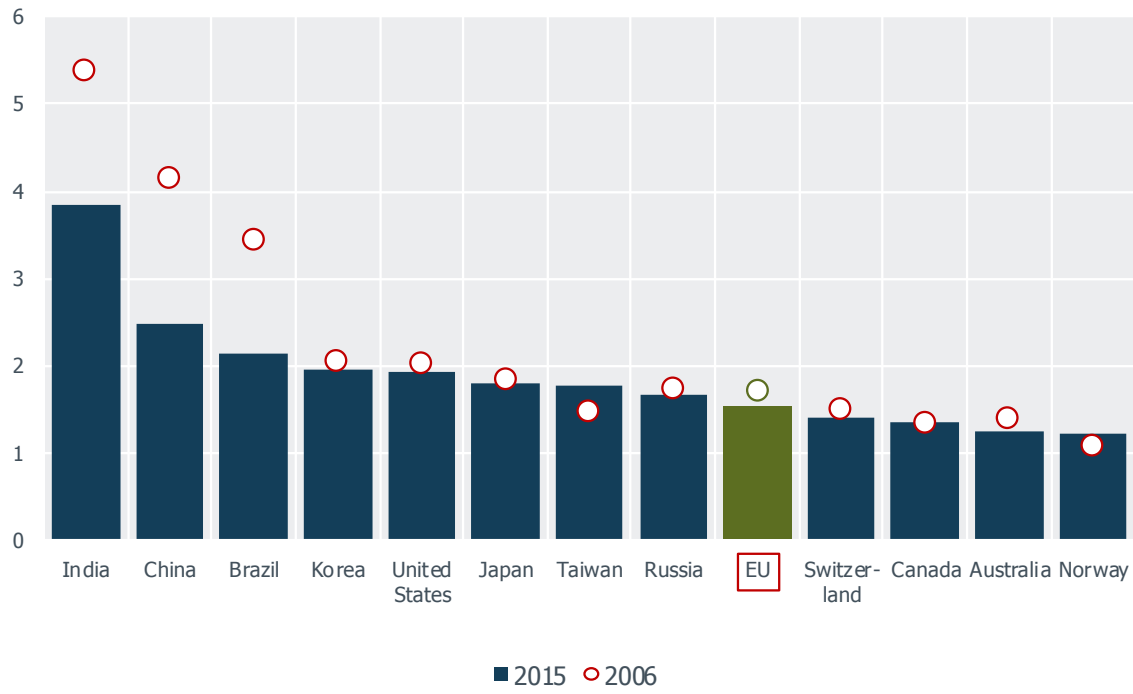
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Source: 2018 PREDICT Dataset.

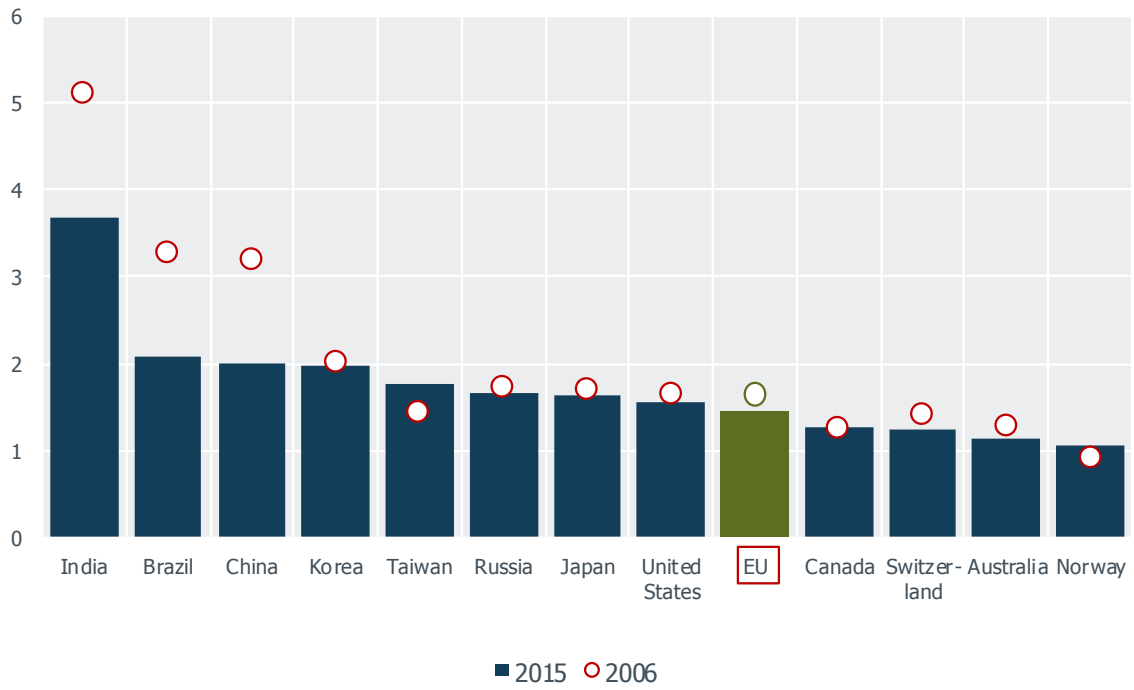
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Note: 2014 for Canada.

Source: 2018 PREDICT Dataset.

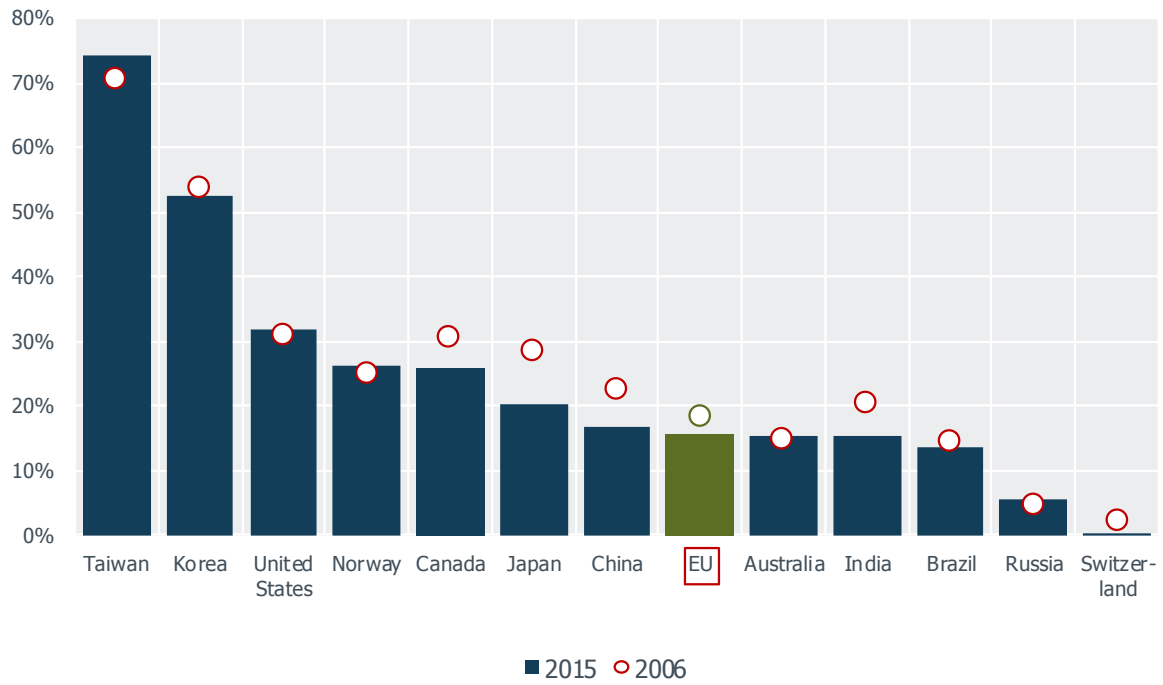
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Source: 2018 PREDICT Dataset.

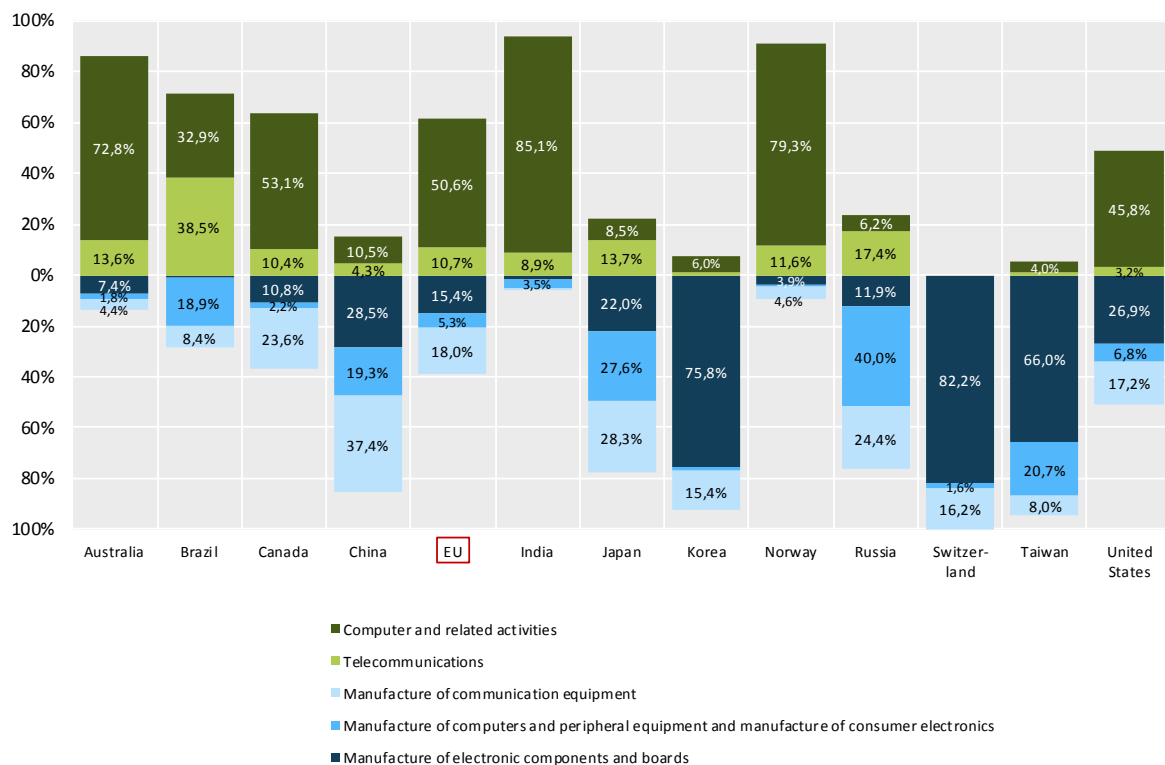
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Note: 2008 is the first year available for Brazil and Switzerland. 2011 is the last year for Brazil , 2012 for Switzerland and 2013 for India.

Source: 2018 PREDICT Dataset.

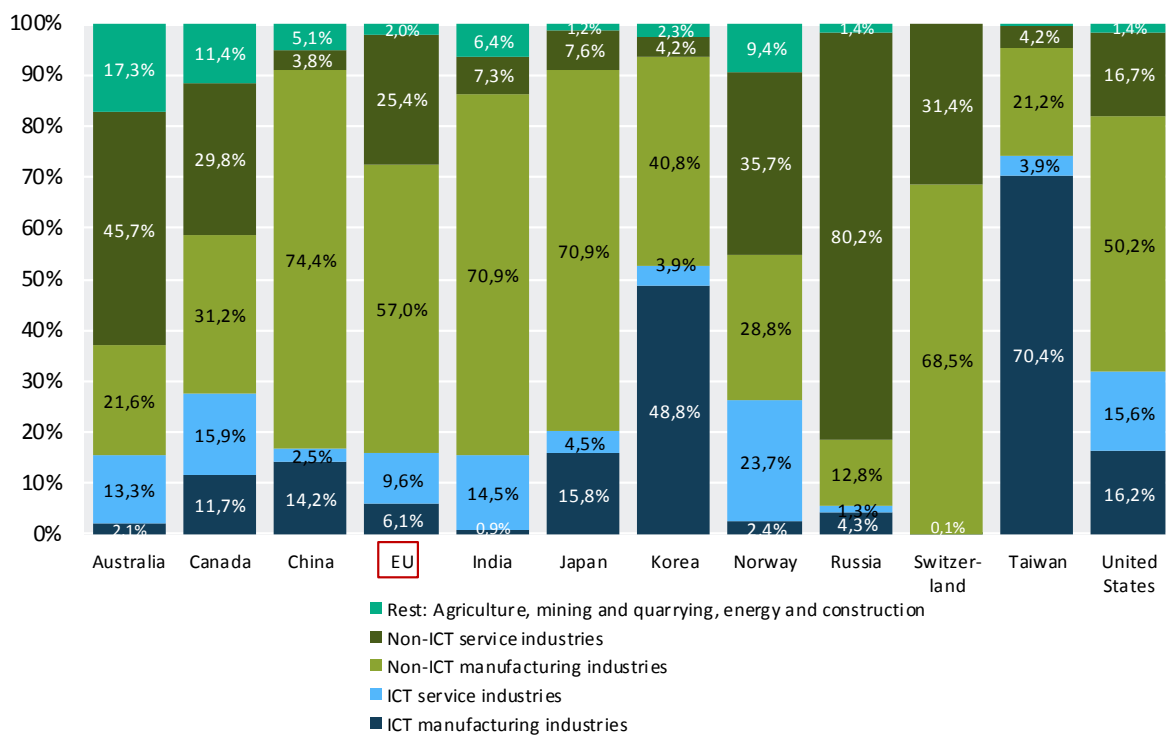
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Source: 2018 PREDICT Dataset.

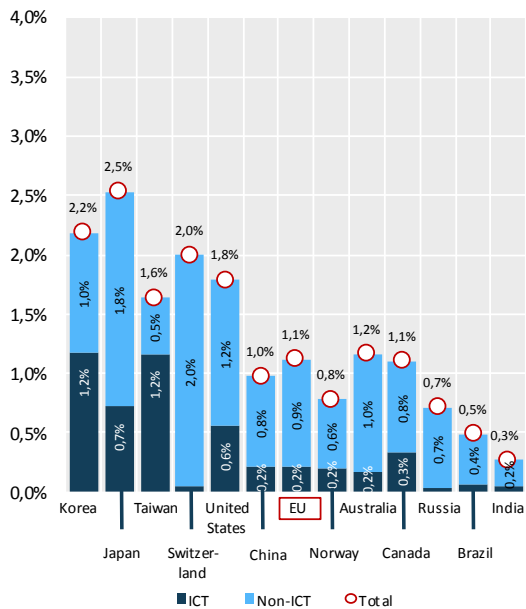
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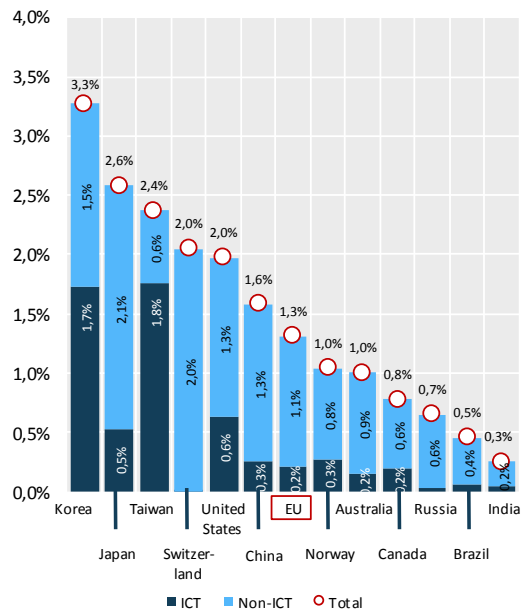
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a) 2006



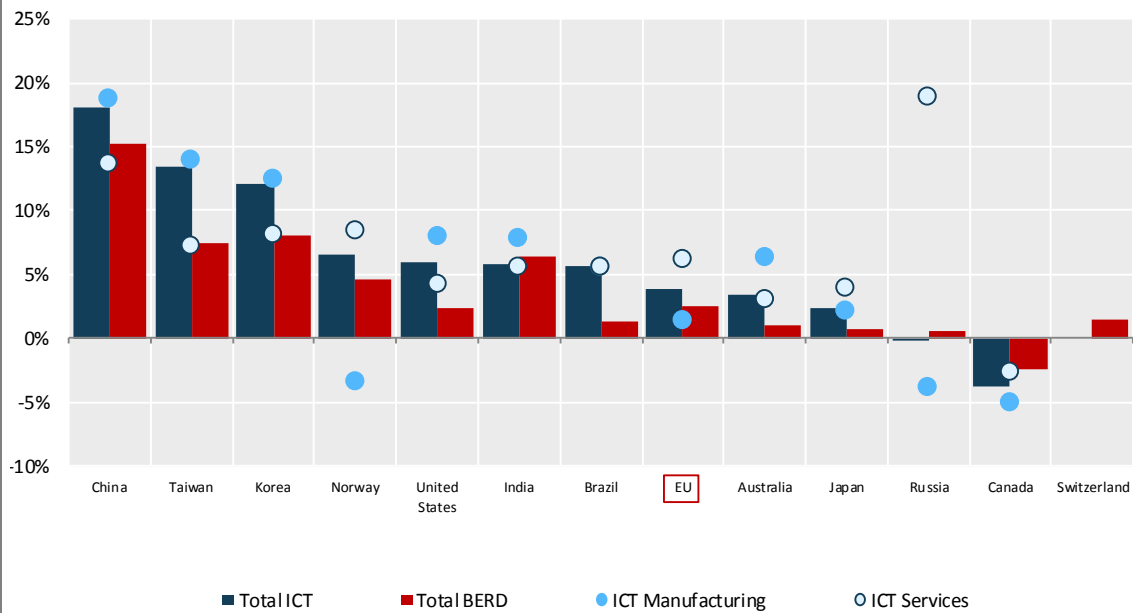
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Note: 2008 is the first year available for Brazil and Switzerland. 2011 is the last year for Brazil, 2012 for Switzerland and 2013 for India.

Source: 2018 PREDICT Dataset.

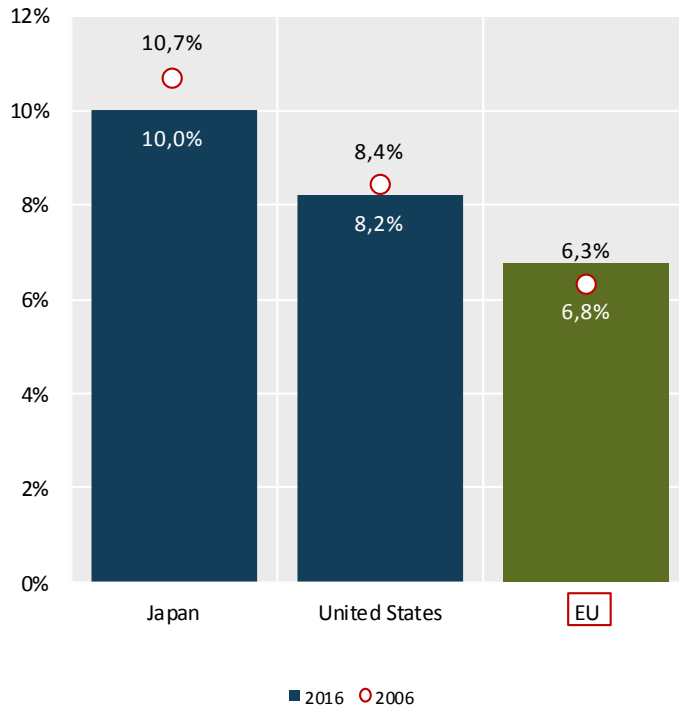
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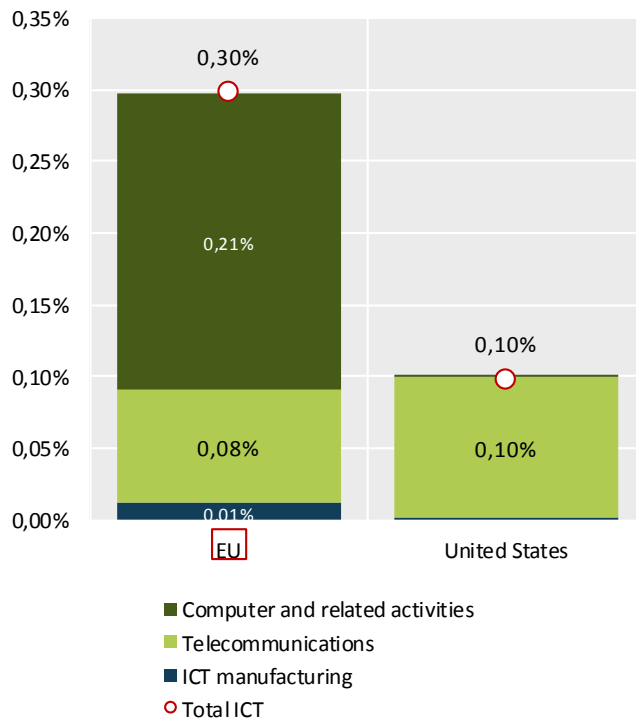
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Source: 2018 PREDICT Dataset.

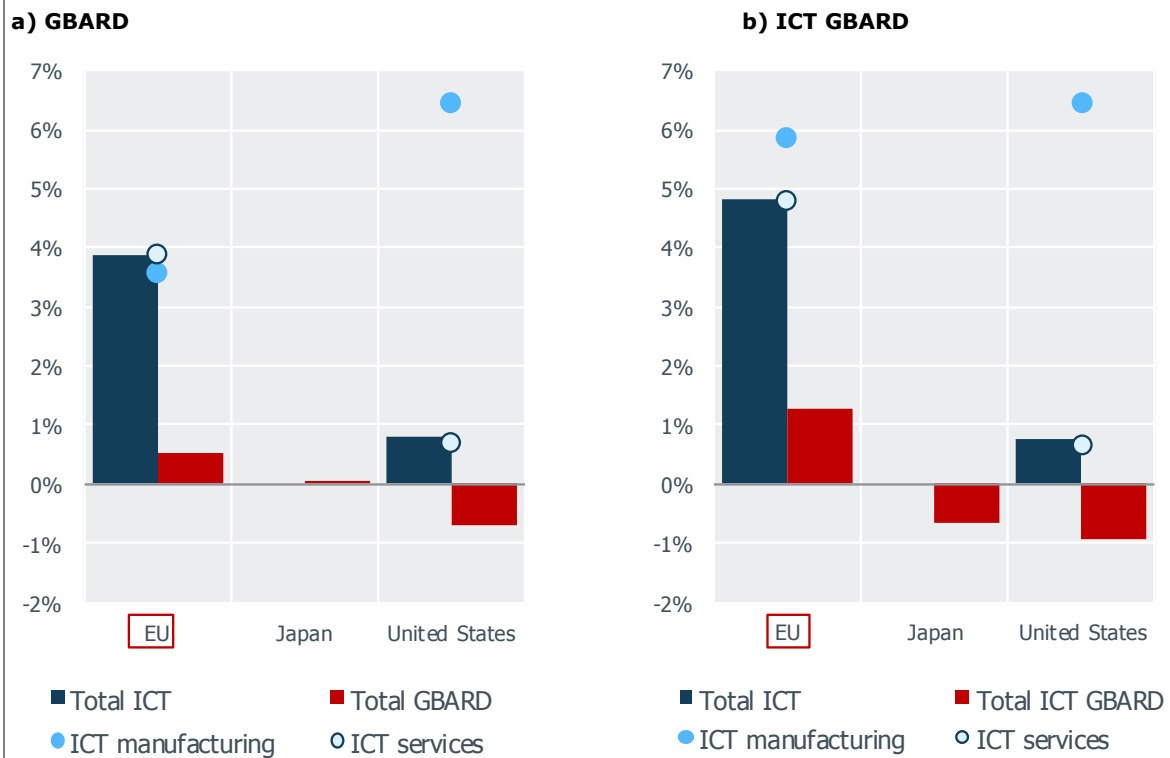
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Note: ICT sector ICT GBARD for United States includes 268 NACE Rev. 2 sector (Manufacture of magnetic and optical media).

Source: 2018 PREDICT Dataset.

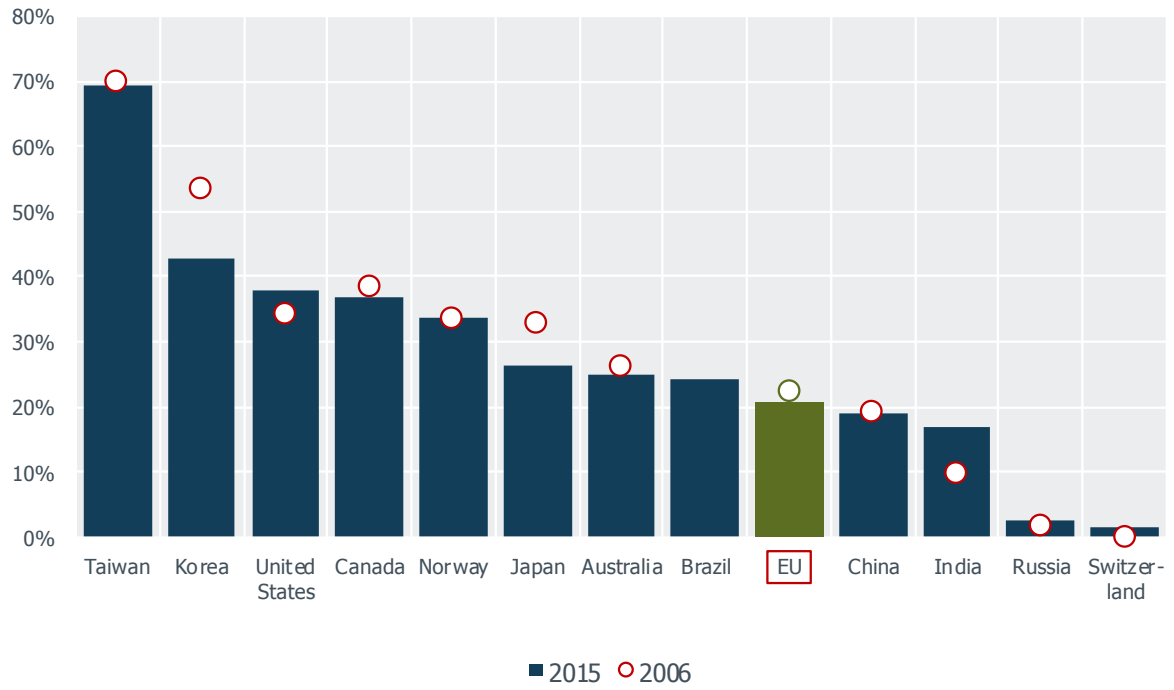
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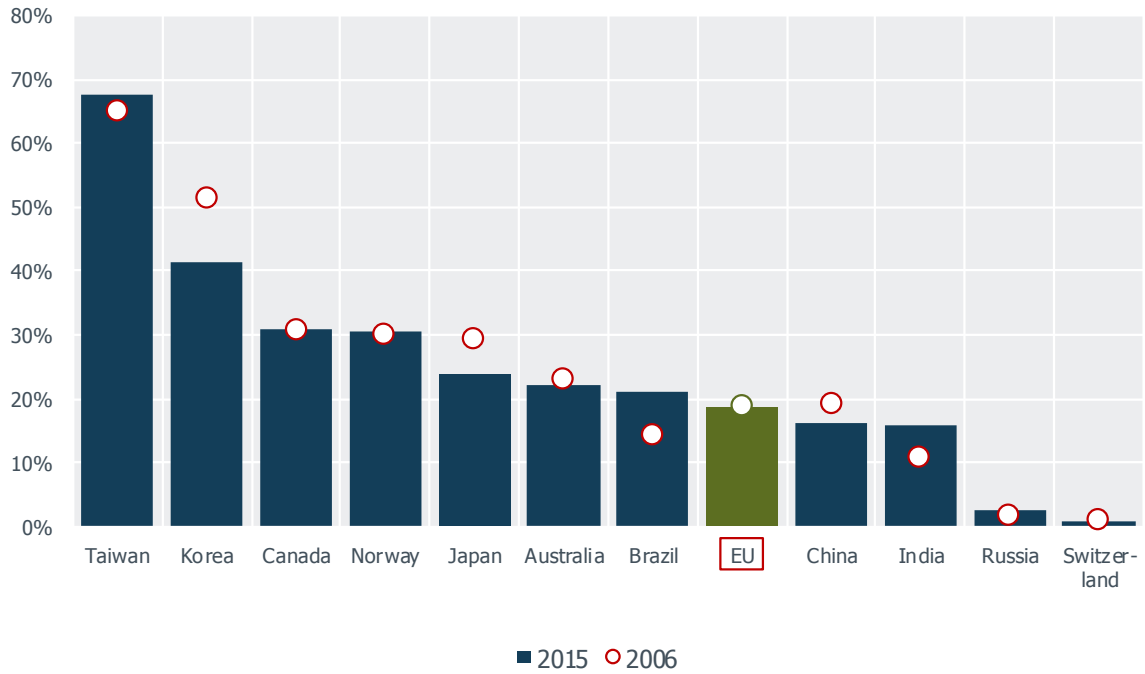
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 Source: 2018 PREDICT Dataset.

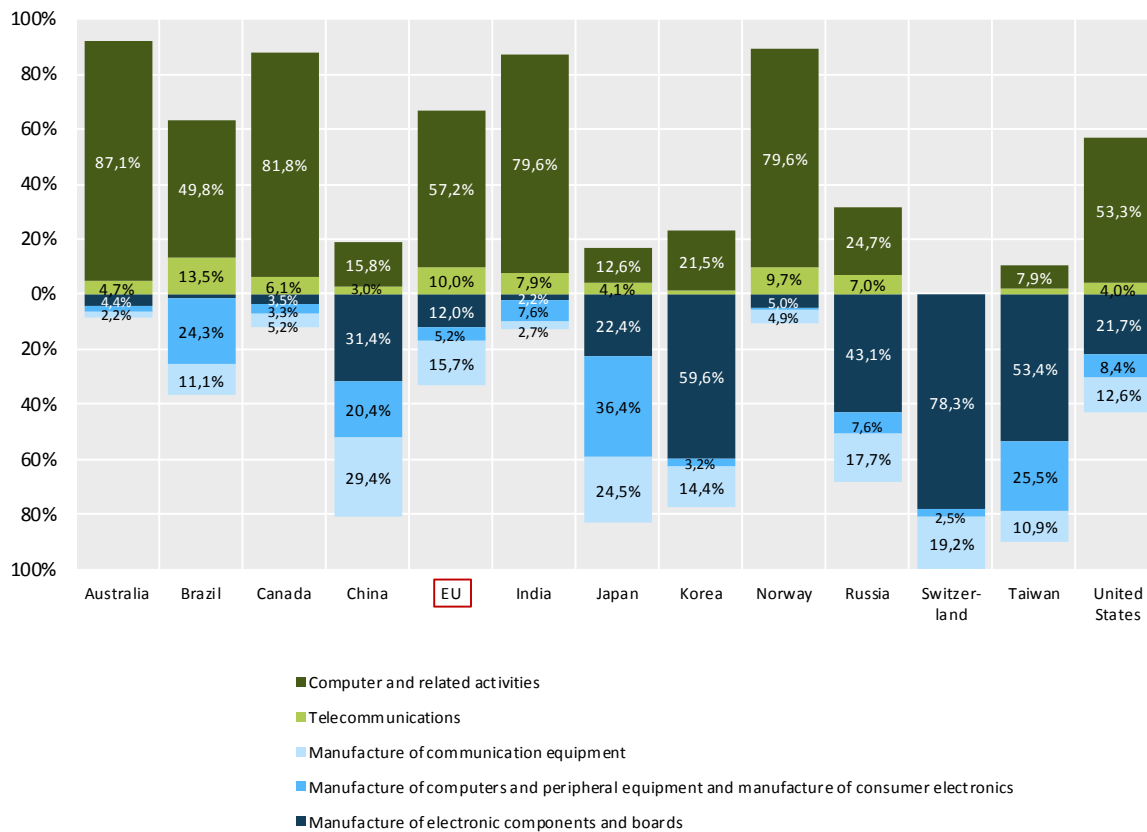
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Note: 2008 is the first year for Brazil and Switzerland. 2011 is the last year for Brazil, 2012 for Switzerland, 2013 for India and 2014 for Canada. ICT PERD for United States not included because of lack of homogeneous data.

Source: 2018 PREDICT Dataset.

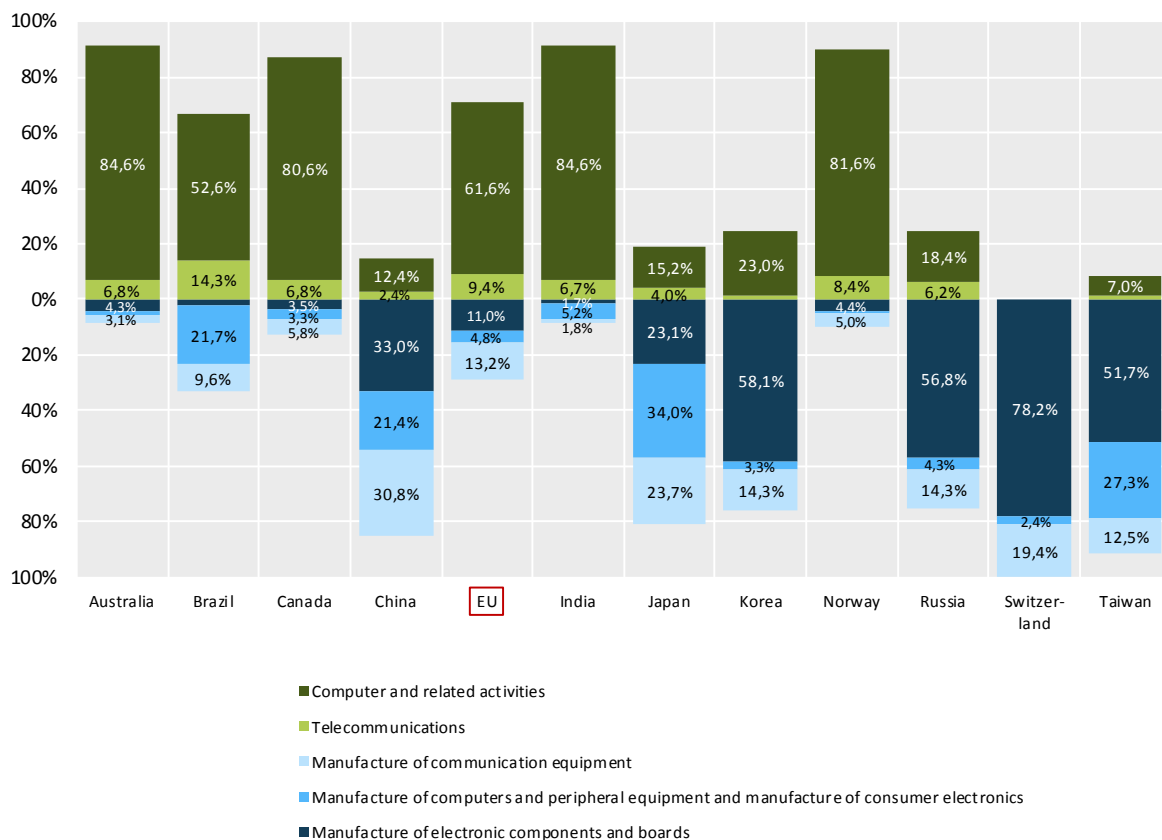
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Source: 2018 PREDICT Dataset.

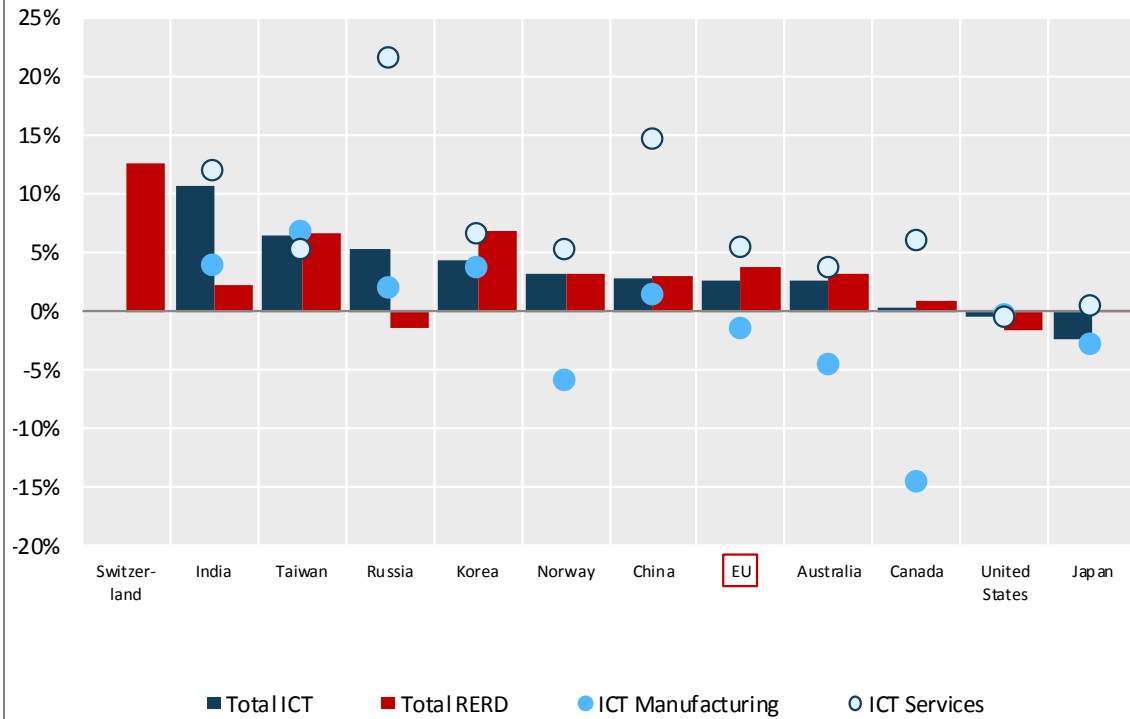
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Note: 2011 for Brazil, 2012 for Switzerland , 2013 for India and 2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing. ICT PERD for United States not included because of lack of homogeneous data.

Source: 2018 PREDICT Dataset.

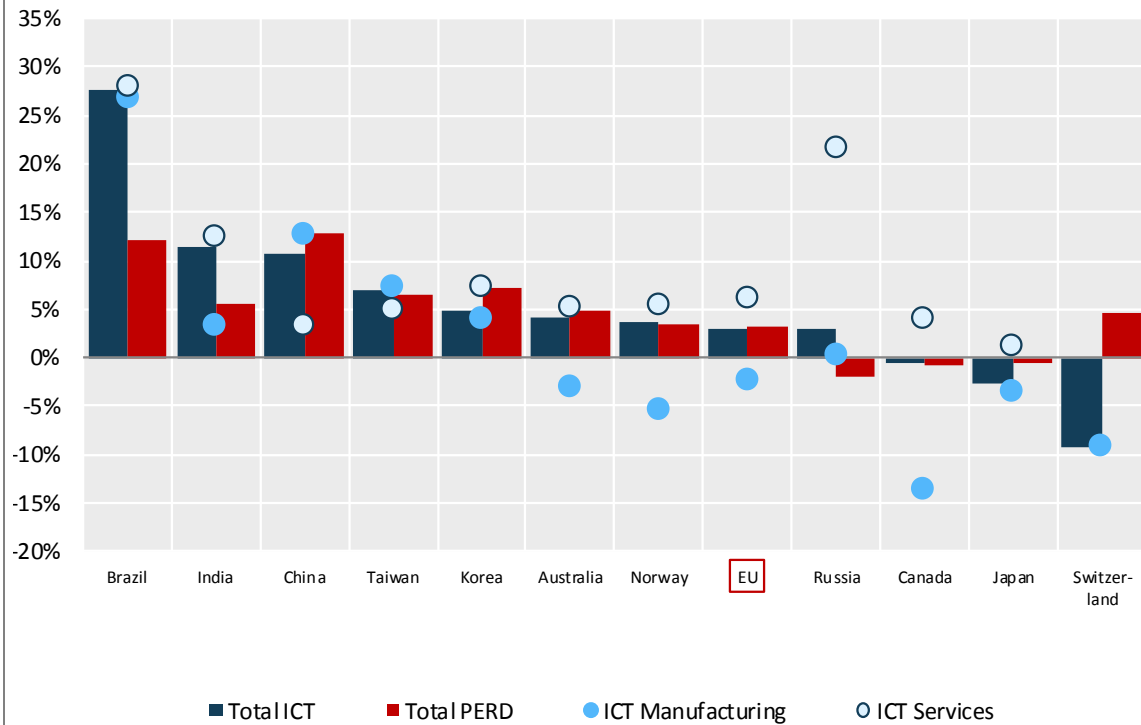
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Note: 2006-2013 for India, 2008-2012 for Switzerland and 2006-2014 for Canada. Data not available for Brazil. ICT sector for Switzerland includes only ICT manufacturing, the data is available but has been excluded due to high growth rate (231%).

Source: 2018 PREDICT Dataset.

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Note: 2008-2011 for Brazil, 2006-2013 for India, 2008-2012 for Switzerland and 2006-2014 for Canada. ICT sector for Switzerland includes only ICT manufacturing. ICT PERD for United States not included because of lack of homogeneous data.

Source: 2018 PREDICT Dataset.

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

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

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

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

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

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

EU28: The EU aggregate in the PREDICT dataset always refers to the aggregate of the 28 countries of the current configuration regardless of the legal status of all 28 countries as Member state of the EU in the respective year. This is to allow for a comparison to the same aggregate.

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 (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.

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), OECD (2007).

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 in 2018: Austria, Belgium, Bulgaria, Croatia, 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. It measures how efficiently labour input is combined with other factors of production and how it is used in the production process. Labour input is defined as total persons engaged in production. Labour productivity only partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their effort, as it depends on the use of other production factors, e.g. physical capital.

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

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.

List of abbreviations used

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

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Publications Office

doi:10.2760/984658

ISBN 978-92-79-86638-8