



JRC TECHNICAL REPORTS

Measures of the Contribution made by ICT to Innovation Output

*An Update of the ICT
Innovation Output
Indicator*

Annarosa Pesole

2016

Measures of the Contribution made by ICT to Innovation Output

This publication is a Technical report by the Joint Research Centre, the European Commission's in-house science service. It aims to provide evidence-based scientific support to the European policy-making process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

JRC Science Hub

<https://ec.europa.eu/jrc>

JRC100892

EUR 27912 EN

ISBN 978-92-79-58260-8 (PDF)

ISSN 1831-9424 (online)

doi:10.2791/569845 (online)

© European Union, 2016

Reproduction is authorised provided the source is acknowledged.

All images © European Union 2016

How to cite: Annarosa Pesole (2016) Measures of the Contribution made by ICT to Innovation Output. An Update of the ICT Innovations Output Indicator; Institute for Prospective Technological Studies, Joint Research Centre. JRC Technical Report EUR 27912 EN; doi:10.2791/569845

Table of contents

Foreword.....	2
Abstract.....	3
1. Introduction	4
2. ICT contribution by components	5
2.1. Technological innovation.....	5
2.2. Absorption of skills.....	6
2.3. Competitiveness of knowledge-intensive sectors.....	7
2.4. Employment in fast-growing firms in innovative sectors.....	9
2.5. ICT contributions for the EU aggregate	10
3. The ICT Innovation Output Indicator	11
4. Conclusion.....	15
References	16
List of figures	17
List of tables	17

Foreword

This report was prepared in the context of the three-year research project on European Innovation Policies for the Digital Shift (EURIPIDIS) jointly launched in 2013 by JRC-IPTS and DG CONNECT of the European Commission. This project aims to improve understanding of innovation in the ICT sector and ICT-enabled innovation in the rest of the economy.

The purpose of the EURIPIDIS project is to provide evidence-based support to the policies, instruments and measurement needs of DG CONNECT for enhancing ICT Innovation in Europe, in the context of the Digital Agenda for Europe and of the ICT priority of Horizon 2020. It focuses on the improvement of the transfer of best research ideas to the market.

EURIPIDIS aims to:

1. better understand how ICT innovation works, at the level of actors such as firms, and also of the ICT “innovation system” in the EU;
2. assess the EU's current ICT innovation performance, by attempting to measure ICT innovation in Europe and measuring the impact of existing policies and instruments (such as FP7 and Horizon 2020); and
3. explore and suggest how policy makers could make ICT innovation in the EU work better.

This report concentrates on point 2 above, and estimates the contribution of ICT to the innovation output indicator presented by the European Commission in 2013.

Abstract

This report presents an update of the *ICT Innovation Output Indicator* based on the latest available data, and provides a measure of the performance of the European Union (EU) and its Member States in ICT innovation. The ICT Innovation Output Indicator is the contribution of Information and Communication Technologies (ICT) to the *Innovation Output Indicator* elaborated by the European Commission in 2013.

The contribution of ICT has been computed for each underlying component of the Innovation Output Indicator for all EU Member States. Depending on the indicator component analysed and data availability, the ICT contribution to innovation can refer either to innovation in the ICT sector as defined by the classification of economic activities, or to ICT use as a general purpose technology in the rest of the economy. The up-to-date ICT contributions for the EU aggregate are:

1. 28% in technological innovation as measured by patents;
2. 19% in absorption of skills as measured by employment in knowledge intensive activities;
3. 27% in competitiveness of knowledge goods as measured by exports of medium-high tech goods;
4. 20% in competitiveness of knowledge services as measured by exports of knowledge intensive services;
5. 23% in innovative firms' dynamics as measured by employment of innovative fast-growing firms.

All data refer to 2013 with the exception of data on patents which refer to 2011. The methodology to compute the ICT Innovation Output Indicator follows the one presented in "*How much does ICT contribute to innovation output? An analysis of the ICT component in the innovation output indicator*" (Pesole, 2015¹). The reader is referred to this report for more detail on the methodology.

The 2013 EU aggregate ICT contributions are very similar to those in 2012 reported by Pesole (2015). The technological innovation component (i.e. ICT PCT patent) increased by two percentage points in 2011 (from 26% to 28%). Similarly, competitiveness of knowledge goods increased from 25% to 27% in 2013. The other contributions remain unchanged.

The ICT Innovation Output Indicator delivers a measure of output-oriented ICT innovation that captures both the technological and non-technological aspects of innovation in ICT and ranks Member States' performance. The three top performing countries remain the same as in Pesole 2015: Finland, Ireland and Sweden.

¹ Pesole (2015) "How much does ICT contribute to innovation output? An analysis of the ICT component in the innovation output indicator," JRC-IPTS Working Papers JRC94372, Institute for Prospective and Technological Studies, Joint Research Centre.
<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC94372/jrc94372.pdf>

1. Introduction

On 13 September 2013, the Commission adopted its Communication 'Measuring innovation output in Europe: towards a new indicator'.² This Communication presents an indicator that measures performance in innovation output and benchmarks the Member States' innovation policies.

The new composite indicator of innovation output comprises the following four components, (three of which come from the Innovation Union Scoreboard³ - hereafter IUS):

- The first component is technological innovation as measured by patents. The number of patent applications per billion GDP is used as a measure of the economy's ability to transform knowledge into technology. The statistics used refer to patent applications⁴, filed at the international phase at the European Patent Office (EPO), under the Patent Cooperation Treaty (PCT)⁵.
- The second focuses on the absorption of skills. Skilled labour is essential for the expansion and efficient deployment of knowledge. Europe's ultimate aim as regards innovation is to create the conditions for the development of a knowledge-based economy to generate growth and competitiveness. This component portrays the structural trends of knowledge-intensive activities as measured by the number of employees with higher education degrees in business industries over total employment.
- The third is the competitiveness of knowledge-intensive goods and services. This measure captures the linkages between innovation and internationalization by looking at both the export shares of high-tech and medium-tech products and of knowledge-intensive services in the total product and service exports of a country. This component indicates the ability of an economy to take part in knowledge-intensive global value chains.
- The last component measures employment in fast-growing firms in innovative sectors. Several studies⁶ suggest that Europe's underperformance in firm growth dynamics and employment growth with respect to the US can be accounted for by the fact that there are fewer young and innovative firms in Europe. The aim of this component is to reflect "the degree of innovativeness of successful entrepreneurial activities".⁷ In order to derive the statistics, data on employment in fast-growing firms have been collected and weighted by apposite sector-specific innovation coefficients, built to reflect the level of innovativeness of each sector.

² Measuring innovation output in Europe: towards a new indicator" COM(2013) 624 final http://ec.europa.eu/research/press/2013/pdf/indicator_of_innovation_output.pdf

³ http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/index_en.htm

⁴ The number of patent applications, based on the priority date, represents the first date on a patent application anywhere in the world and is therefore closest to the invention date. The priority date does not depend on the administrative process of the patent office or the procedure used to file the patent application. On the opposite, looking at granted patent introduces a time lag (and a bias) depending on the patent office. Furthermore, the information reported is older, and it refers to inventions from different years. (OECD - Compendium of Patent Statistics, 2008).

⁵ The PCT offers the possibility to seek patent rights in a large number of countries by filing a single international application with a single patent office (receiving office).

⁶ Bravo-Biosca (2011) "A look at business growth and contraction in Europe" JRC-CONCORD Paper; Haltiwanger, J., Jarmin, R. and Miranda, J. (2010) „Who Creates Jobs? Small vs. Large vs. Young.“ NBER Working Paper No. 16300. Cambridge, MA: NBER.

⁷ Measuring innovation output in Europe: towards a new indicator" COM(2013) 624 final http://ec.europa.eu/research/press/2013/pdf/indicator_of_innovation_output.pdf

This report introduces an up-to-date version (September 2015) of the ICT Innovation Output Indicator that provides a measure of the performance of the EU and its Member States in ICT innovation. The ICT component in innovation can refer to either ICT as a producing sector, as defined by the classification of economic activities, or to ICT use as a general purpose technology in the rest of the economy, according to the indicator analysed and data availability.

This report estimates the ICT contribution for each underlying component of the indicator. The methodology developed to compute the ICT contribution to the Innovation Output Indicator is presented in detail in the 2015 report (see Pesole, 2015⁸). The detailed up-to-date contributions for each component and by Member State are presented in Section 2 of the present report. Section 3 presents the ICT Innovation Output Indicator for 2013 and discusses its variations over time.

2. ICT contribution by components

2.1. Technological innovation

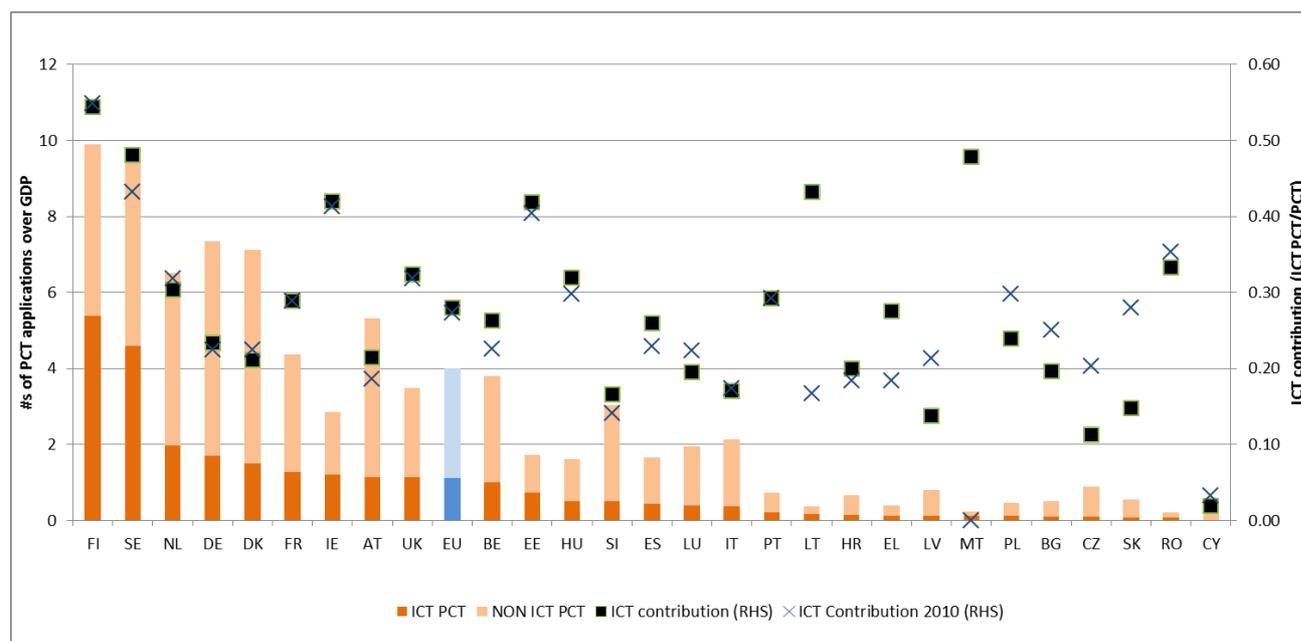
Figure 1 shows the number of applications filed under the PCT (Patent Cooperation Treaty) for ICT and non-ICT patents per billions of GDP in Euro-based purchase power parities. ICT and non-ICT patents are assigned accordingly to the IPC (International Patent Classification) class they belong to. The non ICT bar corresponds to non ICT PCT/GDP and the ICT bar to ICT PCT/GDP (left-hand scale). The right-hand scale shows the contribution of ICT computed as ICT patent applications over the total number of patent applications (ICT PCT/ PCT). Data refer to the latest available year, which was 2011, and cover all EU Member States and the EU aggregate. The graph also shows data for the contribution in 2010, which reveal that there has been little variation in ICT contribution over the years 2010 and 2011.

The Member States in Figure 1 are ranked according to the intensity of ICT patent applications measured over GDP. Finland and Sweden have the highest total number of patent applications per billions of GDP: a total of 9.9 applications, including 5 ICT applications for Finland and a total of 9.5 applications, including 4.6 ICT applications for Sweden. These two countries have ICT contribution shares of 54% and 48% respectively - well above the EU aggregate share of 28%.

The Netherlands, Germany, Denmark, France and Austria follow, with values above the EU aggregate for both the total number of patent applications and ICT patent applications over GDP. However, Germany, Denmark and Austria have ICT contributions that are lower than the EU aggregate (28%). Ireland and the UK have higher ICT patent applications and a higher ICT contribution than the EU aggregate, but they have a lower total of patent applications with respect to the latter. It is interesting to observe that, apart from Finland, Sweden and Ireland, the highest ICT contributions are reported for countries with less intensive patent activities, showing that ICT patents play an important role in the overall patenting activity of the countries. For example, though Estonia, Lithuania and Malta report a small number of total PCT patent applications, they have an ICT contribution of 42%, 43% and 48% respectively.

⁸ Pesole (2015) "How much does ICT contribute to innovation output? An analysis of the ICT component in the innovation output indicator," JRC-IPTS Working Papers JRC94372, Institute for Prospective and Technological Studies, Joint Research Centre. Available at: <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC94372/jrc94372.pdf>

Figure 1: Technological Innovation –PCT, 2011



Source: OECD-PatStat and Eurostat GDP in PPS, elaborated by JRC-IPTS.

Note: Number of patent applications (total and ICT) filed under the PCT, at the international phase, designating the European Patent Office (EPO). Patent counts are based on the priority date and the inventor's country of residence.

2.2. Absorption of skills

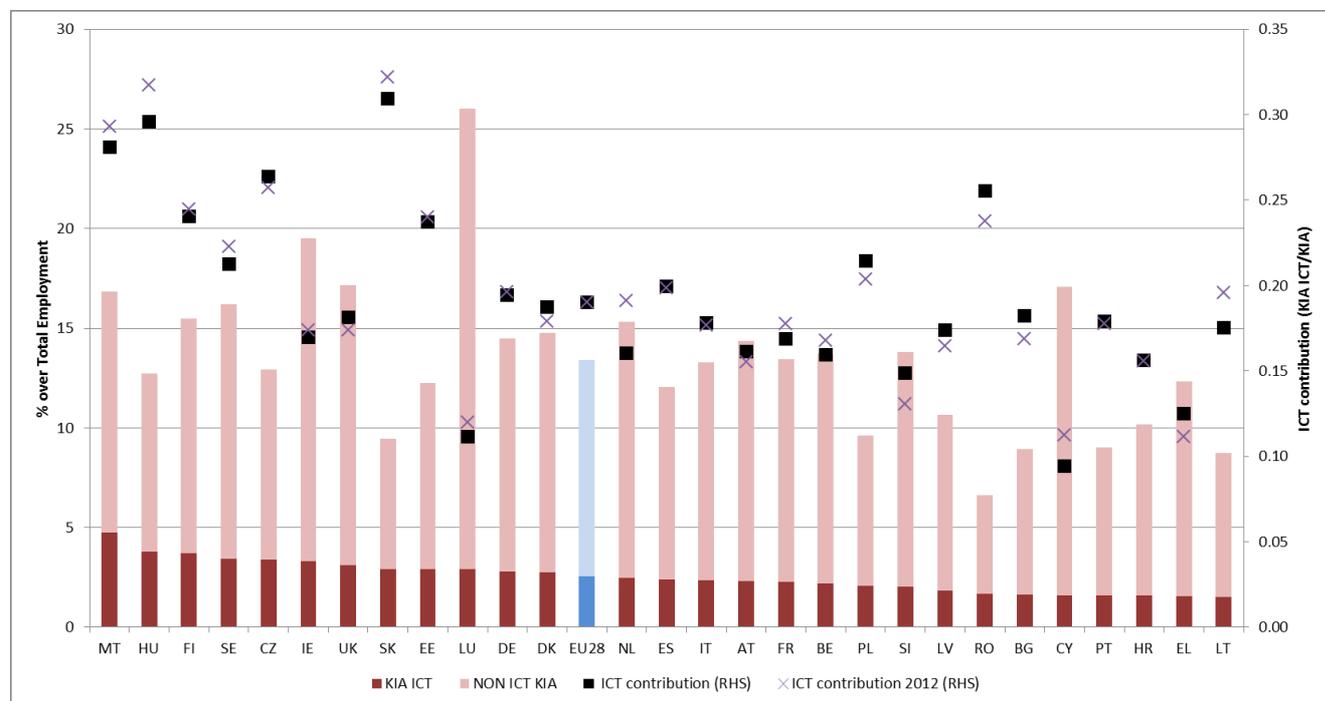
Figure 2 reports data on the "absorption of skills" component. This is indicator 3.2.1 of the IUS and measures the percentage of employees in knowledge-intensive activities (KIA) over total employees in total economy. Knowledge-intensive activities are defined, according to the NACE rev2 classification at the 2-digit level, as those sectors where at least 33% of employees have higher education degrees (ISCED5 or ISCED6). The ICT component has been computed by taking the share of employees in sectors that are defined as knowledge-intensive activities and also belong to the ICT sector over the number of total employees in the economy. For further details, refer to Pesole (2015).

The left-hand scale of Figure 2 shows the percentage of KIA employees and KIA ICT employees over total employment in the economy - (KIA Employment/Total Employment) and (KIA ICT Employment/Total Employment) respectively. The right-hand scale shows the contribution of ICT to KIA employment that has been computed as the relative share of KIA ICT employees over total KIA employees (KIA ICT Employment/KIA Employment). Countries in Figure 2 have been ranked according to the percentage of KIA ICT employees over total employment. Data refer to 2013 and cover all European Member States and the EU28 aggregate. The ICT contribution for 2012 has been added to facilitate comparison over time.

As shown by Figure 2, the contribution of ICT over KIA has been pretty stable over time. Malta and Hungary have the highest percentage of KIA ICT employees over total employment, respectively 4.7% and 3.7%, with a slight reduction for both countries with respect to 2012 of 0.1 percentage points (p.p.) as captured by the lower ICT contribution in 2013. The EU aggregate percentage of KIA ICT employees is 2.5% with a total ICT contribution of 19%. Overall, the picture for 2013 does not differ from the data reported for 2012 in Pesole (2015). This becomes more evident when comparing the

little variation in the ICT contributions in 2012 and 2013 (represented by crosses and squares respectively) reported in Figure 2.

Figure 2: Absorption of skills –KIA, 2013



Source: Labour Force Survey Eurostat, elaborated by JRC-IPTS.

2.3. Competitiveness of knowledge-intensive sectors

Figure 3 and 4 show information on competitiveness of knowledge-intensive goods and services⁹. The third component of the indicator is the weighted sum of these two sub-components.

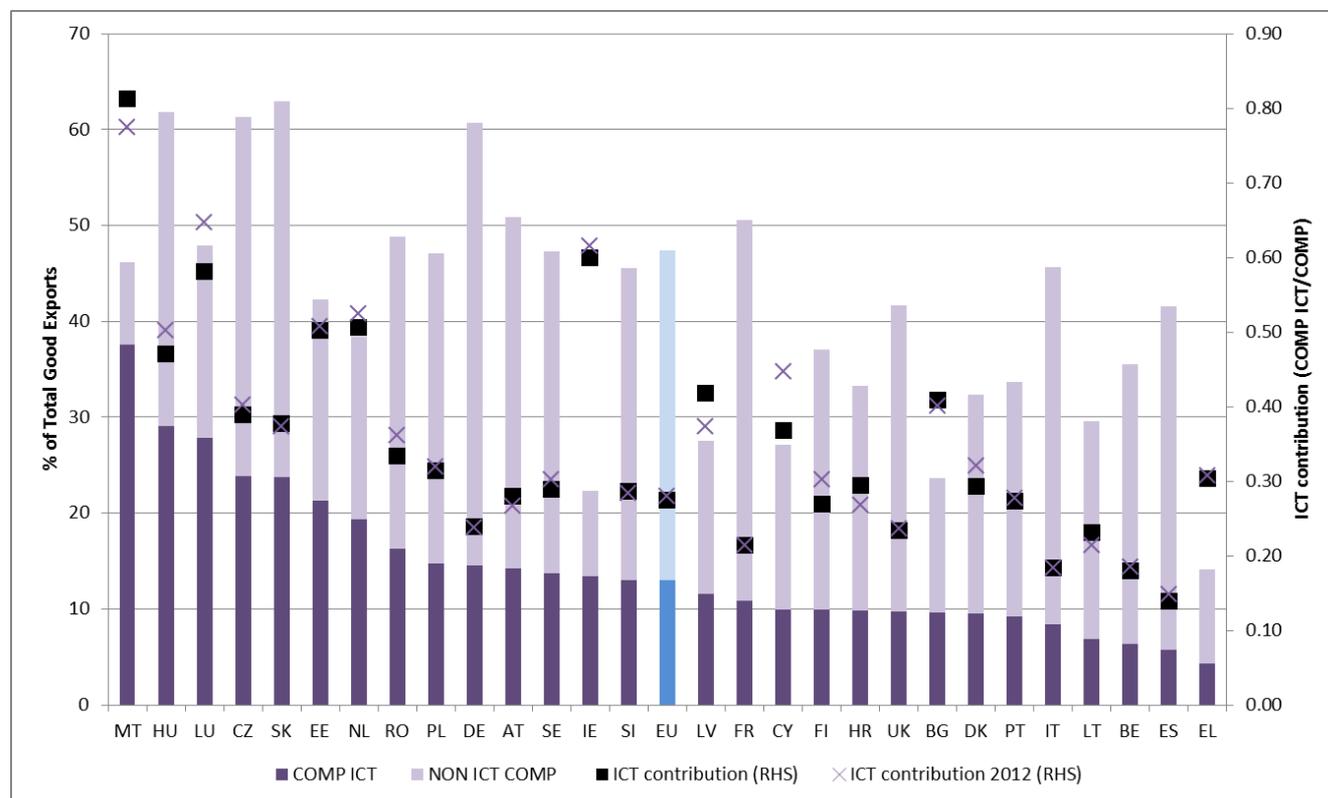
The left-hand scale of Figure 3 shows data on the share of medium-high tech (MHT) exports over total good exports (MHT exports/total goods exports) and on the ICT component over total goods exports. The ICT component has been computed by taking the share of ICT medium-high tech exports over total goods exports (MHT ICT exports/total goods exports). The ICT contribution, shown on the right-hand scale, has been derived as the ratio of ICT medium-high tech exports over total medium-high tech exports (MHT ICT exports/MHT exports). Countries in Figure 3 are ranked according to their share of ICT MHT exports over total goods exports. Data refers to 2013 and the ICT contribution in 2012 has been added for comparison over time. The same structure applies to Figure 4.

Malta has the highest ICT component in export of MHT goods over total goods exports of about 37% and an ICT contribution of 81%, followed by Hungary with an ICT component of 29% and an ICT contribution of 47%. Luxembourg's exports of knowledge-intensive ICT goods have fallen by about 5 p.p. from 33% in 2012 (not shown on the figure) to 28% in 2013. However, its ICT contribution is 58% and is higher than Hungary's ICT

⁹ For a detailed description of the knowledge intensive goods and services refer to Pesole (2015).

contribution. The percentage of ICT knowledge-intensive goods for the EU aggregate is 13%, with an ICT contribution of 27%.

Figure 3: Competitiveness of knowledge-intensive goods –COMP, 2013

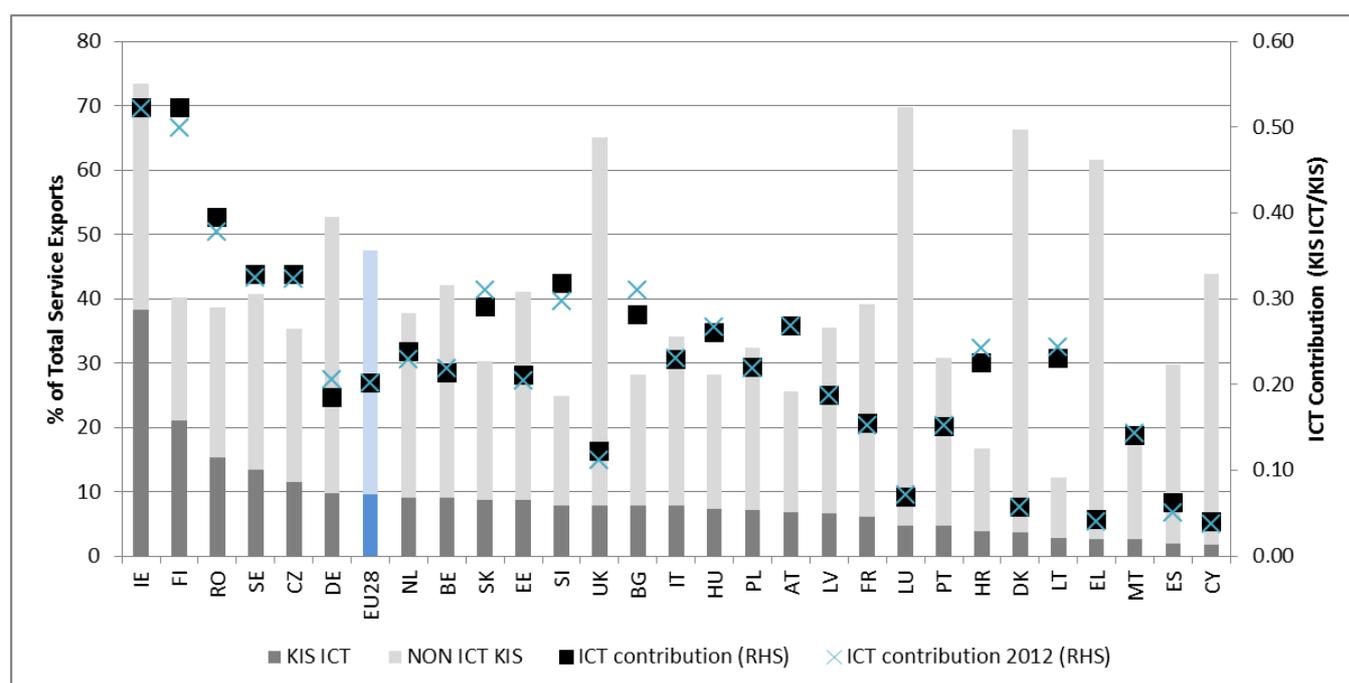


Source: COMEXT Eurostat, elaborated by JRC-IPTS.

Figure 4 displays data on the competitiveness of knowledge-intensive services (KIS). The left-hand scale shows data on knowledge-intensive services (KIS) exports share over total services exports (KIS exports/Total services exports). Here again the ICT component has been computed by taking the share of ICT KIS exports over total services export (KIS ICT exports/Total services exports). The ICT contribution on the right-hand scale shows the share of ICT KIS exports over total KIS exports (KIS ICT exports/KIS exports).

Ireland remains the best performing country. It has an ICT component of 38% of ICT knowledge-intensive services exports over total services exports and an ICT contribution of 52%. Finland follows immediately after with a similar ICT contribution of about 52%, although its ICT overall component (21%) is approximately half that of Ireland. The EU aggregate ICT KIS component is 9.6% and the ICT contribution is about 20%.

Figure 4: Competitiveness of knowledge-intensive services –KIS, 2013



Source: International Trade in Services Eurostat, elaborated by JRC-IPTS.

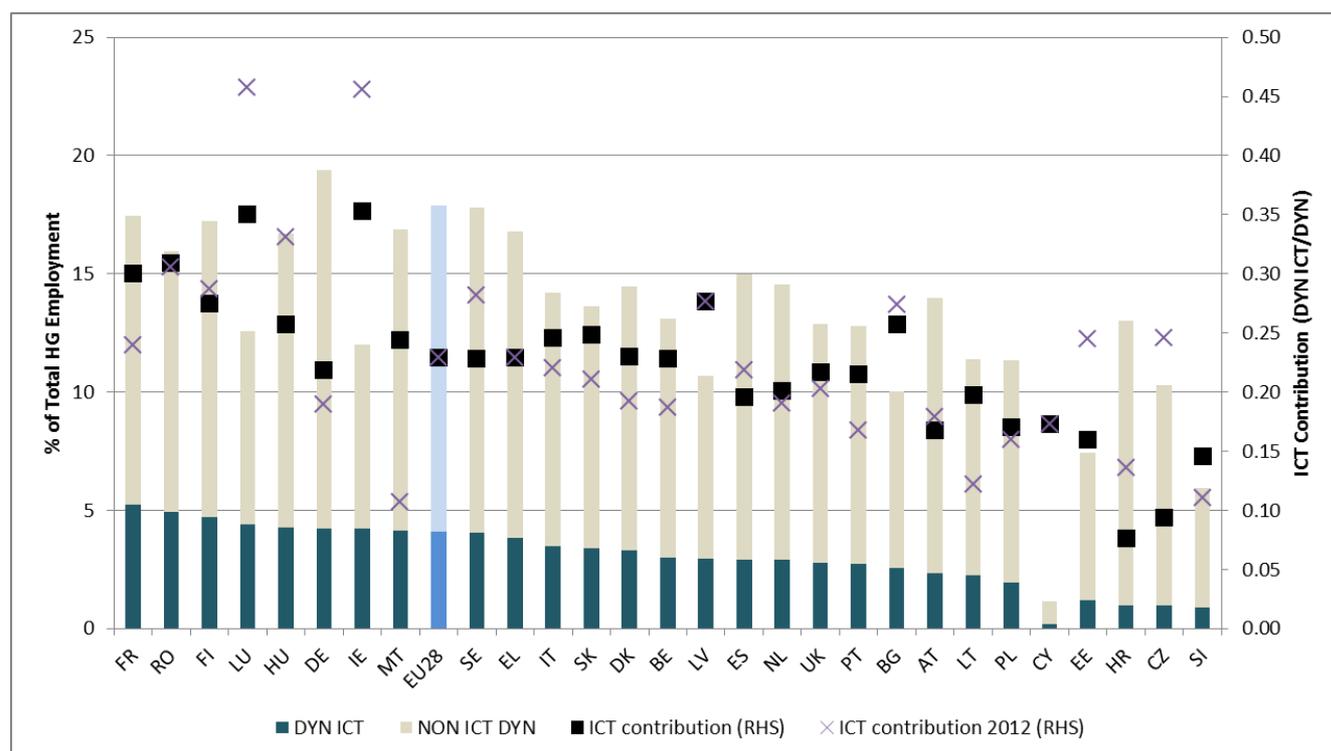
2.4. Employment in fast-growing firms in innovative sectors

The last component of the Innovation Output Indicator is employment in innovative fast-growing firms (DYN). The criteria used to define a firm as innovative and fast-growing are thoroughly described in Pesole (2015), and also the computation of the ICT DYN.

The left-hand scale of Figure 5 shows the share of non ICT and ICT innovative high-growth employment (HGE) over total high-growth employment, respectively (DYN non ICT employment/HGE) and (DYN ICT employment/HGE). The right-hand scale shows the ICT contribution computed as (DYN ICT employment/DYN employment).

France, Romania and Finland had the highest percentage of ICT employees in innovative fast-growing firms in 2013, up 1 p.p. from 2012 (not shown on the figure). In France, a 5% share of ICT employees works in innovative fast-growing firms, which have an ICT contribution of 30% against respectively the 4% and the 23% of the EU aggregate. In Luxembourg, Hungary and Ireland, on the other hand, the percentage of ICT employees in innovative fast-growing firms decreased in 2013 with respect to 2012 (not shown on the figure): from 6% to 4% in Luxembourg, from 5% to 4% in Hungary and from 5.5% to 4% in Ireland. This decrease is reflected in a sharp reduction in the ICT contribution for these countries in 2013 with respect to 2012. As shown in the graph, the ICT contributions for Luxembourg and Ireland went from 46% in 2012 to 35% in 2013, with a reduction of 11 p.p. Hungary's ICT contribution fell 7 p.p. from 33% to 26% and Sweden also saw a reduction in its ICT contribution of about 5 p.p. from 28% to 23%. On the other hand, Malta registered an increase in its ICT contribution of about 13 p.p., from 11% to 24% in 2013.

Figure 5: Employment in fast-growing firms in innovative sectors –DYN, 2013



Source: Structural Business Statistics Eurostat, elaborated by JRC-IPTS.

2.5. ICT contributions for the EU aggregate

This section summarises the data on ICT contribution to the EU aggregate in 2013 (2011 for technological innovation). The ICT contributions for each component are:

1. 28% in technological innovation as measured by patents;
2. 19% in absorption of skills as measured by employment in knowledge intensive activities;
3. 27% in competitiveness of knowledge goods as measured by exports of medium-high tech goods;
4. 20% in competitiveness of knowledge services as measured by exports of knowledge intensive services;
5. 23% in innovative firm's dynamics as measured by employment of innovative fast-growing firms.

With respect to the data for 2012 presented in Pesole (2015), the ICT contribution is rather stable. In technological innovation, it increased by 2 percentage points from 26% to 28%. Equally, the ICT contribution in competitiveness of knowledge goods went from 25% to 27% in 2013. The remaining contributions stayed the same.

3. The ICT Innovation Output Indicator

This section presents the up-to-date version of the ICT Innovation Output Indicator. This is based on the most recent data available as of September 2015, i.e., 2013 data with the exception of data on patents which refer to 2011. The methodology follows Pesole (2015) and the reader is referred to that report for a more detailed methodological description.

Table 1 presents the scores used to compute the final composite indicator by country in 2013 (2011 for PCT patents). For each ICT component (ICT PCT, ICT KIA, etc.), the highest values have been highlighted in green. Values are then graded down to the lowest values, which are highlighted in red. Table 1 looks at the overall performance of the Member States and shows which components contribute the most to the final composite score of each country. Finland, Ireland and Sweden hold the three first positions. As shown by the table, all the three countries perform above average in all ICT components. Finland and Sweden excel in ICT patents and Ireland outperforms the others in trade of ICT services. Malta follows with the highest percentage of ICT KIA employees and trade of ICT goods but the overall score is brought down by low outcomes on both ICT patents and trade in ICT services. The last column of Table 1 provides data on ICT employees in innovative fast-growing firms. France has the highest number of ICT employees, followed by Romania and Finland.

Table 1: ICT Innovation indicators by country, 2013

	ICT PCT	ICT KIA	ICT GOOD	ICT SERV	ICT DYN
EU28	1.12	2.55	13	9.6	4.09
AT	1.14	2.32	14.25	6.88	2.34
BE	1	2.19	6.38	9	2.99
BG	0.1	1.63	9.66	7.9	2.58
HR	0.13	1.59	9.78	3.79	0.99
CY	0.01	1.61	9.98	1.76	1.46
CZ	0.1	3.41	23.83	11.58	0.96
DK	1.5	2.77	9.49	3.74	3.32
EE	0.72	2.91	21.26	8.64	1.19
FI	5.39	3.72	9.97	21.02	4.73
FR	1.26	2.27	10.84	6.05	5.24
DE	1.71	2.81	14.51	9.77	4.24
EL	0.11	1.54	4.3	2.61	3.84
HU	0.51	3.77	29.1	7.34	4.29
IE	1.2	3.31	13.36	38.36	4.24
IT	0.36	2.37	8.35	7.85	3.49
LV	0.11	1.85	11.54	6.65	2.95
LT	0.16	1.53	6.83	2.8	2.25
LU	0.38	2.9	27.8	4.74	4.4
MT	0.11	4.73	37.54	2.59	4.12
NL	1.97	2.46	19.39	9.01	2.92
PL	0.11	2.06	14.79	7.1	1.93
PT	0.21	1.61	9.21	4.66	2.75
RO	0.07	1.69	16.26	15.26	4.93
SK	0.08	2.93	23.73	8.79	3.38
SI	0.5	2.05	13.04	7.92	0.87
ES	0.43	2.4	5.76	1.85	2.93
SE	4.6	3.44	13.67	13.33	4.06
UK	1.13	3.11	9.75	7.91	2.79

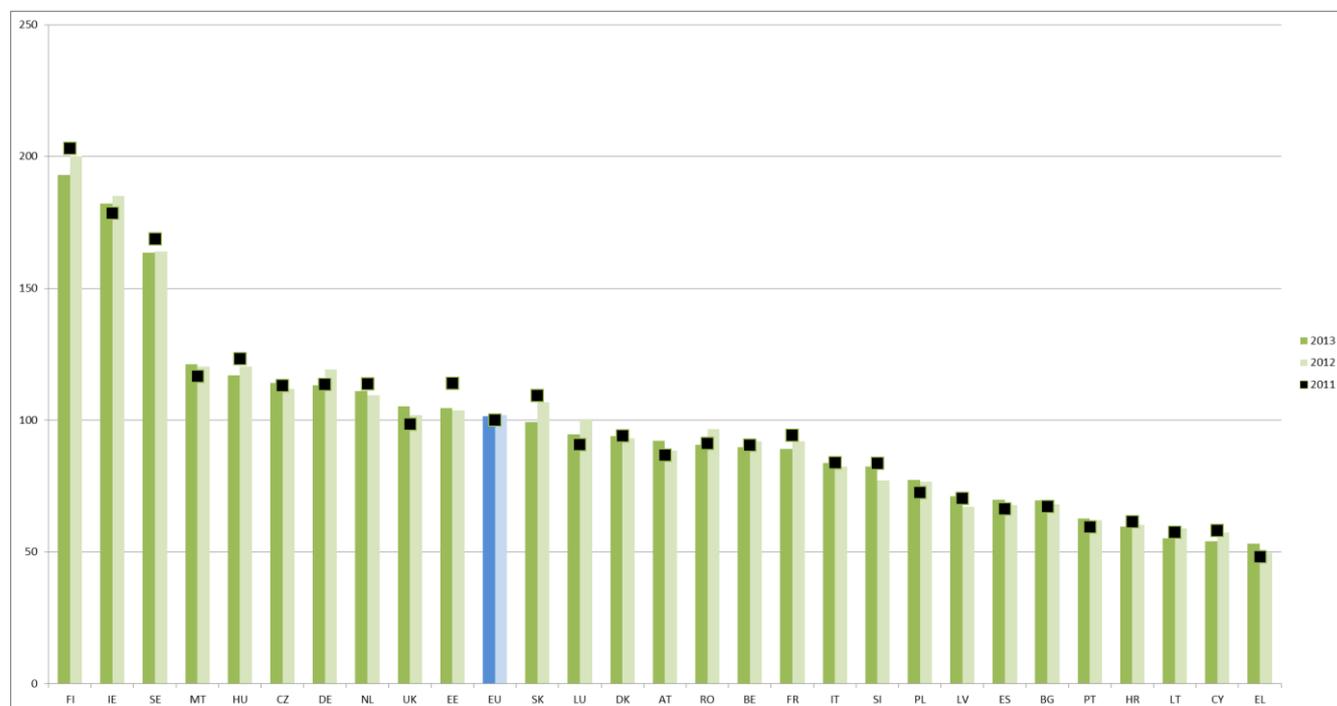
Source: JRC-IPTS calculations based on OECD and Eurostat Data.
Note: Data on PCT patents refer to 2011.

Figure 6 shows the composite ICT Innovation Output Indicator for European Member States over the period 2011-2013. The benchmark was set to equal 100 for Europe in 2011. As shown by the picture below, Finland had the highest score (193) in 2013, followed by Ireland (182) and Sweden (164). These three countries held the top three positions for all three years (2011 to 2013), reporting scores higher than 150 in ICT innovation output. The fourth position in 2013 was taken by Malta with a score of 121.

Comparing the indicators in Table 1 and the ranking in Figure 6, it is possible to understand which factors contributed the most to the final score of the ICT Innovation Output Indicator in 2013 for each Member State. As reported by Table 1, the three highest scores in ICT innovation output (for Finland, Ireland and Sweden) resulted from

very high ICT contributions in the trade of knowledge-intensive services for all three countries, above average levels of fast-growing innovative ICT employment for Ireland and very strong results for ICT patenting in Finland and Sweden. The figure also shows that the scores of the ICT Innovation Output Indicator have been fairly steady over the years. However, both Finland and Ireland displayed lower scores in 2013 with respect to 2012, while Sweden remained stable with respect to 2012.

Figure 6: ICT Innovation Output Indicator, 2013



Source: JRC-IPTS calculations.

Overall, the ranking of the ICT Innovation Output Indicator in 2013 remained very similar to the one in 2012. Though there were small changes affecting most Member States, the general distribution did not show strong variations.

These changes are more evident when we look at Table 2 that reports the scores over the period 2011-2013 by Member State and, in the last column, the percentage difference between the 2012 and 2013 scores. The first three columns of Table 2 show the score of the composite indicator as indexed at 100 for the EU aggregate in 2011. The colour scheme helps us to see the performance of the countries over time (same colour logic applies as for Table 1, the highest score are highlighted in green and graded down to red for the lowest score). As displayed in the table, the overall country ranking remained fairly stable over time, with small variations for a few countries, as mentioned above, despite some remarkable percentage variation between the 2012 and 2013 scores (last column of Table 2).

The first three positions remained unchanged during the entire period considered, even though Finland registered a negative variation of -3.5%. Equally, the last five positions remained the same as in 2012, with Greece closing the ranking, even though Greece had the second best positive percentage variation (of about 7%) after Slovenia (7.1%). In the middle of the ranking, the UK improved its relative position with respect to the EU aggregate, improving its score by 3.3%. At the other extreme, Slovakia, Romania and Luxembourg registered the most negative percentage variations of -7%, -6.1% and -6% respectively. However, the lower scores for these countries do not reflect any major changes in their ranking position, apart from Slovakia which moved below the EU

aggregate score in 2013. This is explained by the fact that the final ranking also depends on the relative differences in the performance of the adjacent countries.

Table 2: ICT Innovation Output Indicator Scores and score differences from 2012 to 2013 (in percentage)

Country	2011	2012	2013	%score difference 2012-2013
FI	203.1	200.2	193.1	-3.52
IE	178.6	185.1	182.3	-1.51
SE	168.8	164.0	163.6	-0.23
MT	116.7	120.4	121.3	0.72
HU	123.3	120.4	117.1	-2.72
CZ	113.2	112.0	114.1	1.85
DE	113.5	119.2	113.4	-4.91
NL	113.9	109.6	111.1	1.36
UK	98.5	101.9	105.2	3.31
EE	113.9	103.6	104.6	0.96
EU	100.0	101.9	101.5	-0.43
SK	109.3	106.8	99.4	-6.96
LU	90.8	100.4	94.7	-5.68
DK	94.1	93.1	93.9	0.80
AT	86.8	88.4	92.1	4.19
RO	91.1	96.5	90.6	-6.17
BE	90.5	91.9	89.7	-2.42
FR	94.3	92.1	89.1	-3.23
IT	83.8	82.4	83.8	1.66
SI	83.6	77.0	82.5	7.10
PL	72.6	76.6	77.3	0.89
LV	70.5	67.2	71.2	5.93
ES	66.4	67.8	69.8	2.90
BG	67.2	68.1	69.5	2.09
PT	59.4	62.0	62.6	1.02
HR	61.5	60.2	59.7	-0.89
LT	57.5	59.0	55.3	-6.23
CY	58.3	57.3	54.0	-5.76
EL	48.2	49.7	53.2	7.08

Source: JRC-IPTS calculations.

4. Conclusion

Although it is often acknowledged that ICT plays an important role as both a driver and an enabler of innovation, a clear measure of how much ICT really contributes to innovation is hard to find. This report follows Pesole (2015) in an attempt to estimate ICT contribution to innovation by measuring the ICT contribution to each underlying component of the Innovation Output Indicator presented by the European Commission in 2013.

This report shows that ICT contributions reported for 2013 (2011 for PCT patent data) varied from 19% in "absorption of skills" to 28% in "technological innovation". The highest ICT shares were for technological innovation as measured by PCT patent applications (28%) and for competitiveness of knowledge-intensive goods, as measured by export of medium-high tech goods (27%), followed by employment in innovative fast growing firms (23%), competitiveness of knowledge services as measured by exports of knowledge intensive services (20%) and finally employment in knowledge-intensive activities (19%).

The results presented in this report highlight and confirm the important role played by ICT in the innovation output of the EU Member States. Over the period 2011-2013, the Member States which performed best in ICT innovation output were Finland, Ireland and Sweden. The overall country ranking remained pretty stable during this period.

References

- Bravo-Biosca (2011) "A look at business growth and contraction in Europe" JRC-CONCORD Paper; Haltiwanger.
- European Commission (2010) Turning Europe into a true Innovation Union, European Commission - MEMO/10/473 06/10/2010. Available at:
[http://europa.eu/rapid/press-release MEMO-10-473_en.htm?locale=en](http://europa.eu/rapid/press-release_MEMO-10-473_en.htm?locale=en)
- European Commission (2011) Conclusions of 4/2/2011 (Council doc. EUCO 2/1/11 REV1) and 1-2/3/2012 (EUCO 4/2/12 REV2).
- European Commission (2013) *Measuring innovation output in Europe: towards a new indicator*, COM(2013) 624 final. Available at:
http://ec.europa.eu/research/press/2013/pdf/indicator_of_innovation_output.pdf
- Jarmin, R. and Miranda, J. (2010) „Who Creates Jobs? Small vs. Large vs. Young.“ NBER Working Paper No. 16300. Cambridge, MA: NBER.
- Pesole, A. (2015) *How much does ICT contribute to innovation output? An analysis of the ICT component in the innovation output indicator*, JRC-IPTS Working Papers JRC94372, Institute for Prospective and Technological Studies, Joint Research Centre. Available at:
<http://publications.jrc.ec.europa.eu/repository/bitstream/JRC94372/jrc94372.pdf>
- Vertesy D., and Tarantola, S. (2014) *The Innovation Output Indicator 2014. Methodology Report*, EUR 26936 EN.

List of figures

Figure 1: Technological Innovation –PCT, 2011	6
Figure 2: Absorption of skills –KIA, 2013.....	7
Figure 3: Competitiveness of knowledge-intensive goods –COMP, 2013	8
Figure 4: Competitiveness of knowledge-intensive services –KIS, 2013	9
Figure 5: Employment in fast-growing firms in innovative sectors –DYN, 2013.....	10
Figure 6: ICT Innovation Output Indicator, 2013	13

List of tables

Table 1: ICT Innovation indicators by country, 2013.....	12
Table 2: ICT Innovation Output Indicator Scores and score differences from 2012 to 2013 (in percentage)	14

Europe Direct is a service to help you find answers to your questions about the European Union

Free phone number (*): 00 800 6 7 8 9 10 11

(*): Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.

It can be accessed through the Europa server <http://europa.eu>

How to obtain EU publications

Our publications are available from EU Bookshop (http://publications.europa.eu/howto/index_en.htm), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents.

You can obtain their contact details by sending a fax to (352) 29 29-42758.

JRC Mission

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

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

*Serving society
Stimulating innovation
Supporting legislation*

