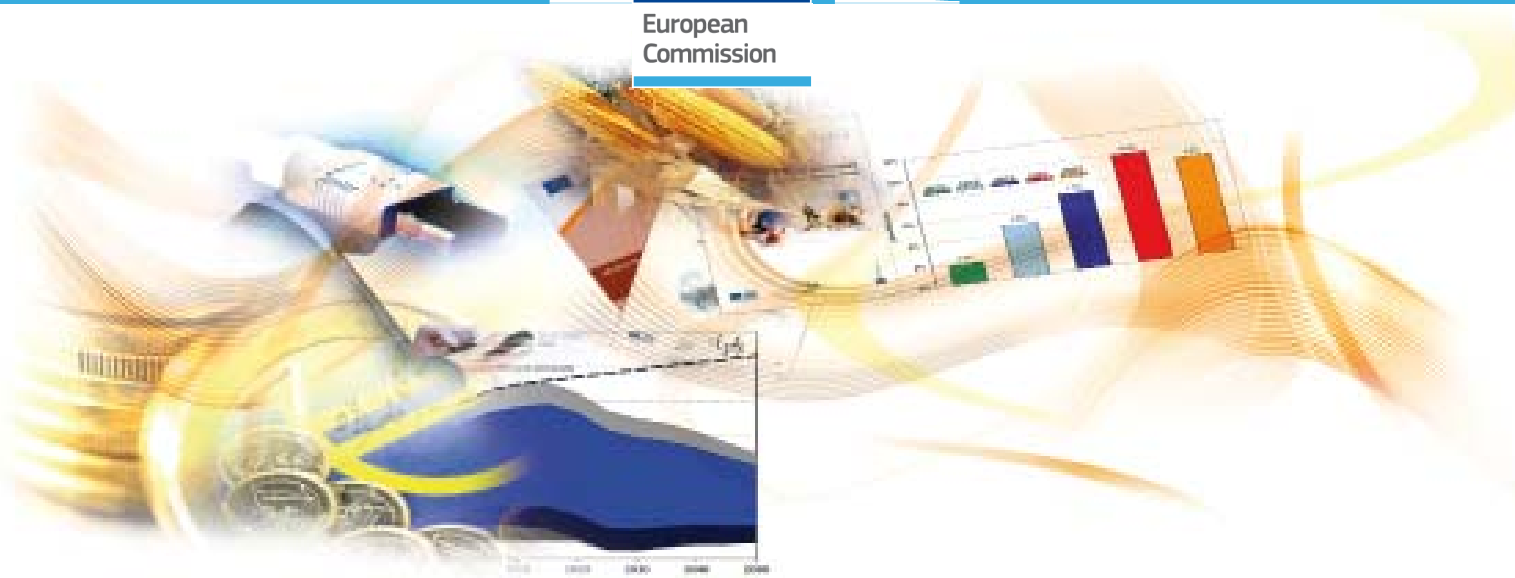# J R C   T E C H N I C A L   R E P O R T S

ICT Sector Definition Transition from NACE Rev. 1.1 to NACE Rev. 2

A Methodological Note

Authors: Matilde Mas, Juan Carlos Robledo, Juan Pérez (Ivie)

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[1] JRC-IPTS is one of the seven research institutes of the European Commission's Joint Research Centre.

[2] For further information see the PREDICT webpage: http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html

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1. INTRODUCTION

R&D has been traditionally identified as one of the main drivers of productivity growth. Since the mid 1990s, new Information and Communication Technologies (ICT) producing sectors were put at the forefront of the explanation of the different paths followed by the European Union (EU) and the United States (US) as regards productivity growth during the expansion years 1995-2007. ICTs provide essential infrastructures and tools for knowledge creation, sharing and diffusion, and boost the innovation capacity of all sectors. Stimulating creative activities in the area of ICT has therefore a double effect on the economy: first, through the growth of the sector itself and second, through the stimulation of R&D and innovation in other sectors of the economy.

From an analytical, and also political, point of view, it has become fundamental to empirically test the impact that R&D expenditures in the ICT producing sectors have on economic growth. To do this, we need a common definition of the ICT sector that will allow us to establish comparisons between countries at a given moment in time in order to carry out cross country analyses. At the same time, we need an ICT definition that holds constant during a period of time so that we can analyze the performance of a country, or set of countries, as time elapses. That is, we also need a common ICT definition in order to analyze the performance over time.

In recent years, we have witnessed two fundamental and closely linked changes that affect our understanding of the role played by the ICT sector, and by the R&D expenditures that it undertakes. The first refers to the change in the classification of economic activities from the previous NACE[3] Rev. 1.1 to NACE Rev. 2, implemented in 2008. NACE Rev. 1.1 had 17 sections and 62 divisions; NACE Rev. 2 has 21 sections and 88 divisions. At the highest level of NACE, some sections can be easily compared with the previous version of the classification. However, the introduction of some new concepts at the section level, e.g. the information section or the grouping of activities linked to environment, makes a straightforward comparison between NACE Rev. 2 and its previous version very difficult.

The second change —at least partially led by the first one— was a new definition for the ICT sector. The OECD (Organisation for Economic Co-operation and Development) had proposed in 2002 a precise definition, accompanied by an operational definition in view of the difficulties faced from a statistical standpoint. With the change in NACE classification, together with the improvements in our understanding of ICT characteristics, a new definition for what should be considered as ICT was proposed by the OECD in 2007.

The two changes just mentioned —new NACE and new ICT definition—represent an improvement in the statistical tools available, but also have the drawbacks that usually accompany all methodological changes. The first inconvenience is that the time series is broken, making it difficult to diagnose improvements/deterioration precisely over time. The second is that it is difficult to establish the different rhythm

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[3] NACE stands for Nomenclature statistique des activités économiques dans la Communauté européenne (Statistical Classification of Economic Activities in the European Community).

followed by countries when the information has to be adjusted to the new requirements. In other words, the changes not only make it difficult to keep track of data across time, but also impede the comparison of information across countries at a given moment in time.

The analysis reported in this methodological note was produced under the project *ICT R&D Macrodata Collection and Analysis* (IPTS-2012-J04-002-NC) between the Information Society Unit of JRC-IPTS[4] and the Valencian Institute of Economic Research (Instituto Valenciano de Investigaciones Económicas - Ivie). This work is part of the European Commission project: "Prospective Insights on R&D in ICT" (PREDICT[5]) jointly funded by DG Communications Networks, Content and Technology (DG CONNECT) and JRC-IPTS.

Our goal was to obtain a homogenous series for years 2006 to 2009 of a set of variables —mainly Gross Value Added (GVA), employment, and Business R&D (BERD)— for the ICT sector according to the new definition suggested by the OECD in 2007 and making use of the new NACE Rev. 2 classification. In order to achieve this goal, we start in Section 2 by establishing the correspondence between the two ICT sector definitions and the two classifications at hand, as well as a methodology for transition from NACE Rev. 1.1 to NACE Rev. 2. We will then present, in Section 3, the results for Italy, which has been taken as an example due to the detailed information it provides. Since the majority of countries cannot provide such detailed information, a compromise is offered as a solution in Section 4. Finally, Section 5 illustrates some of the differences emerging from the methodological changes just sketched and Section 6 presents some concluding remarks.

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[4]   JRC-IPTS is one of the seven research institutes of the European Commission's Joint Research Centre.

[5]   For further information see the PREDICT webpage: http://is.jrc.ec.europa.eu/pages/ISG/PREDICT.html

2.   FROM NACE REV. 1.1 TO NACE REV. 2

The objective of this section is to present the methodology that has been used to reclassify NACE Rev. 1.1 data for ICT R&D over the 2006-2007 period according to NACE Rev. 2 classification, taking into account the 2007 OECD ICT sector definition which appears in Table 1. In order to facilitate the transition towards the new OECD ICT sector definition, the Instituto Valenciano de Investigaciones Económicas (*Valencian Institute of Economic Research*, Ivie) has elaborated correspondence tables, see Table 2. These tables are the first step towards obtaining the links between the two NACE versions.

In practice, it is difficult to provide an ICT database on the basis of a fully comprehensive correspondence between NACE Rev. 2 and NACE Rev 1.1 (Table 2) for several reasons. First, the elaboration of a one-to-one correspondence requires the highest level of disaggregation (or the most detailed level of classification) for economic activities, i.e. four-digit or class level. However, there are no publications that cover all the activities involved for each variable and country at this level of detail. Secondly, a one-to-one relationship between both NACE codes is not available. NACE Rev. 1.1 (ISIC Rev. 3) codes are often linked with more than one NACE Rev. 2 (ISIC Rev. 4) code. For example, 323 NACE Rev. 1.1 is linked with 261, 263 and 264 NACE Rev. 2 codes; 261 NACE Rev. 2 is linked with only one part of 311, 312, 313, 321 and 323 NACE Rev. 1.1 codes. Thus, it is not possible to obtain full codes of NACE REV 1.1 even when aggregating all ICT manufacturing; trade; or services sectors. For these reasons, we need to use approximate correspondences.

Table 1: The 2007 OECD ICT sector definition
(based on NACE Rev. 2)

ICT manufacturing industries		
	261	Manufacture of electronic components and boards
	262	Manufacture of computers and peripheral equipment
	263	Manufacture of communication equipment
	264	Manufacture of consumer electronics
	268	Manufacture of magnetic and optical media
ICT trade industries		
	4651	Wholesale of computers, computer peripheral equipment and software
	4652	Wholesale of electronic and telecommunications equipment and parts
ICT services industries		
	582	Software publishing
	6110	Wired telecommunications activities
	6120	Wireless telecommunications activities
	6130	Satellite telecommunications activities
	6190	Other telecommunications activities
	6201	Computer programming activities
	6202	Computer consultancy activities
	6203	Computer facilities management activities
	6209	Other information technology and computer service activities
	6311	Data processing, hosting and related activities
	6312	Web portals
	9511	Repair of computers and peripheral equipment
	9512	Repair of communication equipment

Source: OECD (2011).

Table 2 provides both correspondences —comprehensive and approximate— based on the 2007 OECD ICT sector definition. In our opinion, the best solution for backcasting estimations is the allocation of full NACE Rev. 1.1 codes that better define each ICT sub-sector. The approximate correspondence facilitates the estimation of NACE Rev. 2 ICT sector series for the NACE Rev. 1.1 period (see MOSPI 2010).

The only year for which national statistical offices provide both versions of NACE data for all variables is 2008. Thus, this will be the linkage year for the backcasting data series. The first step towards estimating 2006-2007 NACE Rev. 2 ICT data is to obtain the 2008 linking coefficients. We present two possible alternatives frequently used by the Statistical Offices when faced with the need of providing homogenous time series following major changes in National Accounts classifications.

Table 2: Correspondences between NACE Rev. 2 and NACE Rev 1.1
(based on the 2007 OECD ICT sector definition)

2007 OECD ICT DEFINITION			COMPREHENSIVE CORRESPONDENCE		APPROXIMATE CORRESPONDENCE	
NACE Rev. 2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1	NACE Rev. 1.1	ISIC Rev. 3.1
261-264, 268	**261-264, 268**	**ICT manufacturing industries**	**2465, 3002P, 311P, 312P, 313P, 3162P, 321P-323P, 365P**	**2429P, 30P, 311P, 312P, 313P, 3162P, 321P-323P, 3694P**	**2465, 30, 32**	**2429, 30, 32**
261	261	Manufacture of electronic components and boards	311P, 312P, 313P, 321P, 323P	311P, 312P, 313P, 321P, 323P	321	321
262	262	Manufacture of computers and peripheral equipment	3002P	30P	30	30
263	263	Manufacture of communication equipment	3162P, 322P, 323P	3162P, 322P, 323P	322	322
264	264	Manufacture of consumer electronics	323P, 365P	323P, 3694P	323	323
268	268	Manufacture of magnetic and optical media	2465	2429P	2465	2429
465	**465**	**ICT trade industries**	**5143P, 5184, 5186**	**5139P, 5151, 5152,**	**5184, 5186**	**5151, 5152**
4651	4651	Wholesale of computers, computer peripheral equipment and software	5184	5151	5184	5151
4652	4652	Wholesale of electronic and telecommunications equipment and parts	5143P, 5186	5139P, 5152	5186	5152
582, 61, 62, 631, 951	**582, 61, 62, 631, 951**	**ICT services industries**	**3002P, 322P, 323P, 5274P, 642P, 72 (ex. 723P-726P)**	**30P, 322P, 323P, 526P, 642P, 72 (ex. 723P-729P)**	**642, 72**	**642, 72**
582	582	Software publishing	7221, 724P	7221, 724P	7221	7221
61	61	Telecommunications	642P	642P	642	642
62	62	Computer programming, consultancy and related activities	3002P, 721, 7222, 723P, 724P, 726P	30P, 721, 7229, 723P, 724P, 729P	721, 7222, 726	721, 7229, 729
631	631	Data processing, hosting and related activities; web portals	723P, 724P	723P, 724P	723, 724	723, 724
951	951	Repair of computers and communication equipment	322P, 323P, 5274P, 725P	322P, 323P, 526P, 725P	725	725

Note: The P indicates that the NACE Rev. 1.1 (ISIC Rev. 3.1) codes are linked with more than one NACE Rev. 2 (ISIC Rev. 4) code

Source: Eurostat (1996, 2008), MOSPI (2010), OECD (2011), UNSD (2002, 2008) and own elaboration.

The first method proposed, which we will refer to as **proportional,** estimates the linking coefficients, $X_{i,j}^{08*}$, as the ratio between NACE Rev. 2 data and NACE Rev. 1.1 data for each individual ICT sub-sector, variable and country as stated in equation 1.

$$X_{i,j}^{08*} = X_{i,j}^{08rev2} \Big/ X_{i,j}^{08rev1}$$

[1]

Being: X the variable (GVA, employment, BERD,…); 08rev2: 2008 NACE Rev. 2 ICT data; 08rev1: 2008 NACE Rev. 1.1 ICT data; *i*: individual ICT sector; *j*: individual country.

This method consists of applying each 2008 linking coefficient to each individual ICT sector, variable and country and for every year of the period 2006-2007 (equations 2

and 3). It should be noted that the linking coefficient, $X_{i,j}^{08*}$, is the same for 2007 and 2006.

$$X_{i,j}^{07rev2} = X_{i,j}^{08*} \times X_{i,j}^{07rev1}$$

[2]

$$X_{i,j}^{06rev2} = X_{i,j}^{08*} \times X_{i,j}^{06rev1}$$

[3]

These linking coefficients assume that the value of the ICT sector under NACE Rev. 1.1 is always a proportion of the value of the ICT sector under NACE Rev.2 remaining constant from one year to the next. However, there is no statistical or economic reason to assume such proportionality. According to what we will refer to as the **additive** method, the difference in the ICT sector between NACE Rev 1.1 and Rev. 2 is due to the fact that ICT NACE Rev. 2 includes/excludes some activities that are excluded/included in ICT NACE Rev. 1.1, i.e. the difference between both NACE should not depend only on the value of either sector but also on the rules that each classification uses to classify activities.

The **additive** method modifies the procedure of estimation in the following way. Let us assume that variable X is composed of only two sectors, ICT and non ICT sectors and that the following relations hold:

$$X_{ICT,j}^{08rev1} = X_{ICT,j}^{08rev2} + d_j^{08}$$

[4]

$$X_{NICT,j}^{08rev1} = X_{NICT,j}^{08rev2} - d_j^{08}$$

[5]

$$X_j^{08rev1} = X_j^{08rev2}$$

[6]

Being: X the variable (GVA, employment, BERD,...); 08rev2: 2008 NACE Rev. 2 data; 08rev1: 2008 NACE Rev. 1.1 data; d_j^{08}: the difference between both NACE data in 2008; ICT: ICT sector; NICT: Non ICT sector; j: individual country.

The linking coefficient that reflects the additive property is d_j^{08}/X_j^{08} computed in 2008. Thus, the hypothesis implies that NACE Rev. 1.1 systematically allocates more/less GDP, employment, etc., to ICT than Rev. 2 does, which is precisely why the measurement of ICT varies between the two versions. In order to improve the linking coefficients it would be advisable to measure d_j^{08} for each individual ICT industry.

Therefore, according to this second method, the 2006-2007 NACE Rev. 2 ICT would be obtained as follows:

$$X_{i,j}^{07rev2} = X_{i,j}^{07rev1} - \left(\frac{d_{i,j}^{08}}{X_j^{08}} * X_j^{07} \right)$$

[7]

$$X_{i,j}^{06rev2} = X_{i,j}^{06rev1} - \left(\frac{d_{i,j}^{08}}{X_j^{08}} * X_j^{06} \right)$$

[8]

Being i: individual ICT sector

3.   ITALY AS AN EXAMPLE

We will present in some detail the results for one European country (Italy) and two variables (GVA and employment). The choice of Italy is not casual. It is the only country with data available for all ICT sub-sectors (manufacturing and services) in both classifications, NACE Rev. 1.1 and NACE Rev. 2, for GVA and employment. Ireland also has data available for all ICT services sub-sectors for GVA and employment but not for all ICT manufacturing sub-sectors. None of the other 25 European countries have the necessary disaggregated NACE Rev. 1.1 for GVA and employment to estimate all the ICT sub-sectors in Table 2. Therefore, another classification is needed.

The first step is to check if there are sizeable differences between the proportional (equations [1] to [3]) and additive (equations [4] to [8]) methods. Table 3 offers the results of the estimation for year 2007 using the Italian data. As can be seen, the differences between the two methods are minor in absolute values (and even less in terms of ratios). As it seems that selecting one method or the other has no practical consequences, we finally opted for the additive method.[6]

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[6]   We opted to select one of them instead of computing an average in order to make the assumptions as clear as possible. The results for the proportional method applied to the complete database are also available upon request.

Table 3: 2007 NACE Rev. 2 ICT data for GVA and employment. Italy

2007 OECD ICT DEFINITION		APPROXIMATE NACE Rev. 1.1 CORRES-PONDENCE	GVA (millions EUR)		Employment (1000 persons)	
NACE Rev. 2	Description		2007 (propor-tional method)	2007 (additive method)	2007 (propor-tional method)	2007 (additive method)
	ICT TOTAL		57,990	57,962	673.60	668.17
261-264, 268	**ICT manufacturing industries**	**2465, 30, 32**	5,637	5,886	108.79	109.81
261	Manufacture of electronic components and boards	321	2.590	2.584	52.68	52.33
262	Manufacture of computers and peripheral equipment	30	551	583	10.60	10.86
263	Manufacture of communication equipment	322	2,301	2,466	40.11	41.09
264	Manufacture of consumer electronics	323	184	211	4.94	5.07
268	Manufacture of magnetic and optical media	2465	11	42	0.46	0.46
465	**ICT trade industries**	**5184, 5186**	3,689	3,568	63.29	60.09
4651	Wholesale of computers, computer peripheral equipment and software	5184	2.536	2.533	46.76	45.22
4652	Wholesale of electronic and telecommunications equipment and parts	5186	1,153	1,035	16.53	14.87
582, 61, 62, 631, 951	**ICT services industries**	**642, 72**	48,665	48,507	501.52	498.27
582	Software publishing	7221	176	169	3.58	2.59
61	Telecommunications	642	25,401	25,298	105.64	105.38
62	Computer programming, consultancy and related activities	721, 7222, 726	15,601	15,603	222.76	221.13
631	Data processing, hosting and related activities; web portals	723, 724	6,236	6,222	149.68	149.40
951	Repair of computers and communication equipment	725	1,250	1,215	19.86	19.76

Source: Own elaboration.

Table 4 shows the linking coefficients for Italy for the reference year, 2008, and for the two variables under considerations, GVA and employment.

Table 4: 2008 linking coefficient for GVA and employment. Italy

(percentage)

2007 OECD ICT DEFINITION		APPROXIMATE NACE Rev. 1.1 CORRES-PONDENCE	2008 GVA Linking coefficient	2008 Employment Linking coefficient
NACE Rev. 2	Description			
	ICT TOTAL		-0.24	0.02
261–264, 268	**ICT manufacturing industries**	**2465, 30, 32**	**0.12**	**0.04**
261	Manufacture of electronic components and boards	321	0.01	-0.05
262	Manufacture of computers and peripheral equipment	30	0.02	0.04
263	Manufacture of communication equipment	322	0.07	0.05
264	Manufacture of consumer electronics	323	0.01	0.01
268	Manufacture of magnetic and optical media	2465	0.00	0.00
465	**ICT trade industries**	**5184, 5186**	**-0.08**	**-0.12**
4651	Wholesale of computers, computer peripheral equipment and software	5184	-0.04	-0.08
4652	Wholesale of electronic and telecommunications equipment and parts	5186	-0.04	-0.04
582, 61, 62, 631, 951	**ICT services industries**	**642, 72**	**-0.27**	**0.11**
582	Software publishing	7221	0.02	0.02
61	Telecommunications	642	-0.25	-0.03
62	Computer programming, consultancy and related activities	721, 7222, 726	0.00	0.15
631	Data processing, hosting and related activities; web portals	723, 724	-0.01	-0.03
951	Repair of computers and communication equipment	725	-0.04	-0.01

Source: Own elaboration

Table 5 shows the 2007 results for Italy obtained after applying equation 7 for GVA and employment (see the grey shaded columns). These data are obtained by subtracting each 2007 NACE Rev. 1.1 ICT data adapted to 2007 OECD ICT sector definition (Table 1) using the approximate correspondence (Table 2) by each individual linking coefficient, shown in Table 4. For example, to obtain the 2007 GVA figure for 261 NACE Rev. 2 sector (2,584 million euro), *manufacture of electronic components and boards*, it is necessary to take the following steps. First, we identify in Table 2, the approximate 2008 NACE Rev 1.1 code, in this case, 321.

Second, we take the estimated 2008 linking coefficient (0.01%) from Table 4. This coefficient equals $\dfrac{d_{261}^{08}}{X^{08}}$, being d_{261}^{08} 222 million euro (= 2917-2695), and X^{08} 2008 total GDP, amounting to 1,575,144 millions of euro. Finally, to get 261 NACE Rev. 2 data for 2007 GVA, we make use of equation 7, subtracting from the 2007 GVA NACE

Rev 1.1 sector 261 (2,803 million euro) the result of multiplying the linking coefficient (0.01%) by the 2007 total GDP NACE Rev 1.1 (1,554,199 million euro).

Table 5: 2007 NACE Rev. 2 ICT data for GVA and employment. Italy

2007 OECD ICT DEFINITION		APPROXIMATE NACE Rev. 1.1 CORRES-PONDENCE	GVA (millions EUR)				Employment (1000 persons)			
			2007	2008	Linked 2007	2008	2007	2008	Linked 2007	2008
NACE Rev. 2	Description		NACE Rev. 1.1		NACE Rev. 2		NACE Rev. 1.1		NACE Rev. 2	
	ICT TOTAL		54,290	54,104	57,962	57,825	673.63	670.71	668.17	665.24
261-264, 268	**ICT manufacturing industries**	**2465, 30, 32**	7,739	7,343	5,886	5,465	119.54	113.50	109.81	103.75
261	Manufacture of electronic components and boards	321	2,803	2,917	2,584	2,695	39.78	38.79	52.33	51.37
262	Manufacture of computers and peripheral equipment	30	949	883	583	513	20.00	19.50	10.86	10.34
263	Manufacture of communication equipment	322	3,579	3,160	2,466	2,032	52.57	48.57	41.09	37.06
264	Manufacture of consumer electronics	323	405	362	211	165	6.65	6.14	5.07	4.56
268	Manufacture of magnetic and optical media	2465	4	21	42	60	0.54	0.50	0.46	0.43
465	**ICT trade industries**	**5184, 5186**	2,284	2,231	3,568	3,532	29.25	26.97	60.09	57.89
4651	Wholesale of computers, computer peripheral equipment and software	5184	1,835	1,852	2,533	2,559	24.82	23.14	45.22	43.59
4652	Wholesale of electronic and telecommunications equipment and parts	5186	449	379	1,035	973	4.43	3.83	14.87	14.30
582, 61, 62, 631, 951	**ICT services industries**	**642, 72**	44,266	44,530	48,507	48,828	524.84	530.24	498.27	503.60
582	Software publishing	7221	545	563	169	182	8.37	10.13	2.59	4.34
61	Telecommunications	642	21,395	21,127	25,298	25,083	97.64	94.74	105.38	102.50
62	Computer programming, consultancy and related activities	721, 7222, 726	15,565	16,857	15,603	16,895	259.17	271.44	221.13	233.31
631	Data processing, hosting and related activities; web portals	723, 724	6,127	5,377	6,222	5,473	142.60	137.41	149.40	144.24
951	Repair of computers and communication equipment	725	633	605	1,215	1,195	17.07	16.52	19.76	19.22

Source: Own elaboration.

The vast majority of European countries do not have the necessary disaggregated NACE Rev. 1.1 information for the period 2006-2008 to estimate all the ICT sub-sectors for each variable. There are several problematic sectors, such as *Manufacture of magnetic and optical media*, 268 NACE Rev. 2., since the equivalent in NACE rev. 1.1, 2465, is a four-digit code which is unavailable or confidential in almost all cases. *ICT trade* is also another four-digit sector, 4651 to 4652 in NACE Rev. 2 codes and 5184 and 5186 in NACE Rev. 1.1. This information is not available for the following variables: BERD, personnel and researchers. Finally, with the exception of Italy and Ireland for GVA, employment and turnover, ICT services industries are only available for two sub-sectors: *telecommunications*, 61 NACE Rev. 2 code, and the sector denominated *computer and related activities* (72 NACE Rev. 1.1 code), which consists of the rest of the ICT services sub-sectors: *software publishing computer programming, consultancy and related activities* (62 NACE Rev. 2), *data processing, hosting and related activities; web portals* (631 NACE Rev. 2) and *repair of computers and communication equipment* (951 NACE Rev. 2).

4. TOWARDS A FEASIBLE COMMON ICT SECTOR DEFINITION

Table 6 takes into account the aforementioned restrictions offering a feasible common ICT sector disaggregation for all the European countries and variables in the reference period (2006-2009) that is presented in the database. This definition takes into account the standard distinction between manufacturing and services. It also includes ICT trade industries as required by the 2007 OECD ICT definition. However, trade information is only available for EU countries.[7] For this reason, the database allows a more precise analysis for EU-27 (including trade) than for the vast majority of non EU countries (which exclude it).

Table 6: Feasible ICT sector disaggregation. 2006-2009

NACE Rev. 2	ISIC Rev. 4	Description	APPROXIMATE CORRESPONDENCE	
			NACE Rev. 1.1	ISIC Rev. 3.1
Feasible ICT sectors disaggregation:				
261-264	**261-264**	**ICT manufacturing industries**[1]	**30, 32**	**30, 32**
261	261	Manufacture of electronic components and boards	321	321
262	262	Manufacture of computers and peripheral equipment	30	30
263	263	Manufacture of communication equipment	322	322
264	264	Manufacture of consumer electronics	323	323
582, 61, 62, 631, 951	**582, 61, 62, 631, 951**	**ICT services industries**	**642, 72**	**642, 72**
61	61	Telecommunications	642	642
582; 62; 631; 951	582; 62; 631; 951	Computer and related activities	72	72
Additional data:				
465	**465**	**ICT trade industries**[2]	**5184, 5186**	**5151, 5152**
4651	4651	Wholesale of computers, computer peripheral equipment and software	5184	5151
4652	4652	Wholesale of electronic and telecommunications equipment and parts	5186	5152

[1] 268 sector not included, except for Australia.
[2] Available only for GVA, employment and Turnover in European countries and for BERD in European countries (only 2008-2009) and Australia.
Source: Eurostat (1996, 2008), MOSPI (2010), OECD (2011), UNSD (2002, 2008) and own elaboration.

Table 7 shows GVA and employment data for two selected European countries, Italy and Germany, following the feasible ICT sector definition of Table 6. This table shows the relative importance of the ICT trade sector, which represented, in 2008, 6% of total GVA ICT sector in Italy and 10% in Germany in 2008. The ICT employment trade share was higher in Italy, over 9%, but similar to GVA shares in Germany, 10%.

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[7]   The only exception is Australia. This country has BERD data for ICT trade industries.

Table 7: Feasible ICT sector disaggregation. GVA and employment. 2007–2008, Italy and Germany

a) Italy

NACE Rev. 2	ISIC Rev. 4	Description	APPROXIMATE CORRESPONDENCE		GVA (millions EUR)		Employment (1000 persons)	
			NACE Rev. 1.1	ISIC Rev. 3.1	Linked 2007	2008	Linked 2007	2008
		ICT TOTAL[1]			57,919	57,765	667.71	664.81
Definitive ICT sectors disaggregation:								
261-264	**261-264**	**ICT manufacturing industries[1]**	**30, 32**	**30, 32**	5,844	5,405	109.35	103.33
261	261	Manufacture of electronic components and boards	321	321	2,584	2,695	52.33	51.37
262	262	Manufacture of computers and peripheral equipment	30	30	583	513	10.86	10.34
263	263	Manufacture of communication equipment	322	322	2,466	2,032	41.09	37.06
264	264	Manufacture of consumer electronics	323	323	211	165	5.07	4.56
582, 61, 62, 631, 951	**582, 61, 62, 631, 951**	**ICT services industries**	**642, 72**	**642, 72**	48,507	48,828	498.27	503.60
61	61	Telecommunications	642	642	25,298	25,083	105.38	102.50
582; 62; 631; 951	582; 62; 631; 951	Computer and related activities	72	72	23,209	23,745	392.89	401.10
Additional data:								
465	**465**	**ICT trade industries**	**5184, 5186**	**5151, 5152**	3,568	3,532	60.09	57.89
4651	4651	Wholesale of computers, computer peripheral equipment and software	5184	5151	2,533	2,559	45.22	43.59
4652	4652	Wholesale of electronic and telecommunications equipment and parts	5186	5152	1,035	973	14.87	14.30

b) Germany

NACE Rev. 2	ISIC Rev. 4	Description	APPROXIMATE CORRESPONDENCE		GVA (millions EUR)		Employment (1000 persons)	
			NACE Rev. 1.1	ISIC Rev. 3.1	Linked 2007	2008	Linked 2007	2008
		ICT TOTAL[1]			79,081	79,720	1,081.11	1,139.93
Definitive ICT sectors disaggregation:								
261-264	**261-264**	**ICT manufacturing industries[1]**	**30, 32**	**30, 32**	18,107	14,400	210.52	223.67
261	261	Manufacture of electronic components and boards	321	321	7,372	6,129	86.98	100.49
262	262	Manufacture of computers and peripheral equipment	30	30	3,455	2,858	41.47	39.44
263	263	Manufacture of communication equipment	322	322	5,989	4,430	64.77	65.78
264	264	Manufacture of consumer electronics	323	323	1,291	982	17.29	17.96
582, 61, 62, 631, 951	**582, 61, 62, 631, 951**	**ICT services industries**	**642, 72**	**642, 72**	53,383	56,697	764.60	797.71
61	61	Telecommunications	642	642	26,312	26,750	183.11	190.00
582; 62; 631; 951	582; 62; 631; 951	Computer and related activities	72	72	27,071	29,947	581.49	607.71
Additional data:								
465	**465**	**ICT trade industries**	**5184, 5186**	**5151, 5152**	7,591	8,623	105.98	118.55
4651	4651	Wholesale of computers, computer peripheral equipment and software	5184	5151	4,070	4,263	66.31	69.65
4652	4652	Wholesale of electronic and telecommunications equipment and parts	5186	5152	3,521	4,360	39.67	48.90

[1] 268 sector not included.

Source: Eurostat (1996, 2008), MOSPI (2010), OECD (2011), UNSD (2002, 2008) and own elaboration.

5. IMPLICATIONS

The implications of the two changes recently introduced —both in the NACE classifications and in the definition of the ICT sector— for the different variables considered by the PREDICT project still have to be checked. We will take 2008 again as the reference year. Figure 1 provides a first overview which illustrates the share of the ICT sector over total sectors in terms of the three main variables: GVA (panel *a*); Employment (panel *b*) and BERD (panel *c*). For the three of them, the new classification and new OECD definition provides, for the EU-27 aggregate, a smaller share of the ICT sector in total than the previous NACE Rev. 1.1 plus the 2002 OECD definition.

According to the new framework, the ICT sector represented 4.06% of total GVA; 2.74% of total employment; and 17.94% of total BERD. These figures have to be compared with the previous higher shares: 4.59%; 3.66%; and 23.67% respectively. However, this result cannot be generalized to all European countries since in a few of them the opposite happens. This is the case for Estonia, Greece, Latvia, Netherlands, Romania, Slovakia, and United Kingdom in terms of GVA; Estonia, Latvia, and Luxembourg in terms of BERD, while for all countries, without exception, the share of ICT employment is lower when using the new classification and new ICT definition.

The opposite result applies to labour productivity (Figure 2). Now, for the vast majority of countries labour productivity is higher when using the new framework. Only in Germany and Portugal is this variable lower when the new NACE Rev. 2 and 2007 OECD definition are used.
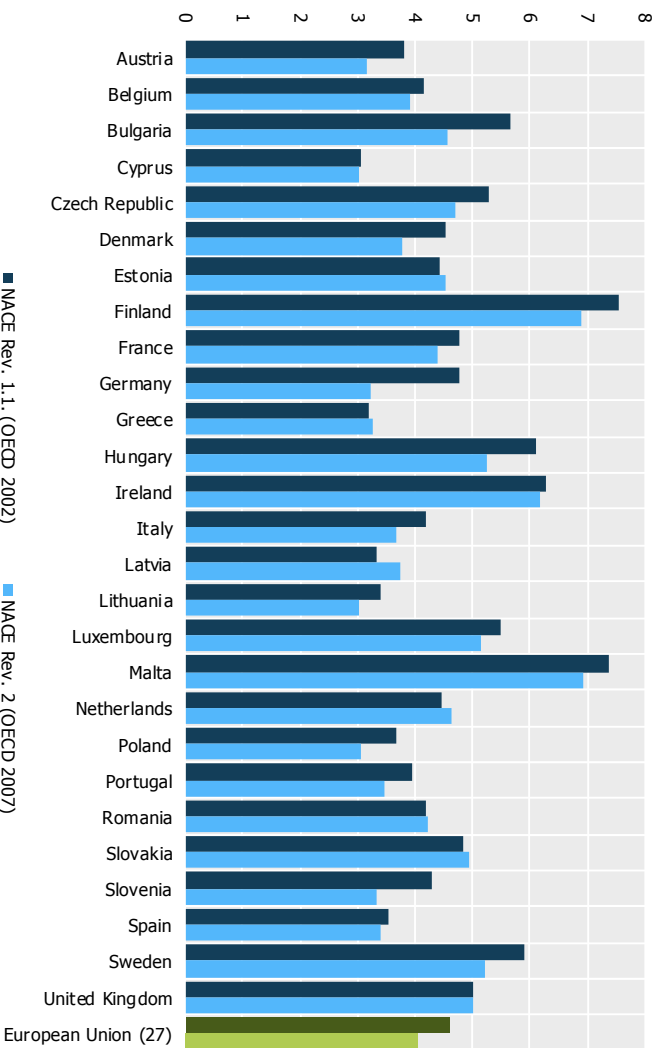
The results presented in Figure 3 indicate that in the EU-27 aggregate ICT BERD intensity is lower in the new framework: 5.38 —when the new classification and new ICT sector definition are applied— versus 6.26 according to the previous methodology. As for the remaining variables, this result applies to almost all European countries. The exceptions are now Austria, Bulgaria, Estonia, Finland, Luxembourg, Malta, Portugal and Spain. However, in all of them the differences can be considered very minor. The most noticeable gap affects the Netherlands, where ICT BERD intensity amounted to 2.33 according to the new framework as compared with 6.32 with the previous one.

Figure 4 expands the results provided by Figure 1 including the non EU-27 countries for which the database offers information. In order to make this comparison, we have to exclude the trade sector[8] from the EU-27 aggregate, since this information is not available for the other countries.
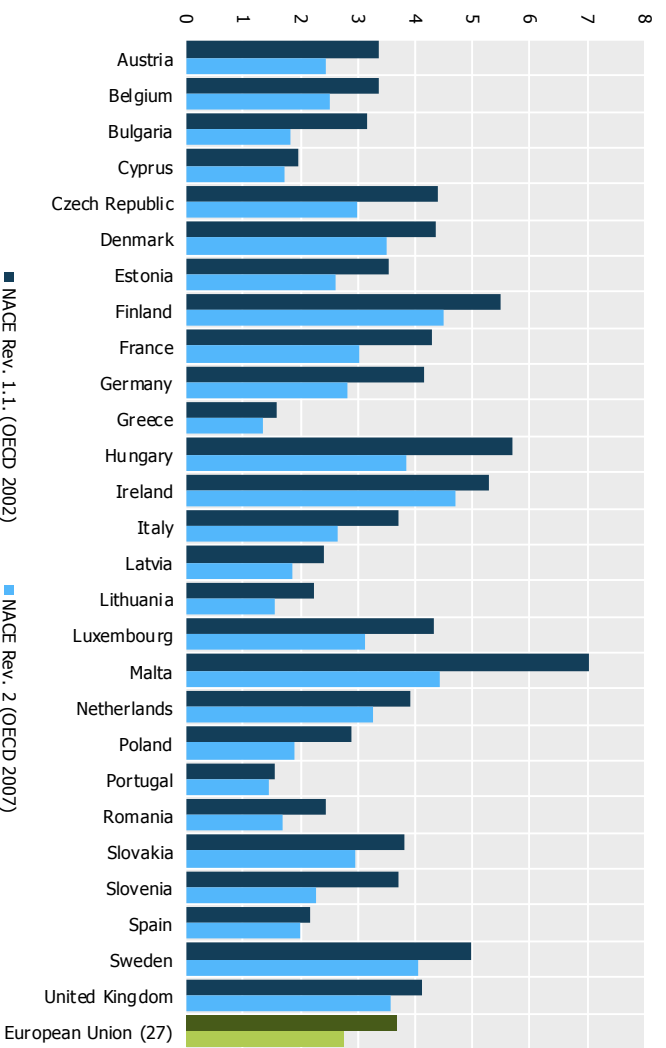
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[8] The ICT sector NACE Rev.2 268 (manufacture of magnetic and optical media) is also excluded.

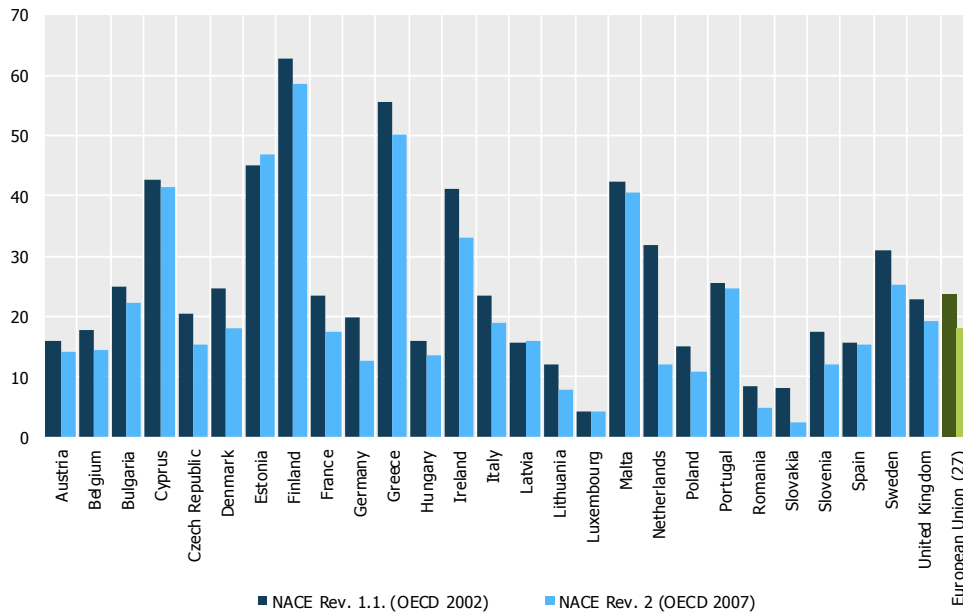**Figure 1: Share of ICT sector. European Union 27. 2008 (percentages)**

a) In total GDP

■ NACE Rev. 1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007)

b) In total employment

■ NACE Rev. 1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007)

18

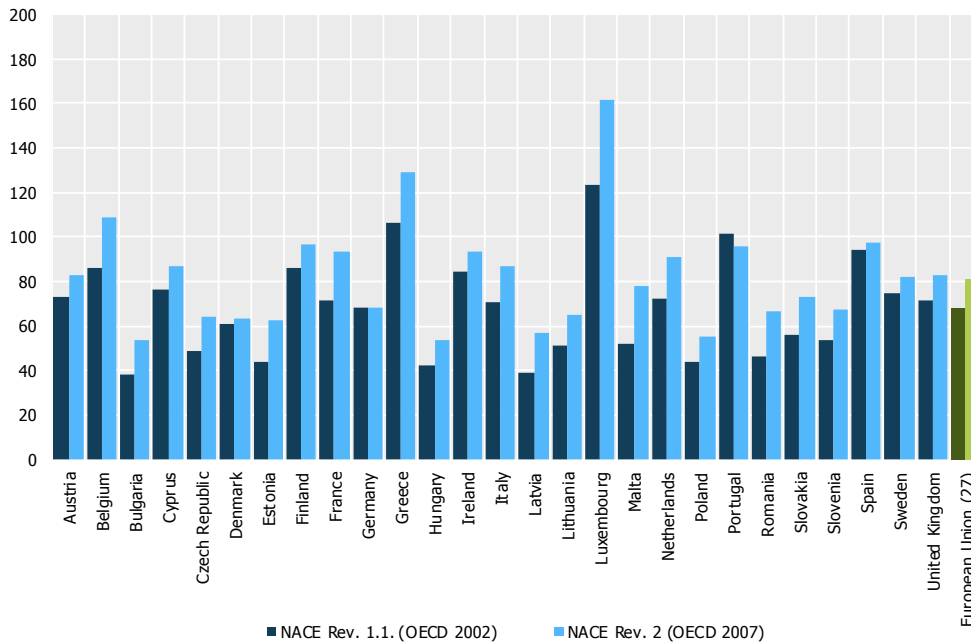**Figure 1 (cont.): Share of ICT sector. European Union 27. 2008 (percentages)**

c) In total BERD

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72 (NACE Rev.1.1. 64 includes only 642 for BERD). 2007 ICT sectors: NACE Rev. 2 261-264, 268, 4651-4652, 582, 61, 62 , 631, 951.
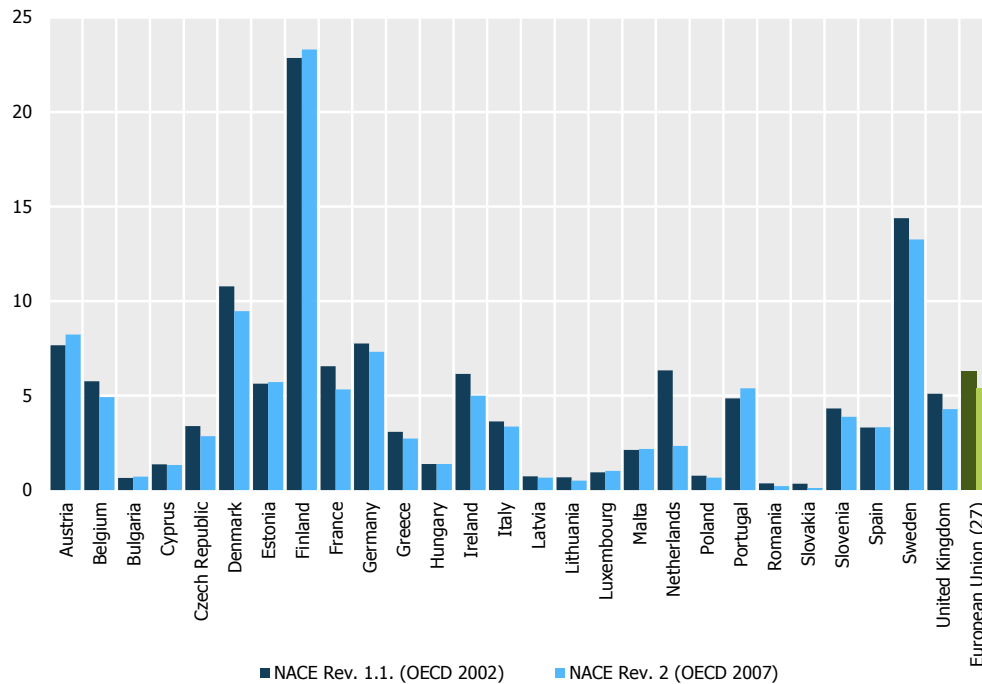*Source:* Eurostat, elaborated by Ivie.

Figure 2: ICT sector labour productivity. European Union 27. 2008, (thousand euros PPS per person)

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72. 2007 ICT sectors: NACE Rev. 2 261-264, 268, 4651-4652, 582, 61, 62 , 631, 951.
Source: Eurostat, elaborated by Ivie.

Figure 3: ICT BERD intensity. European Union 27. 2008, (percentage)

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72 (NACE Rev1.1. 64 includes only 642 for BERD). 2007 ICT sectors: NACE Rev. 2 261-264, 268, 4651-4652, 582, 61, 62 , 631, 951
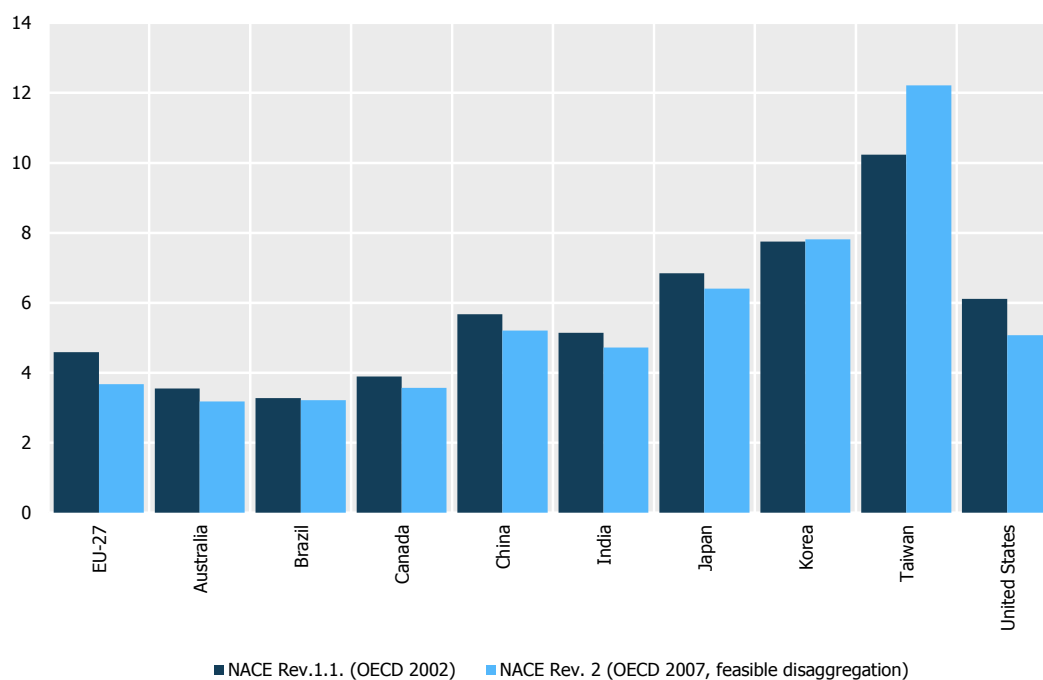*Source:* Eurostat, elaborated by Ivie.

For all countries but Taiwan, the share of the ICT sector in terms of GVA is lower according to the new framework, while the shares in Brazil and Korea are practically unaffected. However it is interesting to note that the ranking of the countries is not affected: Taiwan is the country with the highest share and Brazil and Australia with the lowest.

Panel b of Figure 4 offers the same information but in terms of employment. In all countries considered, the ICT sector has a lower share of total employment according to the new framework than it did in the previous one. A similar result is obtained in terms of BERD since all countries, with the (slight) exception of Canada, show the same profile as the EU-27: a lower share of the ICT sector with to the new framework than with the previous one.
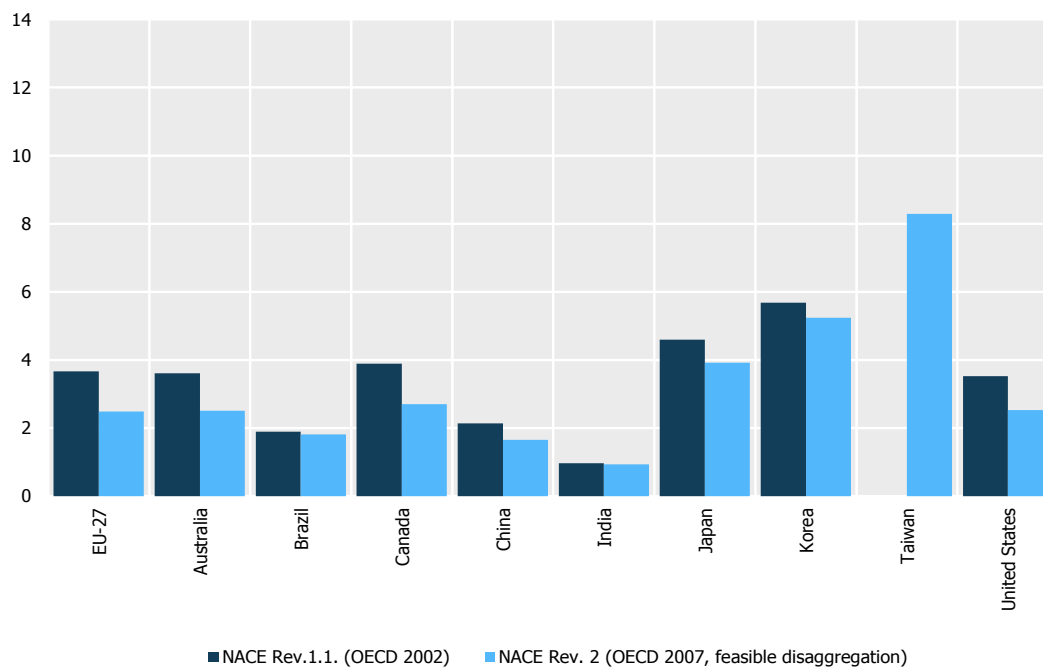
As we have seen in Figure 2, the NACE Rev. 2 classification, together with the 2007 OECD ICT sector definition, provides a higher labour productivity in the ICT sector than the previous NACE Rev. 1.1 and 2002 definition. This result continues to hold for the EU-27 even when we exclude trade and it is also quite general for all countries —and specially marked for the US— with the single (slight) exception of India.

Figure 4: Share of ICT sector. 2008 (percentages)

a) In total GDP

■ NACE Rev.1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007, feasible disaggregation)

b) In total employment

■ NACE Rev.1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007, feasible disaggregation)

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72 (NACE Rev. 1.1. 64 includes only 642 for BERD except for Canada). 2007 definitive ICT sectors disaggregation: NACE Rev. 2 261-264, 582, 61, 62, 631, 951 (Australia includes 268; 951 is not included in Brazil, Canada, China, Japan, Taiwan and US for GVA and employment; 951 is not included in Australia, Brazil, Canada, China, India, Japan and US for BERD; 61 includes Post and courier activities in Korea for GVA and BERD and in Korea and India for employment). *Source:* Eurostat, elaborated by Ivie.

Figure 4 (cont.): Share of ICT sector. 2008 (percentages)
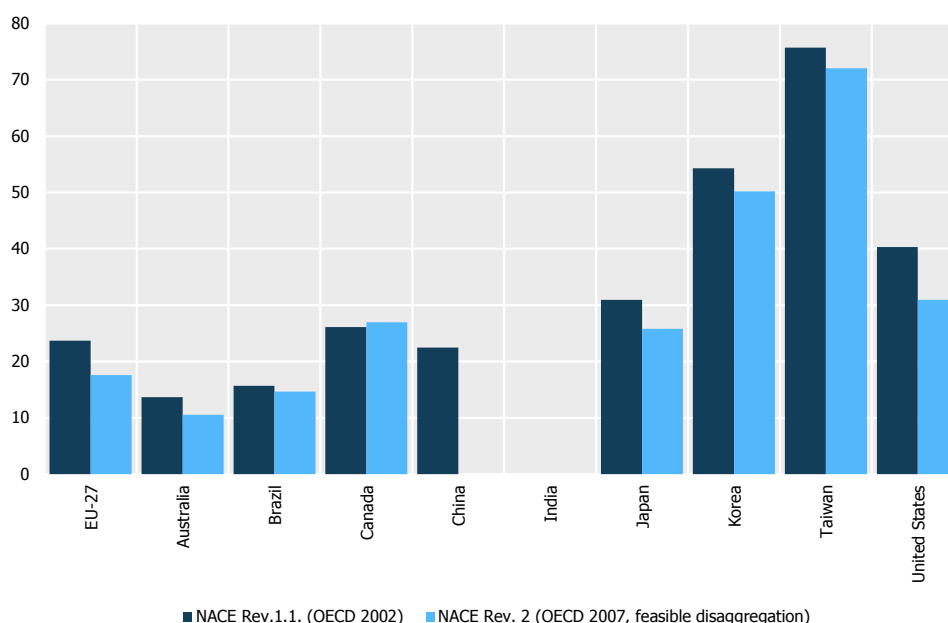
c) In total BERD

■ NACE Rev.1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007, feasible disaggregation)

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72 (NACE Rev. 1.1. 64 includes only 642 for BERD except for Canada). 2007 definitive ICT sectors disaggregation: NACE Rev. 2 261-264, 582, 61, 62 , 631, 951 (Australia includes 268; 951 is not included in Brazil, Canada, China, Japan, Taiwan and US for GVA and employment; 951 is not included in Australia, Brazil, Canada, China, India, Japan and US for BERD; 61 includes Post and courier activities in Korea for GVA and BERD and in Korea and India for employment).
*Source:* Eurostat, elaborated by Ivie.

The differences between the new and old framework for the ICT BERD intensity variable are less noticeable —not only for the majority of the EU-27 countries (figure 3) but also for the rest of countries for which we have been able to gather information— as illustrated by Figure 6. As before, Korea, Japan and the United States stand out for their high ICT BERD intensity and India for its very low ratio.

Figures 7 and 8 look into the implications of the two methodological changes under scrutiny for the sectoral composition of ICT GVA. Figure 7 provides information for the European Union. The most general result, applying to the EU-27 average —and to the great majority of countries— is that the new framework gives more weight to ICT services sectors than the previous one did.[9] For the EU-27 average, NACE 2 plus the 2007 OECD definition shows ICT services sectors as contributing a share of 89.27% to be compared with the previous 80.48%. Bulgaria, Poland and Portugal are the only exceptions to this general result. It is interesting to note the different patterns of country specialization. Finland, Ireland, Hungary and Malta stand out as ICT manufacturing-oriented, specially the first of these countries. On the other hand, the UK, Spain, Luxembourg, Bulgaria, Greece and Latvia are basically ICT service-oriented.

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[9] The reason for this is that in the new definition both manufacturing and services experience a reduction but this reduction is higher in manufacturing.

Figure 5: ICT sector labour productivity. 2008. (thousand euros PPS per person)
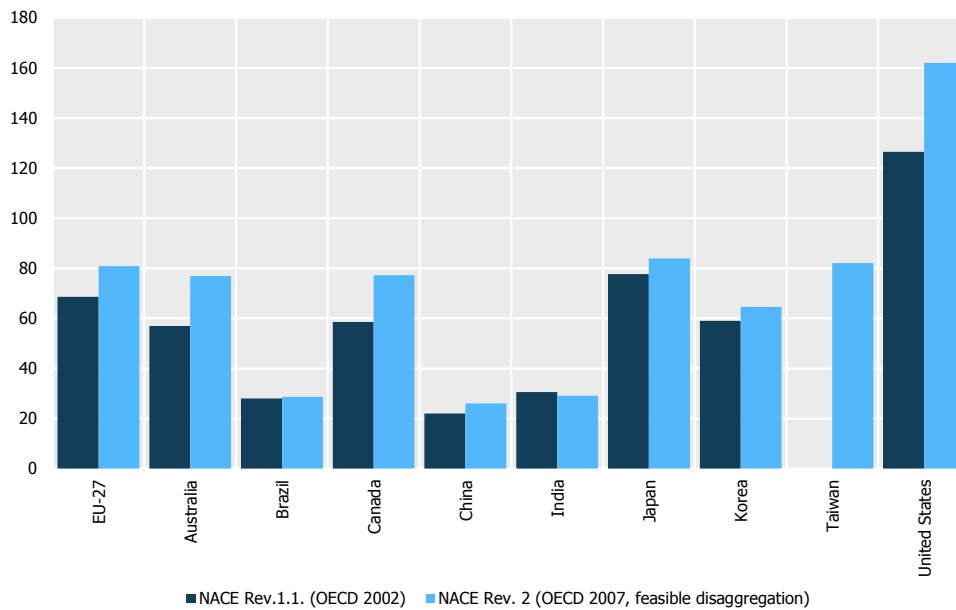
■ NACE Rev.1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007, feasible disaggregation)

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72. 2007 definitive ICT sectors disaggregation: NACE Rev. 2 261-264, 582, 61, 62 , 631, 951 (Australia includes 268; 951 not included in Brazil, Canada, China, Japan, Taiwan and United States; 61 includes Post and courier activities in Korea for GVA and in Korea and India for employment). *Source:* Eurostat, elaborated by Ivie.
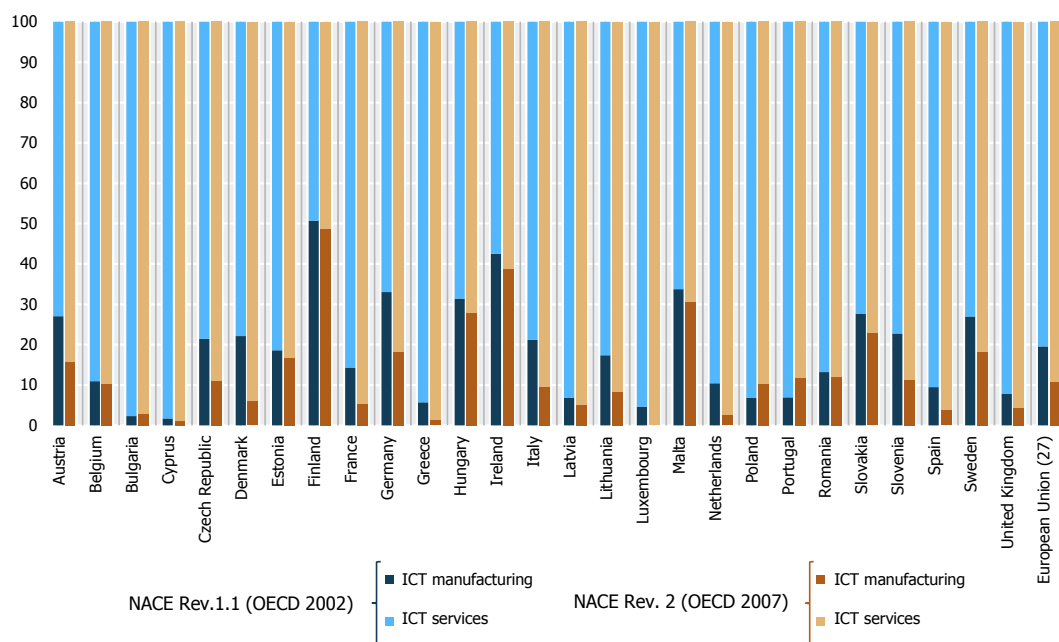
Figure 6: ICT BERD intensity. 2008.* (percentages)

■ NACE Rev.1.1. (OECD 2002)   ■ NACE Rev. 2 (OECD 2007, feasible disaggregation)
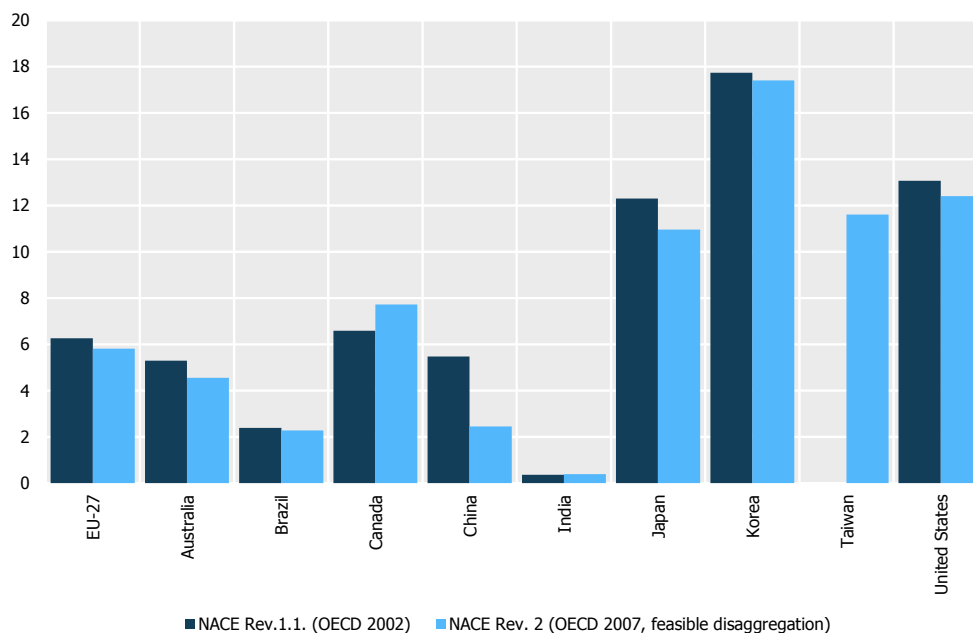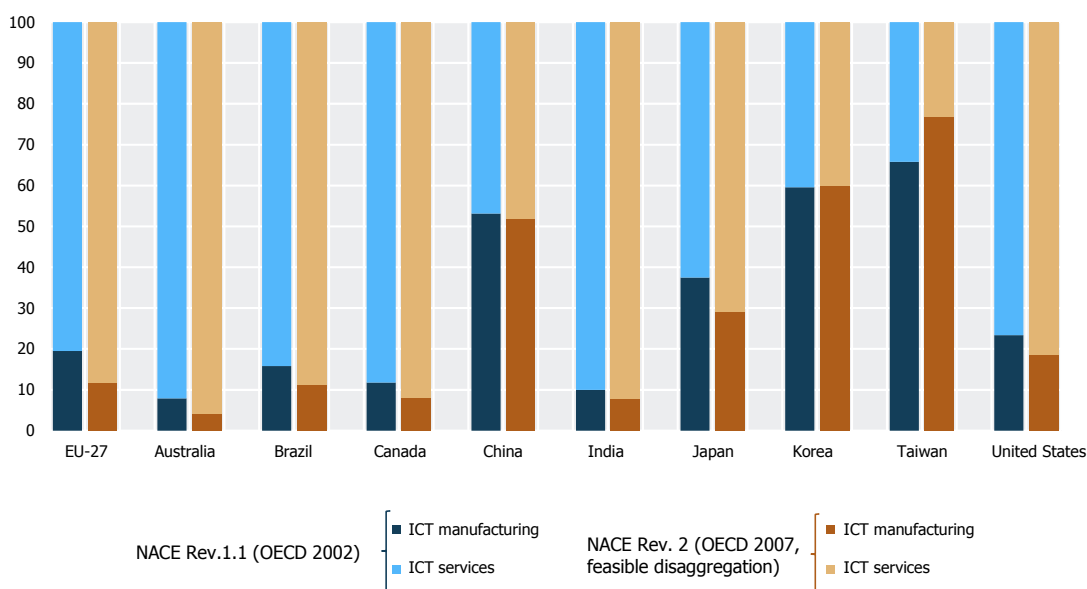
* 2007 for India.

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72 (NACE Rev. 1.1. 64 includes only 642 for BERD except for Canada). 2007 definitive ICT sectors disaggregation: NACE Rev. 2 261-264, 582, 61, 62 , 631, 951 (Australia includes 268; 951 is not included in Brazil, Canada, China, Japan, Taiwan and US for GVA ; 951 is not included in Australia, Brazil, Canada, China, India, Japan and US for BERD; 61 includes Post and courier activities in Korea). *Source:* Eurostat, elaborated by Ivie.

Figure 7: Sectoral composition of ICT GVA. 2008 (percentages)

NACE Rev.1.1 (OECD 2002)
- ICT manufacturing
- ICT services

NACE Rev. 2 (OECD 2007)
- ICT manufacturing
- ICT services

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72. 2007 ICT sectors: NACE Rev. 2 261-264, 268, 4651-4652, 582, 61, 62 , 631, 951.
Source: Eurostat, elaborated by Ivie.

Figure 8: Sectoral composition of ICT GVA. 2008, (percentages)

NACE Rev.1.1 (OECD 2002)
- ICT manufacturing
- ICT services

NACE Rev. 2 (OECD 2007, feasible disaggregation)
- ICT manufacturing
- ICT services

Notes: 2002 ICT sectors: NACE Rev. 1.1. 30, 32, 33, 64, 72. 2007 definitive ICT sectors disaggregation: NACE Rev. 2 261-264, 582, 61, 62 , 631, 951 (Australia includes 2068; 951 not included in Brazil, Canada, China, Japan, Taiwan and United States; ICT services includes Post and courier activities in Korea).
Source: Eurostat, elaborated by Ivie.

Finally, Figure 8 provides the same comparison but refers to the rest of the countries being analyzed. As can be seen, the exclusion of the trade sector due to the absence of statistical information does not modify the result for the EU-27 aggregate since the new framework also provides a higher share of the ICT service sector on total ICT GVA. This result also applies to Australia, Brazil, Canada, China, India, Japan and the United States. In all of them the share of ICT services on total ICT GVA is higher in the new framework. Taiwan and Korea are the only countries for which this rule does not apply, especially in the first one.

6. CONCLUDING REMARKS

This report provides a framework for obtaining a homogenous database on the ICT sector for period 2006-2009 after two important modifications: the movement from NACE Rev. 1.1 classification to NACE Rev. 2; and the change from the OECD 2002 definition of the ICT sector to the new OECD 2007 definition. These changes made it necessary to adjust the data used in the PREDICT reports published previously in order to obtain a set of data comparable across time and across countries.

We have proposed correspondences between NACE Rev. 2 and NACE Rev. 1.1, as well as a feasible common ICT sector disaggregation, based on the 2007 OECD ICT definition. There were two possible methodologies for the transition between the two NACE classifications, additive and proportional, and we finally opted for the first one. This method has been applied to EU-27 countries. The report ends by offering –for some key variables– a comparison between the results obtained under the former OECD (2002) ICT sector definition plus the NACE Rev. 1.1 classification, and those obtained under the new OECD (2007) definition plus the NACE Rev. 2 classification.

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Abstract
This report provides a framework for obtaining a homogenous database on the ICT sector for period 2006-2009 after two important modifications: the movement from NACE Rev. 1.1 classification to NACE Rev. 2; and the change from the OECD 2002 definition of the ICT sector to the new OECD 2007 definition. These changes made it necessary to adjust the data used in the PREDICT reports published previously in order to obtain a set of data comparable across time and across countries.

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