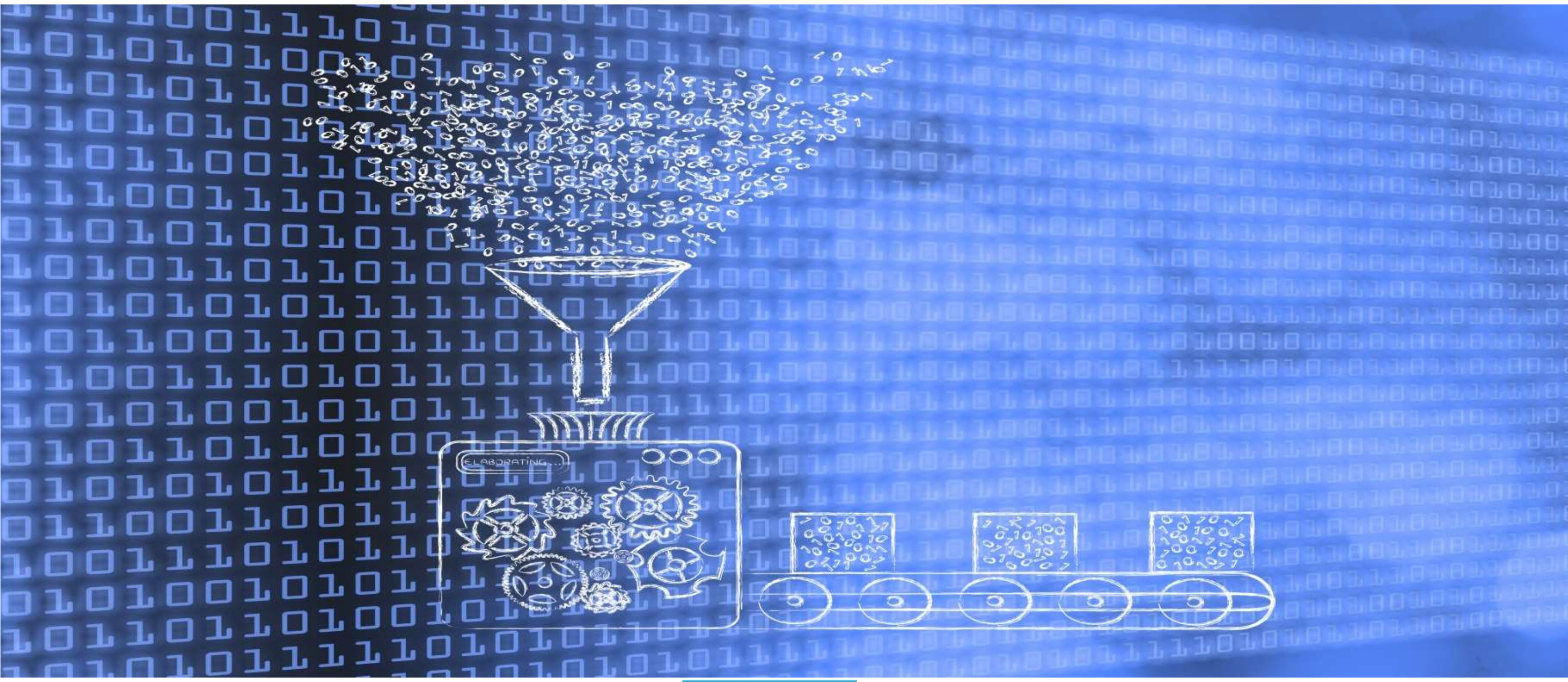
European Commission

JRC TECHNICAL REPORTS

The PREDICT Dataset Methodology

Authors: Benages E., Mínguez C., Pascual F., Robledo J.C., Salamanca J., Papazoglou M., Righi R., Torrecillas J., Vazquez-Prada Baillet M.

Editors: De Prato G., Cardona M., López-Cobo M, Mas M., Fernández de Guevara J.



Joint Research Centre

EUR 31174 EN

Contact information:
Address: Edificio Expo, C/ Inca Garcilaso 3, Sevilla 41092, Spain
Email: JRC-LIST-B6-SECRETARIAT@ec.europa.eu

JRC Science Hub
https://ec.europa.eu/jrc

JRC130001

EUR 31174 EN

PDF ISBN 978-92-76-55603-9 ISSN 1831-9424 doi:10.2760/33739

Luxembourg: Publications Office of the European Union, 2022

How to cite this report: Benages E., Mínguez C., Pascual F.., Robledo J.C., , Salamanca J., Papazoglou M., Righi R., Torrecillas J., Vazquez-Prada Baillet M., The PREDICT Dataset Methodology, De Prato, G., Cardona M., López Cobo, M., Mas M., Fernández de Guevara J. editor(s), EUR 31174 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-55603-9, doi:10.2760/33739, JRC130001.

Contents

Foreword

PREDICT: Prospective Insights on R&D in ICT

PREDICT produces statistics and analyses on ICT industries and their R&D in Europe since 2006. The project covers major competitors worldwide, including 40 advanced and emerging countries – the European Union plus United Kingdom, 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. The ICT sector alone originates almost one fourth of total Business Expenditure in R&D (BERD) for the aggregate of the 40 economies under scrutiny in this project. Besides the impact that ICT uptake has on the organisation of businesses, ICTs also play an important enabling role for innovation in other technological domains. This is reflected at the EU policy level, where "A Europe fit for the digital age" was identified as one of the six European Commission priorities for the years 2019-2024 and digitalisation made a core part of the post-COVID-19 European recovery plan.

Statistics and indicators

PREDICT provides indicators in a wide variety of topics, including value added, employment, labour productivity and Business R&D Expenditure. It distinguishes fine grain economic activities in the ICT and media and content industries (up to 22 individual activities, 14 of which 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. Nowcasting of more relevant data in these domains is also performed, and time series go back to 1995.

Team

PREDICT is a collaboration between the JRC, Directorate B, and the Directorate General for Communications Networks, Content and Technology (CNECT) of the European Commission.

Since 2013, the JRC and the Valencian Institute of Economic Research (Instituto Valenciano de Investigaciones Económicas - Ivie) carry out the data collection and analysis jointly.

Abstract

This methodological report details the work done in the *Prospective Insights on R&D in ICT* (PREDICT) project to produce the PREDICT Dataset. PREDICT provides updated indicators for the Information and Communication Technologies (ICT) sector and for its Research and Development (R&D) in the European Union and in the major ICT leaders worldwide. The Joint Research Centre, Directorate B and the Directorate General for Communications Networks, Content and Technology (DG CNECT) of the European Commission carry out this project jointly. The data and methodologies have been developed in collaboration with the Valencian Institute of Economic Research (Ivie).

The PREDICT Dataset has been deepened and expanded along the years in order to include complementary dimensions, such as the Media and Content sector. Furthermore, for the most important indicators, PREDICT time series have been reconstructed back to 1995, while the main indicators are nowcasted for two additional most current years, thus providing comparable time series for more than 25 years. An additional section addresses the methodological issues arising with nowcasting in times of the COVID crisis.

Keywords

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

Executive summary

The project Prospective Insights on R&D in ICT (PREDICT) provides statistics and analyses on information and communication technologies (ICT) industries and their R&D in Europe since 2006. The project covers major competitors worldwide, including the EU and its Member States, plus 13 advanced and emerging countries — the United Kingdom, 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.

PREDICT provides indicators on a wide variety of topics, including value added, employment, labour productivity and business expenditure on R&D (BERD). It distinguishes fine grain economic activities in the ICT and Media and Content industries (up to 22 individual activities, 14 of which at the class level, i.e. at 4 digits in the ISIC classification) and at a higher level of aggregation for the remaining industries in the economy. For the most important indicators, PREDICT time series have been reconstructed back to 1995, while the main indicators are nowcasted for the last two full calendar years, thus providing comparable time series for more than 25 years. The Joint Research Centre and the Directorate General for Communications Networks, Content and Technology (DG CNECT) of the European Commission are carrying out this project jointly. The data and methodologies have been developed in collaboration with the Valencian Institute of Economic Research (Ivie).

The present report describes in detail the statistical approach and methods that have been used to produce data and analyses. Two definitions of the ICT sector emerge as some of the most important elements of this work. These are: a comprehensive definition of the ICT sector, which is in line with the 2007 OECD's definition, and an operational definition of the ICT sector. The latter is of specific interest, as it makes it possible to maintain comparability with non-EU countries over longer periods in cases where sufficient information is not available to estimate the ICT subsectors of the comprehensive definition.

It is also of major importance that the Media and Content sector is defined in detail, as this allows the monitoring of industries that are engaged in the production, publication and/or electronic distribution of content products. This sector is relevant for the scope of the PREDICT project as it is becoming increasingly intertwined with the ICT sector, which provides most of the means for disseminating Media and Content products.

Another contribution of the present work is that a two-step strategy is designed to estimate the lower levels of the ICT sector definition. This is necessary since the ICT sector is defined at a very fine level of granularity (up to 4-digits of the industrial classification) and data at this level of disaggregation are generally hard to find. For this purpose, PREDICT combines statistics from Eurostat National Accounts, Structural Business Statistics, EU KLEMS, and similar sources for non-EU countries (e.g., OECD, National Statistical Offices, EU KLEMS).

In addition, the timing of release of official statistics at this level of detail, imply a 3-year lag between data publication date and reference date of the PREDICT dataset. Therefore, PREDICT provides forecasts of the results for the two calendar years prior to the release of the dataset. The nowcasting exercise covers the main PREDICT variables: value added, employment, hours worked, labour productivity, BERD and R&D personnel and researchers. The geographical coverage of the nowcasting exercise includes the European Union and its Member States, United Kingdom, Australia, Canada, Japan, Korea, Taiwan and the US.

Finally, it should be noted that because of the Covid-19 pandemic methodological issues have been faced for the nowcasting exercise. In particular, the analysis of production and employment leads to forecasts with lower estimation accuracy.

1 Introduction and definitions

This methodological report details the work done in the *Prospective Insights on R&D in ICT* (PREDICT) project. PREDICT provides updated indicators for the Information and Communication Technologies (ICT) sector and for its Research and Development (R&D) in the European Union and in 12 of among the major ICT leaders worldwide. The Joint Research Centre, Directorate B, carries out this project jointly with the Directorate General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission. The data and methodologies have been developed in collaboration with the Valencian Institute of Economic Research (Ivie).

Digital technologies are crucial to most capital goods, industrial products, and everyday life. The ICT industries are key enablers of both production and the knowledge systems. EU policies have therefore attributed a strategic role to digital technologies in the promotion of growth, innovation and competitiveness. Achieving the Digital Single Market has been identified as one of the top three priorities for the current Commission in the Digital Agenda for Europe. A competitive ICT industry in Europe, able to attract investments and produce innovation, is therefore of pivotal importance especially in a moment in which the digital transformation is affecting every aspect of economy and society.

PREDICT responds directly to the need for statistical information in order to design and monitor related policies effectively. The PREDICT core dataset has been deepened and expanded in order to include complementary dimensions and to allow for longer comparable time series. Since the 2017 release the PREDICT dataset also covers the Media and Content sector. Furthermore, for the most important indicators, time series has been reconstructed backwards up to 1995, while figures are nowcasted for the last two full years. Therefore, time series comparable across countries are covering the main indicators for more than 25 years.

In the following sections, a description of the main characteristics and features of the core dataset and of the complementary sector is provided (section 2), together with an overview of the backward reconstruction of the time series (section 3). Then, the methodological aspects and econometric models of the nowcasting process are presented (section 4), which includes a subsection addressing the issues faced by the nowcasting in the year 2021, when economies were hit by the COVID-19 crisis. Finally, the Annexes collect all the relevant methodological notes concerning the process followed to build each indicator for each country in the dataset.

2 The Core PREDICT Dataset

The PREDICT dataset complies with the statistical definitions, classifications and methods to measure and compare the information society across countries established by the *Guide to measuring the Information Society* (Organisation for Economic Co-operation and Development, OECD 2011).

In order to reconstruct the data back to 1995 and include the Media and Content (MC) sector, it was necessary to fill in missing information. Additional technical information about this reconstruction is provided in the next section.

With respect to the geographical coverage, data is produced for the European Union aggregates[1], the European Member States (MSs), and the major worldwide ICT players: Switzerland, Norway, United Kingdom, Australia, Brazil, Canada, China, India, Japan, South Korea, Russia, Taiwan and United States. The PREDICT dataset ensures comparability with the industrial classification NACE Rev.2[2] from 1995 onwards. It provides detailed information about: the ICT sector and sub-sectors[3]; he Media and content sector (MC); the Retail sale via mail order houses or via Internet sector (RS); and additional economic sectors which allow relevant comparisons.

The economic variables in the PREDICT core dataset are:

1. Business R&D Expenditure (BERD)
2. Gross R&D Expenditure (GERD)
3. R&D personnel (PERD)
4. R&D researchers (RERD)
5. Gross Value Added (GVA)
6. Gross Output (GO)
7. Employment (EMP)
8. Hours worked (HEMP)
9. Labour productivity per employed person (PRODEMP) and per hour worked (PRODHEMP)

The data for all the variables in the core dataset are organised in four blocks, according to economic activity: ICT sector (for both comprehensive and operational definitions), MC sector, RS sector and additional economic sectors of the economy. The ICT sector is provided with different granularity and coverage, depending on the use of the comprehensive definition or the operational definition:

1a. The **comprehensive definition of the ICT sector** (Table 1) is in line with the OECD's definition (2007) and encompasses the following industries of the NACE Rev.2 classification:

- five ICT manufacturing sectors: 261 (i.e. 2611 and 2612), 262, 263, 264 and 268;
- two ICT trade sectors: 4651 and 4652
- five ICT services sectors: 582 (i.e. 5821, 5822, 5823, 5824, 5825, 5826, 5827, 5828, and 5829), 61 (i.e. 611, 612, 613, and 619), 62 (i.e. 6201, 6202, 6203, and 6209), 631 (i.e. 6311 and 6312) and 951 (i.e. 9511 and 9512).

1b. The **operational definition of the ICT sector** (Table 2) provides information to maintain the comparability of countries over longer periods in cases where insufficient information is available to estimate the ICT subsectors of the comprehensive definition. This definition distinguishes between:

- ICT manufacturing, without Manufacture of magnetic and optical media (268);
- ICT services without Trade services (465), encompassing two sub-sectors only: Telecommunication (61), and the aggregate for Computer and related activities (5820, 62, 631, 951).

[1] The data for the EU aggregates refers for the whole period under study to the composition of EU between 2013 and 2020 (EU28) and the aggregate of the 27 countries of the EU without United Kingdom since 2020 (EU27_2020).

[2] Available at: http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

[3] According to latest OECD definition (2007): http://www.oecd.org/science/scienceandtechnologypolicy/38217340.pdf

2. The Media and content sector (Table 3) is defined according to the OECD's definition (2007).

3. The third block encompasses the Retail sale via mail order houses or via Internet sector (4791).

4. The fourth block includes data for selected industries (Table 3) which are meaningful both for comparison with the ICT sector and for comparing EU to the other major economies.

The correspondence tables between NACE Rev.2 and the national classifications of activities are also the same as in the previous edition (Annex I: Correspondence Tables).

2.1 The Media and Content Sector

This section explains why the MC sector is considered relevant and consequently has been included in since the PREDICT 2017 release. The MC sector is defined as "industries that are engaged in the production, publishing and/or the electronic distribution of content products" (OECD, 2011). This definition relies on international standards, particularly on previous work done by the OECD Working Party on Indicators for the Information Society (OECD, 2007).

Table 5 identifies and details the MC sectors from the technical perspective of the industrial classification. It also highlights how these industries carry out a number of heterogeneous economic activities primarily linked to the creation and dissemination of information and cultural products. These industries engage in video and TV production, programming, distribution, broadcasting, and a wealth of other information services. Another distinctive and common feature of these activities is their level of interconnectedness. These activities are becoming increasingly intertwined - both with each other, and with the ICT sector, which provides most of the means for disseminating MC products. Concurrently, rapid changes have occurred in the way these industries work, in their business models for production and distribution, and in their strategies for interaction with key competitors and for the achievement of their targets. From a policy perspective, these circumstances have given rise to a well-founded and growing interest in collecting and analysing information about these flourishing sectors of the economy and their close relationship to the ICT sectors. As a consequence, the PREDICT project includes information about the MC sector at 4-digit level since 2017. The approach used to produce MC sector data is entirely consistent with the general statistical procedure employed to produce ICT data for the PREDICT project and reports. Therefore, the data for the MC sectors can be integrated within the overall PREDICT framework.

Table 1. The comprehensive definition of the ICT sector (based on NACE Rev.2)

NACE Rev.2.	Description
261-264, 268, 465, 582, 61,	A. ICT Total [A=B+C]
261-264, 268	*B. ICT manufacturing industries [B=1 to 5]*
261	[1] Manufacture of electronic components and boards
2611	[1.1] Manufacture of electronic components
2612	[1.2] Manufacture of loaded electronic boards
262	[2] Manufacture of computers and peripheral equipment
263	[3] Manufacture of communication equipment
264	[4] Manufacture of consumer electronics
268	[5] Manufacture of magnetic and optical media
465, 582, 61, 62, 631, 951	*SER. ICT total services [SER=TW+C]*
465	*TW. ICT trade industries [TW=6+7]*
4651	[6] Wholesale of computers, computer peripheral equipment and
4652	[7] Wholesale of electronic and telecommunications equipment and
582, 61, 62, 631, 951	*C. ICT services industries [C=8+9]*
61	[8] Telecommunications
611	[8.1] Wired telecommunications activities
612	[8.2] Wireless telecommunications activities
613	[8.3] Satellite telecommunications activities
619	[8.4] Other telecommunications activities
582, 62, 631, 951	[9] Computer and related activities [9=10+11+12+13]
582	[10] Software publishing
5821	[10.1] Publishing of computer games
5829	[10.2] Other software publishing
62	[11] Computer programming, consultancy and related activities
6201	[11.1] Computer programming activities
6202-6203	[11.2] Computer consultancy and computer facilities management
6202	[11.2.1] Computer consultancy activities
6203	[11.2.2] Computer facilities management activities
6209	[11.3] Other information technology and computer service activities
631	[12] Data processing, hosting and related activities; web portals
6311	[12.1] Data processing, hosting and related activities
6312	[12.2] Web portals
951	[13] Repair of computers and communication equipment
9511	[13.1] Repair of computers and peripheral equipment
9512	[13.2] Repair of communication equipment

Source: Own elaboration based on OECD (2007).

Table 2. The operational definition of the ICT sector (based on NACE Rev.2)

NACE Rev.2.	Description
261-264, 582, 61, 62, 631, 951	**A'. ICT Total (operational) [A'=B'+C]**
261-264	***B'. ICT manufacturing industries (operational) [B'=1 to 4]***
261	[1] Manufacture of electronic components and boards
262	[2] Manufacture of computers and peripheral equipment
263	[3] Manufacture of communication equipment
264	[4] Manufacture of consumer electronics
582, 61, 62, 631, 951	***C. ICT services industries (operational) [C=8+9]***
61	[8] Telecommunications
582, 62, 631, 951	[9] Computer and related activities [9=10+11+12+13]

Source: Own elaboration.

Table 3. MC sector disaggregation (based on NACE Rev.2)

NACE Rev.2.	Description
581, 59, 60, 639	**E. MC sector [E=F+G+H]**
581	***F. Publishing of books, periodicals and other publishing activities [F=14 to 16]***
5811-5812	[14] Book publishing; Publishing of directories and mailing lists
5811	[14.1] Book publishing
5812	[14.2] Publishing of directories and mailing lists
5813-5814	[15] Publishing of newspapers, journals and periodicals
5813	[15.1] Publishing of newspapers
5814	[15.2] Publishing of journals and periodicals
5819	[16] Other publishing activities
59-60	***G. Audiovisual and broadcasting activities [G=17+18]***
59	[17] Motion picture, video and television programme production, sound recording and music publishing activities
591	[17.1] Motion picture, video and television programme activities
5911	[17.1.1] Motion picture, video and television programme production activities
5912	[17.1.2] Motion picture, video and television programme post-production activities
5913	[17.1.3] Motion picture, video and television programme distribution activities
5914	[17.1.4] Motion picture projection activities
592	[17.2] Sound recording and music publishing activities
60	[18] Programming and broadcasting activities
601	[18.1] Radio broadcasting
602	[18.2] Television programming and broadcasting activities
639	***H. Other information service activities [H=19+20]***
6391	[19] News agency activities
6399	[20] Other information service activities n.e.c.

Source: Own elaboration based on OECD (2007).

Table 4. Additional sectors (based on NACE Rev.2)

NACE Rev.2.	Description
10-33	Manufacturing
20-21	Manufacture of chemicals and chemical products; Manufacture of pharmaceuticals, medicinal chemical and botanical products
20	Manufacture of chemicals and chemical products
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
26	Manufacture of computer, electronic and optical products
27-28	Manufacture of machinery and equipment
29-30	Manufacture of transport equipment
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
303	Manufacture of air and spacecraft and related machinery
45-47	Wholesale and retail trade, repair of motor vehicles and motorcycles
49-99	Services, except trade
49-53	Transportation and storage
58-63	Information and communication
64-66	Financial and insurance activities
69-82	Professional, scientific, technical, administration and support service activities
69-75	Professional, scientific and technical activities
85	Education
86-88	Human health and social work activities

Source: Own elaboration.

3 The Backwards Reconstruction of Time Series

From a technical point of view, producing data to reconstruct the time series backwards employs a two-step strategy:

1. Initially, data from Eurostat National Accounts are used as benchmark for Value Added, Gross output and Employment, while the Eurostat R&D survey is used for BERD, PERD and RERD. In particular, the industries provided by the National Accounts (NA) aggregates by industry (up to NACE A*64) are used as benchmarks to disaggregate both Value Added and Employment, and to comply with the OECD (2007) definitions of the ICT and Media and Content sectors.

2. Table 5 shows the available information which is used to estimate both the MC (green cells) and the ICT services sectors (red cells). As reported in the first column of the table, the NA (ESA 2010) covers from 1995 onwards and the industries available for benchmarking are NACE 58, 59-60, 61, 62-63, 95.

3. Then alternative data sources are employed to disentangle the NACE codes into the industries to fulfil in PREDICT. Specifically, the Structural Business Statistics (SBS) are considered as for the NACE Rev.2 from 2008 onwards, while data from EU KLEMS and from the SBS (NACE Rev. 1.1) is used for the period 1995-2007.

4. Table 5 shows the industry classification available in each of the alternative data sources. The procedure at this stage consisted of breaking down NA A*64 aggregates using the alternative data sources available. Since NA data are available since 1995, the same strategy adopted from 2008 onwards was followed for the years 1995-2005, only using the above mentioned specific ancillary sources.

Additional sources of official data (e.g., OECD, National Statistical Offices, EU KLEMS) are employed whenever Eurostat A*64 has missing values. These additional sources of data are directly plugged into the database or used in the imputations of the following step. Standard imputation methods (e.g., the calculation of difference or shares in the available data, data interpolation, etc.) are employed in cases where no alternative sources of information are available. In some cases, "linking coefficients" corresponding to a more aggregated industry are used –as the only way– to maintain the official correspondence between NACE Rev 1.1 and NACE Rev.2.

In general, a distinctive trait of the imputation approach developed for the PREDICT project is that each missing value is considered as a separate case, and no general rules are defined for all the missing values or for groups of missing values. The best imputation strategy is decided for each individual case on the basis of the information available or of the series characteristics (e.g., whether the series are stationary or have a trend, whether or not the percentage structure is stable over time, etc.).

Another key aspect of the procedure relates to how the change from NACE Rev. 1.1 to NACE Rev.2 is dealt with. Since there are no official tables for the correspondence between NACE Rev.2 and NACE Rev. 1.1, Mas et al. (2012)[4] developed a "transition methodology" in order to produce homogeneous series for the PREDICT variables and industries. According to this approach, for each (sub-) sector, variable and country, a linking coefficient is calculated as the ratio between its values in the NACE Rev.2 and in the NACE Rev. 1.1 of 2008 (the linking year). Then the linking coefficient for 2008 is multiplied to each individual item of data for the previous years to estimate, assuming that the value of the sector under

[4] Mas, M., J.C. Robledo and J. Pérez (2012). "ICT Sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note". JRC Technical Reports, Luxemburg. European Commission, 27 pp.

NACE Rev. 1.1 is always a proportion of the value of the sector under NACE Rev.2, and that this proportion remains constant over time.

The methodology is the same for BERD, PERD and RERD. However, these indicators differ as regards the data sources used as benchmarks, the available industry disaggregation, and the alternative information used. This information is reported in Table 5.

Table 5. Data used to estimate the ICT services and the MC sector

a. Macroeconomic variables: value added and employment

Individual codes

Benchmark	Auxiliary sources			
NACE Rev. 2	NACE Rev. 2		NACE Rev. 1.1	
NA (from 1995)	SBS (from 2008)	SBS (2005-2007)	NA/EU KLEMS (1995-2007)[1]	EU KLEMS/SBS (1995-2007)[1,2]
A*64	Codes	Codes	Codes	Codes
58	581	58	221	221
	582		72	7221
59-60	59-60	59-60	92	92
61	61	61	64	642
62-63	62	62	72	721, 7222, 726
	631	63	72	723, 724
	639		92	92
95	951	95	72	725
	952		52	527

Agreggate codes

NACE Rev. 2	NACE Rev. 2		NACE Rev. 1.1	
Computer and related activities	582, 61, 62, 631, 951	582, 61, 62, 631, 951	72	72

b. R&D variables: BERD, PERD and RERD

Individual codes

Benchmark	Auxiliary sources		
NACE Rev. 2	NACE Rev. 2		NACE Rev.1.1
R&D Statistics from 2005	SBS (from 2008)	SBS (2005-2007)	R&D Statistics 1995-2010
Codes	Codes	Codes	Codes
581	581	58	22
582	582		722
59	59-60	59-60	75-99
60			
61	61	61	642
62	62	62	72
631	631	63	72
639	639		72
951	951	95	52

Agreggate codes

NACE Rev. 2	NACE Rev. 1.1
5820, 62, 631, 951	72
85-87	80-85 (ex. 852)
582, 61, 62, 631, 951	72, 642

Notes: Cells show the NACE codes available for each corresponding data sources.MC sector industries marked in green and ICT industries in red.

4 Nowcasting Methodology

A common thread running through the PREDICT database is the need for a high level of disaggregation (3- or 4-digit level) in the information in order to achieve the required ICT, MC and RS classifications. Statistics that enable such a high level of detail in the industry breakdown are generally published only after a significant delay. The requirements therefore envisage a 3-year lag, due to the timing of releases by Statistical Offices of both National Accounts and R&D data with the necessary level of industry disaggregation.

Nowcasting aims to shorten this delay and make the information available in the ICT sector database, at least for the main aggregates, as policy-makers need insights into the state of the sector today rather than three years ago if they are to have sufficient room for manoeuvre in policy making. The objective, therefore, is to nowcast the present values of the main variables included in the PREDICT database: value added, employment, hours worked, labour productivity, business R&D expenditure (BERD), business R&D personnel (PERD) and business R&D researchers (RERD). These variables are nowcasted for the ICT sector and some of its sub-industries, and for the MC and RS sectors.

Nowcasting is currently on the research agendas of academics, statistical offices and central banks. According to Eurostat's *Glossary on Rapid Estimates* (Eurostat, 2012), "nowcasting is a rapid evaluation produced during the current reference period *T* (the present) for a hard economic variable of interest observed for the same reference period *T*. Nowcasting makes use of the real-time data flow available between *T* and *T-1*". Hence, the term *nowcast* refers to the prediction of the current values of the relevant variables by using other contemporaneous information. Nowcasting differs from forecasting in that the latter "is the process of making statements about events whose actual outcomes (typically) have not yet been observed. A common place example might be an estimation for a statistical variable of interest related to a specific future date" (Eurostat, 2012).[5] However, both types of estimation methods are closely related to the aims of this work.

A variety of different methodologies has been developed to reduce the delay with which official statistics become available. What they have in common is the use of contemporaneous, generally higher frequency (quarterly, monthly or daily), information for the variable to be nowcasted. However, they differ in the number of variables used, how this auxiliary information is processed, the way different frequencies are integrated, and the forecasting technique used.

This methodological note describes the approach followed in PREDICT nowcasting, which offers the nowcasted values for the variables described above, for both the European Union countries and the selected non-European countries. The data is obtained for the two subsequent years to those included in the database. The length of the time series allows individual estimations for each variable by country and by industry. This framework allows the predictors to influence each dependent variable differently in each country. One of the main issues in the methodology is the fact that in general, given the definition of the ICT industry used in PREDICT, the number of proxies that can be used as predictors is limited. They are taken from the Quarterly National Accounts (value added and employment). The main challenge was to select the industry disaggregation that best proxy the ICT industries.

[5] Other related terms used in the Eurostat Glossary are *ex-ante forecast*, a forecast that only uses the information (i.e. the value of economic variables) available at the time of the actual forecast and not the value of some variables available for the forecasting horizon; *ex-post forecast,* a forecast that uses the information (i.e. the value of economic variables) which extends beyond the time at which the actual forecast is prepared, and *projections,* the process of moving forward in time through the imagining of future events, or by means of estimates based on certain assumptions or past trends.

4.1 Nowcasting Main Objectives

The objectives of the nowcasting exercise are outlined below.

Variables: The nowcasting exercise covers the main PREDICT variables: value added, employment, hours worked, labour productivity, BERD and R&D personnel and researchers. Value added and BERD are nowcasted in current euros, and they are then converted into purchasing power parities (PPPs).

Geographical coverage: The geographical coverage of the nowcasting exercise includes the European Union and its Member States, United Kingdom, Australia, Canada, Japan, Korea, Taiwan and the US. It is extremely difficult to estimate the values for the remainder of the PREDICT countries (Brazil, China, India and Russia) given the lack of short-term statistics with a sufficient degree of industry-level disaggregation, and as a result, data for these countries are not nowcasted.

Industry disaggregation: The target industry disaggregation for the EU countries consists of the comprehensive definition for total ICT sector, ICT manufacturing sector and ICT services sector, the Telecommunications sector (IT), the Computer and related activities sector (IC) and ICT Trade Industries (TW), in addition to the Media and content (MC) and the Retail sale sector (RS). Given the available information in terms of industry disaggregation and the nature of short-term statistics variables, it would not seem possible to produce reliable results when attempting to take the industry disaggregation any further.

Additionally, given the fact that the objective is to compare the EU countries with non-EU economies, we also estimate the operational definition of the ICT industries. This definition excludes the ICT trade industries (NACE 465) and Manufacture of magnetic and optical media (NACE 268) and is the one to be used whenever EU and non-EU countries are to be compared.

4.2 Outline of the Main Nowcasting Methodologies

Several methodological approaches for nowcasting data have been developed in the literature. Nowcasting is increasingly used to obtain real-time data for macroeconomic aggregates such as GDP, inflation, exports, and so on. Researchers choose the most appropriate method according to their final objectives, frequency of releases, and information availability.

Nowcasting methodologies are broadly grouped into three categories:

1. *Transfer rates*. This methodology consists of using the relationship between the variable to be nowcasted with another that is known at the time the estimate is made. Nowcasted values are projected using transfer coefficients, which measure the past relationship between the two variables. In general, transfer rates have the advantage of being easy to implement. However, their disadvantage is that they do not capture changes in trends or in the underlying variables. Furthermore, this method does not explicitly use all the additional information available at the time of nowcasting. This method is used, for example, to estimate patent data (Dernis 2007; Eurostat 2010). These authors estimate the European Patent Office (EPO) regional applications under the Patent Cooperation Treaty (PCT) using ratios of the regional EPO PCT applications at the regional phase to EPO designated PCT applications.

2. *Trend analysis*. This method extrapolates the trend in the variable to be nowcasted from its past values. Different procedures can be used to extract the trend component: single equation methods (linear trend with constant, declining or rising growth rates, saturation curves, etc.), or methods of smoothing data (arithmetic moving averages, exponential moving averages, Hodrick-Prescott filter). Additionally, the non-structural Box-Jenkins approach –known as the ARIMA (autoregressive integrated moving averages) models– can also be used for prediction via the Census Bureau X-11 or TRAMO-SEAT programs. In general, all these techniques require longer time series than those included in the PREDICT database.

3. *Econometric methods*. These methods are based on the projection of the variables into a set of explanatory variables. Hence, the information is provided by exogenous variables contemporaneous to the period to be nowcasted. That is, these models incorporate the most up-to-date information from additional variables closely related to that to be nowcasted, very often relying on information with a different frequency, or released in a non-synchronous pattern. The literature provides a wide variety of models (see, for example, the survey by Castle, Hendry, and Kitov, 2013) tailored to the specific purpose of the nowcast and to the variable of interest.

The main methodological problems (Castle, Hendry, and Kitov, 2013; Bánbura, Giannone and Reichlin, 2011) that arise in the *Econometric methods* are derived from the fact that not all the disaggregated contemporaneous nowcasted data are known when they are needed (e.g. nowcasted final demand components are not known when the nowcasting quarterly GDP is published; nowcasted data for all the European MS are not available when nowcasting data for EU). The missing data problem describes the fact that data on some variables are released after they are required for the nowcasting process. The latency problem refers to the issue that the same set of variables is not always available at the time of nowcasting. The change of database problem refers to the issue that the original information used is frequently revised or updated so that the previous estimates suffer from measurement errors breakdown problems derive from the change in the long-run means of the nowcasted variables. Finally, frequently there are more variables than observations.

Most of the *Econometric methods* combine data with diverse frequencies. For example, higher frequency statistics, such as monthly industrial production or high-frequency financial data, are used to nowcast quarterly GDP. When *Econometrics methods* are applied, the nowcasting methodology should therefore consider the procedure to exploit this information –mixed frequencies and a large number of variables– in the most efficient way to avoid any loss of information. That is, the first stage consists of converting data with different frequencies into the same frequency. This problem is usually overcome by using one of three approaches: *Mixed-data sampling models* (MIDAS), which link a low-frequency variable with a higher frequency variable by means of a lag polynomial (Ghysels, Sinko and Valkanov, 2007; Andreou, Ghysels and Kourtellos, 2011); the *Factor model,* which uses a factor model to reduce all the monthly or quarterly indicators of all the different variables to a set of common factors (Boivin and Ng, 2005); or *Bridge equations*, which are less restrictive and easier to interpret than the MIDAS and Factor models. The basic idea behind the bridge equations is that the current value of the nowcasted variable depends on its own lagged values and on transformed versions of the observed high-frequency indicators converted to lower frequency (e.g. from monthly to quarterly frequencies).

4.3 Nowcasting Methodology

This section outlines the general framework for nowcasting PREDICT variables. The general methodology is applied only for value added, employment, hours worked and BERD. Labour productivity is calculated as the ratio of value added and hours worked nowcasted values. Business R&D personnel and researchers are calculated with transfer rates using nowcasted BERD data, as described later on.

4.3.1 General Approach: Value Added, Employment, Hours Worked and BERD

Before describing the framework, it is important to note that the nowcasting envisaged here has some specific features that shape the methodology and differentiate it from other approaches in the literature. The main issue is related to the fact that the objective is to release annual data referring to the last two full calendar years. By contrast, nowcasting methodologies are usually designed to update estimates on a monthly or quarterly basis, incorporating new information released in the meantime. These updates are carried out continuously until the official data for the nowcasted variables are published. The particular feature of nowcasting the PREDICT dataset means that monthly or quarterly statistics are not necessary, as the estimate can be based on annual data or annualised quarterly data, thus completing the statistics chosen to perform the estimations. This implies that the usual nowcasting problems derived from different data frequencies are not present here.

The PREDICT database includes data that starts 1995, which allows us to use time-series methods applied individually to each country. Therefore, our general model is based on the definition of the following equation for each industry *l* and country *c* to be nowcasted:

$$Y_{clt} = \alpha + \delta_{cl} X_{clt} + \varepsilon_{clt} \tag{1}$$

where Y_{clt} stands for the variable to be nowcasted (value added, employment or BERD) for country *c* at time *t* in industry *l*; X_{clt} is a matrix of correlates, predictors or independent variables for a given country and industry, and $_{clt}$ is white noise. Value added, employment and BERD show marked trends, as they are not stationary. Hence, the estimation is carried out in first differences (noted by *D.*).

$$D.Y_{clt} = \alpha + \delta_{cl} D.X_{clt} + \varepsilon_{clt} \tag{2}$$

The model of equation (2) is estimated for each of the EU countries, including the EU, which is treated as an additional country, and for the non-EU countries. Although the model is estimated in first differences, first order serial correlation is tested using the Breush-Godfrey test. In the event that first order correlation exists, alternative definitions of the explanatory variables are used, and if necessary, a trend or alternatively, an autoregressive term –AR(1)- are included in the estimation,[6] i.e. we include the lag of the dependent variable. In all the models finally selected, the first order correlation is rejected. Tables 3-5, which describe the variables included in the estimation of each model, report the cases in which a trend or an AR(1) term are included.

4.3.2 Independent Variables

For the sake of uniformity, the independent variables must be confined to a common set of indicators for all countries. This set of indicators is based on the availability of information for both the estimation period and the two nowcasting years. Because the objective of the analysis is to nowcast indicators of the ICT sector, which is quite detailed, the number of possible correlates is quite low, particularly in the case of BERD for which there are almost no variables to proxy the R&D intensity at the detailed industry

[6] In all the estimations in which first order serial correlation is detected, the inclusion of a trend or an AR(1) term solved the issue, removing the need for higher order autoregressive terms.

level. In fact, the predictors are limited to indicators of value added and employment of the nearest industry aggregation to that of the PREDICT database.

Table 6. Explanatory variables for the estimation of VA, employment, hours worked and BERD used according to the estimated sector*

Variables from Quarterly NA, annualised

Estimated sector	Independent variables: VA, Persons employed and GFCF in intellectual property. Industry disaggregation
ICT Sector (comprehensive and operational)	NACE C (Manufacturing) + J (Information and communication); Intellectual Property (only for BERD) Total economy
ICT manufacturing sector (comprehensive and operational)	NACE C (Manufacturing); Intellectual Property (only for BERD) Total economy
ICT total services sector and ICT services sector	NACE J (Information and communication); Intellectual Property (only for BERD) Total economy
ICT trade industries	NACE G_I (Wholesale and retail trade, transport, accommodation and food service activities) for the EU countries and G for the Non-EU Countries; Intellectual Property (only for BERD) Total economy
Telecommunications sector	NACE J (Information and communication); Intellectual Property (only for BERD) Total economy
Computer and related activities sector	NACE J (Information and communication); Intellectual Property (only for BERD) Total economy
Media and content sector	NACE J (Information and communication); Intellectual Property (only for BERD) Total economy
Retail sale sector	NACE G_I (Wholesale and retail trade, transport, accommodation and food service activities) for the EU countries and G for the Non-EU Countries; Intellectual Property (only for BERD) Total economy

* The explanatory variables used for the estimation of each sector are the same for GVA, EMP, HEMP, BERD. Additionally, gross fixed capital formation in intellectual property is added for the estimation of BERD.

Source of NA data: Eurostat for EU countries and OECD and national statistics offices for non-EU countries.

The variables selected as independent variables and the industry disaggregation to proxy PREDICT industry are specified in table 6.[7] Two indicators from the Quarterly National Accounts are used as independent variables: value added and persons employed. The quarterly data is annualised by aggregating all four quarters of each year (or the last four available quarters if the whole year is not available). This information captures the differences in the economic cycle of each economy and the possible changes in the means of the variable. Quarterly National Accounts (QNA) offer information disaggregated according to the A*10 industry breakdown,[8] both for value added and persons employed. Depending on the industries to nowcast, different industry aggregations of the two predictors will be

[7] The final selection of variables is the result of several tests carried out in the Interim Nowcasted dataset and subsequent tests, and the experience of the Nowcasting exercise in previous PREDICT projects. Some additional variables were tested and discarded because they did not improve the results in value added, employment or BERD. Among the variables tested were employees with higher education from the Labour Force Survey, and turnover from Eurostat's Short Term Statistics. Other potential independent variables were also discarded because they did not cover the nowcasting years, which were necessary to carry on the nowcasting exercise (EPO patents, R&D from the EU's Industrial Scoreboard, among others).

[8] A*10 NACE Rev. 2 industry breakdown: A) Agriculture, forestry and fishing; B-E) Industry (except construction); C) Manufacturing; F) Construction; G-I) Wholesale and retail trade, transport, accommodation and food service activities; J) Information and communication; K) Financial and insurance activities; L) Real estate activities; M_N) Professional, scientific and technical activities; administrative and support service activities; O-Q) Public administration, defence, education, human health and social work activities; R-U) Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies.

used. Table 1 shows the industry aggregation used for the nowcasting of each ICT sector[9] in the case of all four variables to be nowcasted (value added, employment, hours worked and BERD).

In the case of BERD there are no short-term variables for the period required that proxy R&D intensity. In fact, there is no specific information on R&D with monthly/quarterly frequency that can be used as a basis for the nowcasting procedure. For example, the EPO patents information and R&D expenditures from Eurostat's R&D does not go up to the last year. The only available information for the last year is the Gross Fixed Capital Formation in intellectual property published in the National Account Statistics for the aggregated economy (not available by industries). This variable is included as an additional independent variable in the BERD estimations, as well as value added and persons employed.

The basic specification therefore includes value added and persons employed, and gross fixed capital formation in intellectual property in the case of BERD. Additionally, as mentioned earlier, the dependent variable in the estimation is the first difference of the PREDICT variables (value added, employment, hours worked and BERD). Given the fact that the series in first differences are sometimes quite erratic, particularly in the case of BERD we have tested alternative specifications including up to three dummies covering up to the three sharpest jumps in series. Alternatively, in some cases (countries/ICT sector or subsector) the profile of the series suggested that the variable behaved differently before and after 2010. Therefore, an additional specification was considered, including a step dummy variable for these years. The following subsections offer more details on the selection of the best model for each variable and on the definition of the dummy variables.

Table 7 shows the data sources used for each country. Data for the EU countries and UK come from the same source, Eurostat (Quarterly National Accounts). Additional data sources were used for the remaining countries, essentially National Accounts from their National Statistical Offices or from the OECD. The indicators for these additional countries were chosen to match as closely as possible (in terms of industry disaggregation and definition of the variable) those selected for the EU countries.

[9] In the Interim Nowcasted dataset alternative industry disaggregations of the independent variables were tested. In general, the correspondence of the ICT industry with the industry disaggregation available in the Quarterly National Accounts shown in table 1 was the most effective.

Table 7. Data sources for the independent variables, by country

Country	Source of data
EU and Member States	Eurostat: Quarterly National Accounts (VA, persons employed and GFCF in intellectual property)
United Kingdom	Eurostat: Quarterly National Accounts (VA, persons employed and GFCF in intellectual property) Office of National Statistics: Gross Value Added (VA), Employment by industry (persons employed) and Gross fixed capital formation (GFCF in intellectual property)
Australia	Australian Bureau of Statistics: Quarterly National Accounts (VA, persons employed)
Canada	Statistics Canada: Canadian socioeconomic database from Statistics Canada – CANSIM (employees and VA)
Japan	Cabinet Office: Quarterly National Accounts (VA). Japan Industrial Productivity (JIP) from Research Institute of Economy, Trade and Industry (RIETI) and Hitotsubashi University and Labour Force Survey from e-STAT portal in Japan (persons employed)
Korea	Korean Statistical Information Service: Quarterly National Accounts (VA and persons employed)
Taiwan	National Statistics of the Republic of China: Quarterly National Accounts (VA and persons employed)
US	Bureau of Economic Analysis (BEA): Quarterly National Accounts (VA). Bureau of Labor Statistics (BLS): Current Employment Statistics (employees)

4.3.3 Selection of Models

The nowcasting strategy consists of estimating a linear regression for each country, variable and ICT sector or subsector for the period with existing data (publication date of data minus 3 years, minus 4 years for Canada for GVA). The dependent variable is the first difference of value added, employment, hours worked or BERD, and the predictors are the first differences of value added, employment, and also gross fixed capital formation in intellectual property in the case of BERD. Additionally, several specifications are tested, including up to three impulse dummies[10] that capture the three sharpest jumps in the series, or a step dummy[11] to capture differences in the profile of the dependent variable before and after 2010. Lastly, a trend or an AR(1) additional term is included if first order correlation in the residuals is observed. Therefore, a range of models is estimated for each country/variable/industry. First, three different alternatives are defined: models with only value added as the predictor, with only persons employed, and with the two variables. For each of the alternatives, several models are estimated including a step dummy, or, alternatively, one, two or three dummy variables for the first, second and third sharpest jumps (impulse dummies) in the dependent variable. Eventually a trend or an AR(1) term is included if autocorrelation is detected. In the case of BERD, intellectual property is included in addition to the other variables described. More specifically, of all the possible models estimated, the one that includes the highest number of predictors is the following:

$$D.Y_{clt} = \alpha + \delta_1 D.GVA_{clt} + \delta_2 D.PersonsEmployed_{clt} + \delta_3 D.IntelectualProperty_{clt} + \\ +\delta_4 Dummy1 + \delta_5 Dummy2 + \delta_6 Dummy3 + \delta_7 Dummy10\_19 + \delta_8[AR(1) or\ a\ trend] + \varepsilon_{clt} \quad (3)$$

where *Dummy1*, *Dummy2* and *Dummy3* stand for the impulse dummy variables that take the value 1 for the year in which the highest, the second or the third variation in the dependent variable occurs. These dummy variables are not systematically related to specific years, as they vary across countries and industries within each independent variable. *Dummy10_19* is a step dummy variable that takes value 1 for years 2010-2018 and 0 for the rest of the years. Intellectual property is only included in the BERD models, and if *Dummy10_19* is included, the variables *Dummy1*, *Dummy2*, and *Dummy3* are not considered. Finally, for each ICT subsector, different industry aggregations from the QNA are used, as described in table 6.

We used a twofold criterion to select the best model estimated for each country/ICT industry/variable. First, we employ a criterion based on the goodness of fit of the model estimated for the years without nowcasted data. For each model, we calculate the average root mean squared errors ($RMSE_{95t-3}$) so that the model specification with lower RMSE is preferred. This criterion is combined with a second indicator that evaluates the model's predictive capacity. To implement the latter criterion we use the years we take out the last two available years to form a training set from 1995 to the publication year minus 5. We re-estimate each model for the training set and compute the test error defined as the root mean squared error of the predictions for the test set, that is, for last two available years 2018 and 2019 ($RMSE_{t-3t-4}$). This second procedure allows us to test the performance of the model to make out-of-sample predictions. Our model may perfectly fit the data used for the estimations, but may fail to make out-of-sample predictions; this is known as the overfitting problem. With this second criterion, we choose the model with the lowest prediction error out of the training set.

To combine the two criteria we calculate what we call the total RMSE ($RMSE_{total}$) as follows:

$$RMSE_{total} = RMSE_{95t-3} + RMSE_{t-3t-4} \quad (4)$$

[10] An impulse dummy is a variable that takes the value one for the year in which the dependent variable shows a sharp jump, and zero otherwise.

[11] The step dummy is defined as a variable that takes the value one starting 2010 and zero before 2010.

and we choose the model with the lowest $RMSE_{total}$. What are the advantages of combining the two *RMSE*? Essentially, by doing so we can select the model that makes good predictions in the test set combined with the model that also behaves well over the whole period. When only one of the criteria is used, misleading results may arise in some cases. For example, we observed cases in which the best model selected according only to the out-of-sample prediction capacity performed poorly when it was estimated for the whole period (adjusted R-squared below 0.1). Additionally, because we only test the out-of-sample predictive capacity using only two years, the $RMSE_{t-3t-4}$ is prone to be affected by unusual data in the test set.

Tables 8, 9 and 10 in the Annex show the description of the best models selected according to the criteria based on the minimum $RMSE_{total}$ for the PREDICT year 2022. Each table shows, for each country, the variables finally considered in the estimations (including the industry disaggregation used for value added and persons employed). The table also specifies whether dummies were included in the period 1995-2017 (in the training set) or in years 2018-2019. It also reports the estimation method (plain OLS or OLS including a trend or an AR(1) term to overcome the serial correlation problems), the adjusted R-squared of the model estimated for 1995-2018, and the $RMSE_{95t-3,}$ $RMSE_{t-3t-4}$. Table 8 shows the information for the model estimated for value added, table 9 for employment, table 10 for hours worked and table 11 for BERD.

4.3.4 Transfer Rates: Personnel and Researchers

The estimation of R&D personnel and researchers is based on the definition of transfer rates. Two transfer rates are defined for each year, country and industry:

$$Transfer\ Rate^{Personnel} = \frac{R\&D\ Personnel}{BERD} \quad (5)$$

$$Transfer\ Rate^{Researchers} = \frac{Researchers}{BERD} \quad (6)$$

The problem here is which transfer rate to apply to estimate the values for the nowcasting years. The possible alternatives are: the transfer rate of the last year before nowcasting starts, or an average of the most recent years. Using an average of the previous years is a good alternative if the transfer rate is stable in time (stationary). However, it may be misleading if this rate shows a marked trend. To overcome this issue we proceeded as follows:

- For each country, industry and variable (personnel and researchers) the following regression model is estimated using the available non-nowcasted data for:

  $$Transfer\ Rate_{clt}^{Personnel\ or\ Researcher} = \alpha + \delta Trend + \varepsilon_{clt} \quad (7)$$

- The predicted transfer rates for the nowcasting years are obtained using the estimated parameters of equation (7) if the parameter is statistically significant. Otherwise, we use the transfer rate of the last year.
- The predicted transfer rates are used to obtain the values of personnel and researchers using the nowcasted BERD data.

The advantage of this procedure is that it takes into account the previous evolution of the variables, only if the transfer rate does not show a trend (the estimated parameter is not statistically significant), we use the estimated transfer rate corresponding to the last available year.

The only exception to this procedure is in the Retail sale sector. The transfer rates are quite volatile, and the estimated transfer rates from a trend regression frequently yield negative values. We therefore opted to use the transfer rate of the last available year in this sector.

4.4 Nowcasted Data

Although the models for ICT sector value added, employment, hours worked and BERD are estimated in first differences, the files delivered consist of the absolute values of the variables. To recover the levels of the original variables, the estimated increases (first differences) for the nowcasting years are obtained using the procedures described above. To this end, we use the estimated parameters and the value of the predictors for the nowcasting years. These increases are applied to the original values of the variables of the last year to obtain the nowcasted data.

Once all the variables for all sectors have been nowcasted individually for the EU countries, some decisions must be taken to guarantee the internal coherence of the database. For the comprehensive classification we proceed as follow. The first decision concerns the fact that the total ICT sector has to be equal to the aggregation of the ICT manufacturing, the ICT services sectors and ICT trade industries, and, in the same vein, the total ICT services sector has to be equal to the aggregation of the Telecommunications sector and Computer and related activities. With the approach described up to now, these two conditions are not guaranteed. We took the nowcasted data for the total ICT sector as a benchmark, and proportionally adjusted the nowcasted data of the ICT manufacturing, the ICT services sector and ICT trade industries to this benchmark. Additionally, these adjusted data of the ICT services sector are also used as a benchmark to proportionally adjust the values of the Telecommunications and Computer and related activities sector.

To guarantee the coherence between the comprehensive and operational classification we take the former as reference. Then we calculate the operational ICT manufacturing and services subsectors as follows. First, we calculate the operational total ICT manufacturing by substracting from the comprehensive ICT manufacturing the share of Manufacture of magnetic and optical media sector (NACE Rev. 2 268). Given both the absence of reliable results to estimate such an industry disaggregation and its small weight within the ICT manufacturing (e.g. it was 0.16% for the Gross Value Added of EU27 in 2018-2019), we obtain the estimation of the Manufacture of magnetic and optical media sector by applying the last two years' average share (Manufacture of magnetic and optical media / ICT manufacturing) to the nowcasted value for ICT manufacturing. Second, we subtract from the total comprehensive ICT services the trade industry. Finally, total operational ICT sector is calculated aggregating the operational ICT manufacturing and ICT services industries.

An additional issue that is worth mentioning is the treatment of the European Union as an additional country. This means that the aggregation of EU countries in each industry does not coincide with the estimated data. For example, in the case of the ICT sector value added, the difference between the EU value and the aggregation of countries is around 0.5 pp between the last PREDICT 2022 database period (2018-2019) and the nowcasted years (2020-2021)[12].

4.5 Main Issues

The availability of nowcasted data is an asset as it will provide timely information on the evolution of the ICT, MC and RS sectors. This will help to monitor their development and facilitate policy decisions. To nowcast data many decisions have to be taken, such as selecting the nowcasting technique and the most suitable data.

The objective of the nowcasting exercise is to obtain an estimation of the PREDICT variables for the last two calendar years, i.e. the two years subsequent to the current PREDICT database. The variables to be nowcasted are value added, employment, hours worked, labour productivity, BERD and business R&D personnel and researchers. In terms of industry disaggregation, the objective is to nowcast the total ICT sector, the ICT manufacturing sector, ICT services, including the ICT Trade industry, Telecommunications and IC sector, the Media and content industry and the Retail sale sector. The aim is to produce estimates for the EU, its Member States, United Kingdom, Australia, Canada, Japan, Korea, Taiwan and the US.

The development of the methodology needs to bear in mind that the final methodology must 1) be understandable and replicable by third parties (e.g., new contractors), 2) rely on official data as much as possible; and 3) employ a consistent framework for value added, employment, hours worked and BERD.

[12] The difference between ICT GVA in the ICT sector for the years 2018-2019 in the EU and the sum of the individual European countries is 8.3%, whereas this difference is 8.8% for the nowcasted years 2020-2021.

The two previous paragraphs restrict the possible methodological alternatives because only a small number of possible explanatory variables are available, and because the time span of the data is short. Additionally, as the PREDICT Nowcasting project aims to produce yearly data, the typical issues in the literature do not arise for heterogeneous data frequencies. That is, the annual data can be estimated from annual or annualised quarterly predictors.

The Final Nowcasted Dataset is the result of the nowcasting exercise carried out within the PREDICT project. The approach followed was based on the estimation of regression models for each EU Member State, for the EU and for some additional countries. The estimations rely only on three predictors: GVA, persons employed and gross fixed capital in intellectual property obtained from the Quarterly National Accounts. Several models were estimated for each PREDICT variable, and tests were conducted to determine which one has higher explanatory power, and which has the best out-of-sample prediction capacity (minimal overfitting). Overall, the models fit reasonably well with the data, although there is variability across ICT sectors and variables.

THE PREDICT nowcasting dealt with additional issues during the two years of the COVID-19 crisis. The nowcasting for 2020 and 2021, especially for the former year, implied more uncertainty surrounding these two years and the asymmetric nature of the crisis. COVID-19 has generated adverse effects of different magnitude depending on the sectors of activity or the economic variables considered.

The large oscillations presented in the last two years by the independent variables, which serve as input in the models, have an impact on the predictions. In general terms, the fact that the regressors present atypical values far from their historical mean values translates into (higher variation rates and) a greater amplitude in the confidence intervals, i.e., the accuracy of the estimations is lower.

Annex I: Correspondence Tables

Table A I Approximate correspondence between NACE Rev.2 (ISIC Rev. 4) and NACE Rev 1.1 (ISIC Rev. 3.1) for ICT, MC and RS sectors and additional sectors

a) Comprehensive definition of ICT sector (based on the 2007 OECD ICT sector definition)

NACE Rev.2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1
261-264, 268	**261-264, 268**	**ICT manufacturing industries**	**2465, 30, 32**	**2429, 30, 32**
261	261	Manufacture of electronic components and boards	321	321
2611	2610P	Manufacture of electronic components	321P	321P
2612	2610P	Manufacture of loaded electronic boards	321P	321P
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
268	268	Manufacture of magnetic and optical media	2465	2429
465	**4651, 4652**	**ICT trade industries**	**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
582, 61, 62, 631, 951	**582, 61, 62, 631, 951**	**ICT services industries**	**642, 72**	**642, 72**
582	582	Software publishing	7221	7221
5821	5820P	Publishing of computer games	7221P	7221P
5829	5820P	Other software publishing	7221P	7221P
61	61	Telecommunications	642	642
611	611	Wired telecommunications activities	642P	642P
612	612	Wireless telecommunications activities	642P	642P
613	613	Satellite telecommunications activities	642P	642P
619	619	Other telecommunications activities	642P	642P
62	62	Computer programming, consultancy and related activities	721, 7222, 726	721, 7229, 729
6201	6201	Computer programming activities	7222P	7229P
6202	6202P	Computer consultancy activities	721, 7222P	721, 7229P
6203	6202P	Computer facilities management activities	7222P	7229P
6209	6209	Other information technology and computer service activities	7222P, 726	7229P, 729
631	631	Data processing, hosting and related activities; web portals	723, 724	723, 724
6311	6311	Data processing, hosting and related activities	723, 724P	723, 724P
6312	6312	Web portals	724P	724P
951	951	Repair of computers and communication equipment	725	725
9511	9511	Repair of computers and peripheral equipment	725P	725P
9512	9512	Repair of communication equipment	725P	725P

Table A I (cont.) Approximate correspondence between NACE Rev.2 (ISIC Rev. 4) and NACE Rev 1.1 (ISIC Rev. 3.1) for ICT, MC and RS sectors and additional sectors

b) Operational definition of ICT sector

NACE Rev.2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1
261-264	**261-264**	**ICT manufacturing industries**	**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

c) Media and content (MC sector) (based on the 2007 OECD definition)

NACE Rev.2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1
581, 59, 60, 639	**581, 59, 60, 639**	**MC sector**	**221, 921, 922, 924**	**221, 9211-9213, 922**
581	**581**	**Publishing of books, periodicals and other publishing activities**	**221 (ex. 2214)**	**221 (ex. 2213)**
5811-5812	5811-5812	Book publishing; Publishing of directories and mailing lists	2211	2211
5811	5811	Book publishing	2211P	2211P
5812	5812	Publishing of directories and mailing lists	2211P	2211P
5813-5814	5813	Publishing of newspapers, journals and periodicals	2212, 2213	2212
5813	5813P	Publishing of newspapers	2212	2212P
5814	5813P	Publishing of journals and periodicals	2213	2212P
5819	5819	Other publishing activities	2215	2219
59-60	**59-60**	**Audiovisual and broadcasting activities**	**2214, 921, 922**	**2213, 9211-9213**
59	59	Motion picture, video and television programme production, sound recording and music publishing activities	2214, 921	2213, 9211-9213
591	591	Motion picture, video and television programme activities	921	9211-9212
5911	5911	Motion picture, video and television programme production activities	9211P	9211P
5912	5912	Motion picture, video and television programme post-production activities	9211P	9211P
5913	5913	Motion picture, video and television programme distribution activities	9212	9211P
5914	5914	Motion picture projection activities	9213	9212
592	592	Sound recording and music publishing activities	2214	2213
60	60	Programming and broadcasting activities	922	9213
601	601	Radio broadcasting	922P	9213P
602	602	Television programming and broadcasting activities	922P	9213P
639	**639**	**Other information service activities**	**924**	**922**
6391	6391	News agency activities	924P	922P
6399	6399	Other information service activities n.e.c.	924P	922P

Table A I (cont.) Approximate correspondence between NACE Rev.2 (ISIC Rev. 4) and NACE Rev 1.1 (ISIC Rev. 3.1) for ICT, MC and RS sectors and additional sectors

d) Retail sale via mail order houses or via Internet (RS sector)

NACE Rev.2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1
4791	4791	Retail sale via mail order houses or via Internet	5261	5251

e) Additional sectors

NACE Rev.2	ISIC Rev. 4	Description	NACE Rev. 1.1	ISIC Rev. 3.1
10-33	10-33	Manufacturing	15-21, 22 (ex. 221), 23-36	15-21, 22 (ex. 221), 23-36
20-21	20-21	Manufacture of chemicals and chemical products; Manufacture of pharmaceuticals, medicinal chemical and botanical products	24 (ex. 2465)	24 (ex. 2429)
20	20	Manufacture of chemicals and chemical products	24 (ex. 244, 2465)	24 (ex. 2423, 2429)
21	21	Manufacture of pharmaceuticals, medicinal chemical and botanical products	244	2423
26	26	Manufacture of computer, electronic and optical products	30, 32, 33	30, 32, 33
27-28	27-28	Manufacture of machinery and equipment	29, 31	29, 31
29-30	29-30	Manufacture of transport equipment	34-35	34-35
29	29	Manufacture of motor vehicles, trailers and semi-trailers	34	34
30	30	Manufacture of other transport equipment	35	35
303	303	Manufacture of air and spacecraft and related machinery	353	353
45-47	45-47	Wholesale and retail trade, repair of motor vehicles and motorcycles	50-52 (ex. 527)	50-52 (ex. 526)
49-99	49-99	Services, except trade	221, 527, 60-99 (ex. 7011, 90)	221, 526, 60-99 (ex. 7010P, 90)
49-53	49-53	Transportation and storage	60-63 (ex. 633), 641	60-63 (ex. 6304), 641
58-63	58-63	Information and communication	221, 642, 72 (ex. 725), 921, 922, 924	221, 642, 72 (ex. 725), 9211-9213, 922
64-66	64-66	Financial and insurance activities	65-67	65-67
69-82	69-82	Professional, scientific, technical, administration and support service activities	633, 71, 73, 74, 852	6304, 71, 73, 74, 852
69-75	69-75	Professional, scientific and technical activities	73, 741-744, 7481, 7487, 852	73, 741-742, 7494, 7499P, 852
85	85	Education	80	80
86-88	86-88	Human health and social work activities	85 (ex. 852)	85 (ex. 852)

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

Source: Own elaboration

Table A II Correspondences between NACE Rev.2 and ANZSIC (Australia)

a) ICT sector

	NACE Rev.2	ANZSIC 2006
ICT manufacturing industries		
Manufacture of electronic components and boards	261	2429P
Manufacture of electronic components and boards	2611	2429P
Manufacture of electronic components	2619	2429P
Manufacture of computers and peripheral equipment	262	2421
Manufacture of communication equipment	263	2422
Manufacture of consumer electronics	264	2429P
Manufacture of magnetic and optical media	268	2429P
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	3492
Wholesale of electronic and telecommunications equipment and parts	4652	3493
ICT services industries		
Software publishing	582	542
Publishing of computer games	5821	542P
Other software publishing	5829	542P
Telecommunications	61	58, 591P
Wired telecommunications activities	611	5801, 591P
Wireless telecommunications activities	612	5802P, 591P
Satellite telecommunications activities	613	5802P, 591P
Other telecommunications activities	619	5809, 591P
Computer programming, consultancy and related activities	62	70
Computer programming activities	6201	70P
Computer consultancy and computer facilities management activities	6202-6203	70P
Computer consultancy activities	6202	70P
Computer facilities management activities	6203	70P
Other information technology and computer service activities	6209	70P
Data processing, hosting and related activities; web portals	631	591P, 592
Data processing, hosting and related activities	6311	592
Web portals	6312	591P
Repair of computers and communication equipment	951	9422
Repair of computers and peripheral equipment	9511	9422P
Repair of communication equipment	9512	9422P

Table A II (cont.) Correspondences between NACE Rev.2 and ANZSIC (Australia)

b) RS sector

	NACE Rev.2	ANZSIC 2006
Retail sale via mail order houses or via Internet	4791	431P

c) MC sector

	NACE Rev.2	ANZSIC 2006
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	5413
Publishing of directories and mailing lists	5812	5414
Publishing of newspapers, journals and periodicals	5813-5814	5411-5412
Publishing of newspapers	5813	5411
Publishing of journals and periodicals	5814	5412
Other publishing activities	5819	5419
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	55
Motion picture, video and television programme activities	591	551
Motion picture, video and television programme production activities	5911	5511
Motion picture, video and television programme post-production activities	5912	5514, 5512P
Motion picture, video and television programme distribution activities	5913	5512P
Motion picture projection activities	5914	5513
Sound recording and music publishing activities	592	552
Programming and broadcasting activities	60	56,57
Radio broadcasting	601	561, 57P
Television programming and broadcasting activities	602	562, 57P
Other information service activities		
News agency activities	6391	602P
Other information service activities n.e.c.	6399	602P

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

Source: Own elaboration

Table A III Correspondences between NACE Rev. 2 and CNAE (Brazil)

ICT SECTOR

	NACE Rev. 2	CNAE 2.0
ICT manufacturing industries		
Manufacture of electronic components and boards	261	261
Manufacture of electronic components	2611	261P
Manufacture of loaded electronic boards	2612	261P
Manufacture of computers and peripheral equipment	262	262
Manufacture of communication equipment	263	263
Manufacture of consumer electronics	264	264
Manufacture of magnetic and optical media	268	268
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	4651
Wholesale of electronic and telecommunications equipment and parts	4652	4652
ICT services industries		
Software publishing	582	6202, 6203
Publishing of computer games	5821	6202P, 6203P
Other software publishing	5829	6202P, 6203P
Telecommunications	61	61
Wired telecommunications activities	611	6110, 6141
Wireless telecommunications activities	612	6120, 6142
Satellite telecommunications activities	613	6130, 6143
Other telecommunications activities	619	6190
Computer programming, consultancy and related activities	62	6201, 6204, 6209
Computer programming activities	6201	6201
Computer consultancy and computer facilities management activities	6202-6203	6204
Computer consultancy activities	6202	6204P
Computer facilities management activities	6203	6204P
Other information technology and computer service activities	6209	6209
Data processing, hosting and related activities; web portals	631	631
Data processing, hosting and related activities	6311	6311
Web portals	6312	6319
Repair of computers and communication equipment	951	951
Repair of computers and peripheral equipment	9511	9511
Repair of communication equipment	9512	9512

Table A III (cont.) Correspondences between NACE Rev. 2 and CNAE (Brazil)

RS SECTOR

	NACE Rev. 2	CNAE 2.0
Retail sale via mail order houses or via Internet	4791	4713P

MC SECTOR

	NACE Rev. 2	CNAE 2.0
MC sector		
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	5811, 5821
Publishing of directories and mailing lists	5812	5819, 5829
Publishing of newspapers, journals and periodicals	5813-5814	5812, 5813, 5822, 5823
Publishing of newspapers	5813	5812, 5822
Publishing of journals and periodicals	5814	5813, 5823
Other publishing activities	5819	5819, 5829
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	59
Motion picture, video and television programme activities	591	591
Motion picture, video and television programme production activities	5911	5911
Motion picture, video and television programme post-production activities	5912	5912
Motion picture, video and television programme distribution activities	5913	5913
Motion picture projection activities	5914	5914
Sound recording and music publishing activities	592	5920
Programming and broadcasting activities	60	60
Radio broadcasting	601	601
Television programming and broadcasting activities	602	602
Other information service activities		
News agency activities	6391	6391
Other information service activities n.e.c.	6399	6399

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

Source: Own elaboration

Table A IV Correspondences between NACE Rev. 2 and CSIC (China)

ICT SECTOR

	NACE Rev. 2	CSIC 2017
ICT manufacturing industries		
Manufacture of electronic components and boards	261	397, 398
Manufacture of electronic components	2611	397P, 398P
Manufacture of loaded electronic boards	2612	397P, 398P
Manufacture of computers and peripheral equipment	262	391
Manufacture of communication equipment	263	392, 393
Manufacture of consumer electronics	264	395, 396
Manufacture of magnetic and optical media	268	2664
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	5176
Wholesale of electronic and telecommunications equipment and parts	4652	5177
ICT services industries		
Software publishing	582	8625
Publishing of computer games	5821	8625P
Other software publishing	5829	8625P
Telecommunications	61	63
Wired telecommunications activities	611	6311, 6321
Wireless telecommunications activities	612	6312, 6322
Satellite telecommunications activities	613	633
Other telecommunications activities	619	6319
Computer programming, consultancy and related activities	62	65 (ex. 656, 657)
Computer programming activities	6201	651
Computer consultancy and computer facilities management activities	6202-6203	652-655
Computer consultancy activities	6202	652-655P
Computer facilities management activities	6203	652-655P
Other information technology and computer service activities	6209	659
Data processing, hosting and related activities; web portals	631	64, 656
Data processing, hosting and related activities	6311	64 (ex. 642), 656
Web portals	6312	642
Repair of computers and communication equipment	951	812
Repair of computers and peripheral equipment	9511	8121
Repair of communication equipment	9512	8122-8129

Table A IV (cont.) Correspondences between NACE Rev. 2 and CSIC (China)

RS SECTOR

	NACE Rev. 2	CSIC 2017
Retail sale via mail order houses or via Internet	4791	5292, 5293

MC SECTOR

	NACE Rev. 2	CSIC 2017
MC sector		
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	8621P
Publishing of directories and mailing lists	5812	8621P
Publishing of newspapers, journals and periodicals	5813-5814	8622, 8623
Publishing of newspapers	5813	8622P, 8623P
Publishing of journals and periodicals	5814	8622P, 8623P
Other publishing activities	5819	8626, 8629
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	873, 875-877
Motion picture, video and television programme activities	591	873, 875, 876
Motion picture, video and television programme production activities	5911	8730P
Motion picture, video and television programme post-production activities	5912	8730P
Motion picture, video and television programme distribution activities	5913	875
Motion picture projection activities	5914	876
Sound recording and music publishing activities	592	877
Programming and broadcasting activities	60	871, 872, 874
Radio broadcasting	601	871, 874P
Television programming and broadcasting activities	602	872, 874P
Other information service activities		
News agency activities	6391	861
Other information service activities n.e.c.	6399	657

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

Source: Own elaboration

Table A V Correspondences between NACE Rev.2 and JSIC (Japan)

a) ICT sector

	NACE Rev.2	JSIC Rev. 13
ICT manufacturing industries		
Manufacture of electronic components and boards	261	28 (ex. 283)
Manufacture of electronic components and boards	2611	28 (ex. 2814, 283, 284)
Manufacture of electronic components	2612	2814, 284
Manufacture of computers and peripheral equipment	262	303
Manufacture of communication equipment	263	301 (ex. 3014, 3015)
Manufacture of consumer electronics	264	3014, 302 (ex. 3022)
Manufacture of magnetic and optical media	268	2832
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	5432P
Wholesale of electronic and telecommunications equipment and parts	4652	5432P
ICT services industries		
Software publishing	582	3913, 3914
Publishing of computer games	5821	3913P
Other software publishing	5829	3913P, 3914
Telecommunications	61	37
Wired telecommunications activities	611	371
Wireless telecommunications activities	612	372P
Satellite telecommunications activities	613	372P
Other telecommunications activities	619	373
Computer programming, consultancy and related activities	62	3911, 3912
Computer programming activities	6201	3911P, 3912
Computer consultancy and computer facilities management activities	6202-6203	3911P
Computer consultancy activities	6202	3911P
Computer facilities management activities	6203	3911P
Other information technology and computer service activities	6209	3911P
Data processing, hosting and related activities; web portals	631	3921, 40 (ex. 4013)
Data processing, hosting and related activities	6311	3921, 4012
Web portals	6312	4011
Repair of computers and communication equipment	951	9021P
Repair of computers and peripheral equipment	9511	9021P
Repair of communication equipment	9512	9021P

Table A V (cont.) Correspondences between NACE Rev.2 and JSIC (Japan)

b) RS sector

	NACE Rev.2	JSIC Rev. 13
Retail sale via mail order houses or via Internet	4791	611P, 619P

c) MC sector

	NACE Rev.2	JSIC Rev. 13
MC sector		
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	414P
Publishing of directories and mailing lists	5812	414P
Publishing of newspapers, journals and periodicals	5813-5814	414P, 415
Publishing of newspapers	5813	414P
Publishing of journals and periodicals	5814	414P
Other publishing activities	5819	415
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	42
Motion picture, video and television programme activities	591	411, 4169P
Motion picture, video and television programme production activities	5911	4111, 4112
Motion picture, video and television programme post-production activities	5912	4113, 4169P
Motion picture, video and television programme distribution activities	5913	4114
Motion picture projection activities	5914	4114
Sound recording and music publishing activities	592	412, 4169P
Programming and broadcasting activities	60	381, 382
Radio broadcasting	601	3822
Television programming and broadcasting activities	602	381, 3821, 3823, 3829
Other information service activities		
News agency activities	6391	4161
Other information service activities n.e.c.	6399	3922, 3929, 4013

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

Source: Own elaboration

Table A VI Correspondences between NACE Rev.2 and KSIC (South Korea)

a) ICT sector

	NACE Rev.2	KSIC Rev. 10
ICT manufacturing industries		
Manufacture of electronic components and boards	261	261, 262
Manufacture of electronic components and boards	2611	261, 262 (ex. 2622)
Manufacture of electronic components	2612	2622
Manufacture of computers and peripheral equipment	262	263
Manufacture of communication equipment	263	264
Manufacture of consumer electronics	264	265
Manufacture of magnetic and optical media	268	266
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	4651
Wholesale of electronic and telecommunications equipment and parts	4652	4652
ICT services industries		
Software publishing	582	582
Publishing of computer games	5821	5821
Other software publishing	5829	5822
Telecommunications	61	612
Wired telecommunications activities	611	6121
Wireless telecommunications activities	612	6122
Satellite telecommunications activities	613	6123
Other telecommunications activities	619	6129
Computer programming, consultancy and related activities	62	62
Computer programming activities	6201	6201
Computer consultancy and computer facilities management activities	6202-6203	6202
Computer consultancy activities	6202	62021
Computer facilities management activities	6203	62022
Other information technology and computer service activities	6209	6209
Data processing, hosting and related activities; web portals	631	631
Data processing, hosting and related activities	6311	6312
Web portals	6312	6311
Repair of computers and communication equipment	951	9511, 9512
Repair of computers and peripheral equipment	9511	9511
Repair of communication equipment	9512	9512

Table A VI (cont.) Correspondences between NACE Rev.2 and KSIC (South Korea)

b) RS sector

	NACE Rev.2	KSIC Rev. 10
Retail sale via mail order houses or via Internet	4791	4791

c) MC sector

	NACE Rev.2	KSIC Rev. 10
MC sector		
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	58111, 58112
Publishing of directories and mailing lists	5812	58113
Publishing of newspapers, journals and periodicals	5813-5814	5812
Publishing of newspapers	5813	58121
Publishing of journals and periodicals	5814	58122-58123
Other publishing activities	5819	5819
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	59
Motion picture, video and television programme activities	591	591
Motion picture, video and television programme production activities	5911	5911
Motion picture, video and television programme post-production activities	5912	5912
Motion picture, video and television programme distribution activities	5913	5913
Motion picture projection activities	5914	5914
Sound recording and music publishing activities	592	592
Programming and broadcasting activities	60	60
Radio broadcasting	601	601
Television programming and broadcasting activities	602	602
Other information service activities		
News agency activities	6391	6391
Other information service activities n.e.c.	6399	6399

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

Source: Own elaboration

Table A VII Correspondences between NACE Rev.2 and SIC (Taiwan)

a) ICT sector

	NACE Rev.2	SIC (9th version)
ICT manufacturing industries		
Manufacture of electronic components and boards	261	26
Manufacture of electronic components and boards	2611	2691, 2699P
Manufacture of electronic components	2612	26 (ex. 2691, 2699P)
Manufacture of computers and peripheral equipment	262	271
Manufacture of communication equipment	263	272
Manufacture of consumer electronics	264	273
Manufacture of magnetic and optical media	268	274
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	4641P
Wholesale of electronic and telecommunications equipment and parts	4652	4641P
ICT services industries		
Software publishing	582	582
Publishing of computer games	5821	-
Other software publishing	5829	-
Telecommunications	61	61
Wired telecommunications activities	611	-
Wireless telecommunications activities	612	-
Satellite telecommunications activities	613	-
Other telecommunications activities	619	-
Computer programming, consultancy and related activities	62	62
Computer programming activities	6201	6201
Computer consultancy and computer facilities management activities	6202-6203	6202
Computer consultancy activities	6202	-
Computer facilities management activities	6203	-
Other information technology and computer service activities	6209	6209
Data processing, hosting and related activities; web portals	631	631
Data processing, hosting and related activities	6311	6312
Web portals	6312	6311
Repair of computers and communication equipment	951	952
Repair of computers and peripheral equipment	9511	9521
Repair of communication equipment	9512	9522

Table A VII (cont.) Correspondences between NACE Rev.2 and SIC (Taiwan)

b) RS sector

	NACE Rev.2	SIC (9th version)
Retail sale via mail order houses or via Internet	4791	4874

c) MC sector

	NACE Rev.2	SIC (9th version)
MC sector		
Publishing of books, periodicals and other publishing activities	**581**	**581**
Book publishing	5811	5813
Publishing of directories and mailing lists	5812	5819P
Publishing of newspapers, journals and periodicals	5813-5814	5811, 5812
Publishing of newspapers	5813	5811
Publishing of journals and periodicals	5814	5812
Other publishing activities	5819	5819P
Audiovisual and broadcasting activities	**59-60**	**59-60**
Motion picture, video and television programme production, sound recording and music publishing activities	59	59
Motion picture, video and television programme activities	591	591
Motion picture, video and television programme production activities	5911	5911
Motion picture, video and television programme post-production activities	5912	5912
Motion picture, video and television programme distribution activities	5913	5913
Motion picture projection activities	5914	5914
Sound recording and music publishing activities	592	592
Programming and broadcasting activities	60	60
Radio broadcasting	601	601
Television programming and broadcasting activities	602	602
Other information service activities	**639**	**639**
News agency activities	6391	6391
Other information service activities n.e.c.	6399	6399

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

Source: Own elaboration

Table A VIII Correspondences between NACE Rev.2 and NAICS (US and Canada)

a) ICT sector

	NACE Rev.2	NAICS2012
ICT manufacturing industries		
Manufacture of electronic components and boards	261	3344
Manufacture of electronic components and boards	2611	334412-334417; 334419
Manufacture of electronic components	2619	334418
Manufacture of computers and peripheral equipment	262	3341
Manufacture of communication equipment	263	3342
Manufacture of consumer electronics	264	3343
Manufacture of magnetic and optical media	268	3346
ICT trade industries		
Wholesale of computers, computer peripheral equipment and software	4651	42343 (41731 in Canada)
Wholesale of electronic and telecommunications equipment and parts	4652	4236P (41732 in Canada)
ICT services industries		
Software publishing	582	5112
Publishing of computer games	5821	5112P
Other software publishing	5829	5112P
Telecommunications	61	517
Wired telecommunications activities	611	5171
Wireless telecommunications activities	612	5172
Satellite telecommunications activities	613	5174
Other telecommunications activities	619	5179
Computer programming, consultancy and related activities	62	5415
Computer programming activities	6201	541511
Computer consultancy and computer facilities management activities	6202-6203	541512, 541513
Computer consultancy activities	6202	541512
Computer facilities management activities	6203	541513
Other information technology and computer service activities	6209	541519
Data processing, hosting and related activities; web portals	631	5182
Data processing, hosting and related activities	6311	5182P
Web portals	6312	5182P
Repair of computers and communication equipment	951	811212, 811213
Repair of computers and peripheral equipment	9511	811212
Repair of communication equipment	9512	811213

Table A VIII (cont.) Correspondences between NACE Rev.2 and NAICS (US and Canada)

b) RS sector

	NACE Rev.2	NAICS2007
Retail sale via mail order houses or via Internet	4791	4541

c) MC sector

	NACE Rev.2	NAICS2007
MC sector		
Publishing of books, periodicals and other publishing activities		
Book publishing	5811	51113
Publishing of directories and mailing lists	5812	51114
Publishing of newspapers, journals and periodicals	5813-5814	51111, 51112
Publishing of newspapers	5813	51111
Publishing of journals and periodicals	5814	51112
Other publishing activities	5819	51119
Audiovisual and broadcasting activities		
Motion picture, video and television programme production, sound recording and music publishing activities	59	512
Motion picture, video and television programme activities	591	5121
Motion picture, video and television programme production activities	5911	51211
Motion picture, video and television programme post-production activities	5912	51219
Motion picture, video and television programme distribution activities	5913	51212
Motion picture projection activities	5914	51213
Sound recording and music publishing activities	592	5122
Programming and broadcasting activities	60	515
Radio broadcasting	601	51511
Television programming and broadcasting activities	602	51512, 5152
Other information service activities		
News agency activities	6391	51911
Other information service activities n.e.c.	6399	51919

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

Source: Own elaboration

Annex II: Regression Tables

Table A1.a. Description of the estimation models for GVA. Total ICT sector (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed	2	Yes	Yes	OLS	0.589	362.499	546.446
BE	Persons employed, GVA	0	Yes	No	OLS	0.575	321.762	364.644
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.814	105.807	441.896
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.888	20.251	22.842
CZ	Persons employed, GVA	0	Yes	No	OLS	0.796	248.415	737.748
DE	Persons employed	0	Yes	No	OLS	0.309	3 805.926	3 699.806
DK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.343	262.650	146.885
EE	Persons employed, GVA	0	Yes	Yes	OLS	0.789	29.317	113.652
EL	Persons employed, GVA	1	No	No	OLS	0.749	291.928	142.054
ES	Persons employed, GVA	2	Yes	No	OLS	0.420	945.184	528.555
FI	Persons employed, GVA	3	No	No	OLS	0.761	857.135	339.166
FR	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.626	1 695.049	2 408.861
HR	Persons employed, GVA	3	No	No	OLS	0.559	69.950	51.753
HU	Persons employed, GVA	3	No	Yes	OLS	0.471	265.665	494.517
IE	*Model not estimated because there is a break in the series of the dependent variable*							
IT	Persons employed, GVA	3	No	Yes	OLS	0.627	1 391.347	498.917
LT	Persons employed, GVA	2	Yes	Yes	OLS	0.422	47.938	82.477
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.557	100.839	88.566
LV	Persons employed, GVA	3	No	Yes	OLS	0.644	42.749	41.548
MT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.815	29.955	5.349
NL	Persons employed, GVA	Step dummy from 2010	Yes	No	OLS	0.429	951.910	907.128
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.530	496.455	679.780
PT	Persons employed, GVA	2	Yes	No	OLS	0.646	151.407	374.559
RO	Persons employed, GVA	1	Yes	Yes	OLS	0.720	386.205	396.974
SE	Persons employed, GVA	1	Yes	No	OLS	0.799	935.067	1 401.145
SI	Persons employed, GVA	0	Yes	No	OLS	0.648	32.615	18.489
SK	Persons employed, GVA	2	Yes	No	OLS	0.663	107.637	126.195
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.709**	**7 544.938**	**16 439.440**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.767**	**9 230.164**	**19 930.030**

Table A1.b. Description of the estimation models for GVA. Total ICT sector (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed	2	Yes	Yes	OLS	0.646	310.068	438.367
BE	Persons employed, GVA	0	Yes	No	OLS	0.553	271.980	334.417
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.828	100.031	441.046
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.895	19.399	25.081
CZ	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.870	194.018	474.051
DE	Persons employed	0	Yes	No	OLS	0.241	4 005.208	3 330.770
DK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.385	240.388	106.316
EE	Persons employed, GVA	0	Yes	Yes	OLS	0.822	26.404	109.774
EL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.589	306.479	214.348
ES	Persons employed, GVA	2	Yes	No	OLS	0.370	875.989	332.605
FI	Persons employed, GVA	3	No	No	OLS	0.759	841.906	234.731
FR	Persons employed, GVA	2	Yes	No	OLS	0.697	1 391.952	2 311.900
HR	Persons employed, GVA	3	No	No	OLS	0.612	63.981	75.791
HU	Persons employed, GVA	3	No	Yes	OLS	0.404	283.185	502.241
IE	*Model not estimated because there is a break in the series of the dependent variable*							
IT	Persons employed, GVA	3	No	Yes	OLS	0.676	1 300.514	310.984
LT	Persons employed, GVA	2	Yes	Yes	OLS	0.374	47.825	91.086
LU	Persons employed, GVA	1	Yes	No	OLS	0.210	97.696	40.362
LV	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.559	43.109	5.791
MT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.816	29.270	3.685
NL	Persons employed, GVA	Step dummy from 2010	Yes	No	OLS	0.706	475.399	814.031
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.539	469.953	687.173
PT	Persons employed, GVA	0	Yes	No	OLS	0.682	131.120	368.498
RO	Persons employed, GVA	1	Yes	Yes	OLS	0.727	384.745	365.402
SE	Persons employed, GVA	1	Yes	No	OLS	0.791	912.604	1 421.404
SI	Persons employed, GVA	0	Yes	No	OLS	0.710	27.292	34.973
SK	Persons employed, GVA	1	Yes	No	OLS	0.598	116.201	109.629
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.695**	**7 334.261**	**15 362.350**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.768**	**11 651.541**	**18 815.020**
UK	Persons employed, GVA	1	Yes	Yes	OLS	0.887	2 325.582	2 760.873
AU	Persons employed, GVA	3	No	Yes	OLS	0.828	934.367	655.338
CA	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.898	844.530	802.529
JP	Persons employed, GVA	3	No	Yes	OLS	0.946	6 522.907	5 448.056
KR	Persons employed, GVA	1	Yes	No	OLS	0.978	1 566.273	A1 637.539
TW	Persons employed, GVA	3	No	No	OLS	0.861	1 638.455	1 392.734
US	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.954	12 256.170	7 144.795

Note: NACE sectors C26+J for CA, JP and US for the predictor of Persons employed.

Table A1.c. Description of the estimation models for GVA. ICT manufacturing (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.884	106.023	147.656
BE	Persons employed, GVA	2	No	Yes	OLS	0.561	108.974	32.198
BG	Persons employed	0	Yes	No	OLS	0.440	11.082	32.412
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.232	5.839	13.029
CZ	Persons employed	3	No	Yes	OLS	0.605	69.289	69.109
DE	Persons employed, GVA	3	No	No	OLS	0.645	1 329.710	1 319.993
DK	Persons employed, GVA	3	No	No	OLS	0.398	77.031	5.618
EE	Persons employed, GVA	2	Yes	No	OLS	0.648	14.785	13.482
EL	Persons employed, GVA	3	No	Yes	OLS	0.255	45.655	30.371
ES	Persons employed, GVA	1	No	Yes	OLS	0.393	133.133	144.329
FI	Persons employed, GVA	3	No	Yes	OLS	0.771	790.065	484.886
FR	Persons employed, GVA	0	Yes	No	OLS	0.701	535.454	2 168.042
HR	Persons employed, GVA	3	No	Yes	OLS	0.708	20.793	63.728
HU	Persons employed, GVA	2	Yes	No	OLS	0.553	162.712	403.358
IE	*Model not estimated because there is a break in the series of the dependent variable*							
IT	Persons employed, GVA	2	No	Yes	OLS	0.433	254.680	113.152
LT	Persons employed, GVA	3	No	No	OLS	0.317	13.502	20.418
LU	Persons employed	3	No	No	OLS	0.603	1.522	0.543
LV	Persons employed	3	No	Yes	OLS	0.795	10.071	30.168
MT	Persons employed, GVA	3	No	Yes	OLS	0.697	21.032	16.623
NL	Persons employed, GVA	2	No	No	OLS	0.357	311.422	155.444
PL	Persons employed, GVA	2	Yes	No	OLS	0.260	134.295	165.081
PT	GVA	2	No	Yes	OLS	0.833	30.803	20.915
RO	Persons employed, GVA	3	No	Yes	OLS	0.925	76.755	21.000
SE	Persons employed, GVA	3	No	No	OLS	0.836	589.889	36.288
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.209	15.896	13.790
SK	Persons employed	2	Yes	No	OLS	0.546	78.734	32.704
EU27_2020	**GVA**	**2**	**No**	**No**	**OLS**	**0.641**	**3 300.444**	**1 532.181**
EU28	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.671**	**3 459.651**	**2 569.638**

Table A1.d. Description of the estimation models for GVA. ICT manufacturing (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.884	106.023	147.656
BE	Persons employed, GVA	2	No	Yes	OLS	0.562	108.852	32.319
BG	Persons employed	0	Yes	No	OLS	0.427	11.049	31.679
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.242	5.676	13.060
CZ	Persons employed	3	No	Yes	OLS	0.591	69.869	70.647
DE	Persons employed, GVA	3	No	No	OLS	0.649	1 315.358	1 327.239
DK	Persons employed, GVA	3	No	No	OLS	0.397	76.981	5.351
EE	Persons employed, GVA	2	Yes	No	OLS	0.648	14.788	13.481
EL	Persons employed, GVA	3	No	Yes	OLS	0.257	45.528	30.428
ES	Persons employed, GVA	1	No	Yes	OLS	0.393	133.133	144.329
FI	Persons employed, GVA	3	No	Yes	OLS	0.771	790.076	484.771
FR	Persons employed, GVA	0	Yes	No	OLS	0.700	535.331	2 173.099
HR	Persons employed, GVA	3	No	Yes	OLS	0.708	20.792	63.729
HU	Persons employed, GVA	2	Yes	No	OLS	0.553	162.708	402.993
IE	*Model not estimated because there is a break in the series of the dependent variable*							
IT	Persons employed, GVA	2	No	Yes	OLS	0.425	257.785	110.740
LT	Persons employed, GVA	3	No	No	OLS	0.321	13.407	20.692
LU	Persons employed	3	No	No	OLS	0.603	1.522	0.543
LV	Persons employed	3	No	Yes	OLS	0.795	10.071	30.168
MT	Persons employed, GVA	3	No	Yes	OLS	0.697	21.032	16.623
NL	Persons employed, GVA	2	No	No	OLS	0.357	312.052	159.657
PL	Persons employed, GVA	1	Yes	No	OLS	0.253	134.384	161.920
PT	GVA	2	No	Yes	OLS	0.833	30.803	20.915
RO	Persons employed, GVA	3	No	Yes	OLS	0.925	76.764	20.982
SE	Persons employed, GVA	3	No	No	OLS	0.837	589.734	36.278
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.212	15.938	13.661
SK	Persons employed	2	Yes	No	OLS	0.546	78.732	32.688
EU27_2020	**GVA**	**2**	**No**	**No**	**OLS**	**0.644**	**3 283.757**	**1 523.124**
EU28	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.675**	**3 436.649**	**2 569.160**
UK	Persons employed, GVA	2	No	No	OLS	0.476	710.890	98.596
AU	Persons employed, GVA	3	No	No	OLS	0.516	99.565	129.499
CA	Persons employed, GVA	0	No	No	OLS	0.270	373.695	19.655
JP	Persons employed, GVA	0	No	Yes	OLS	0.634	A1 542.990	6 125.124
KR	Persons employed, GVA	1	Yes	No	OLS	0.979	1 310.057	10 209.020
TW	Persons employed, GVA	2	Yes	Yes	OLS	0.790	1 738.259	647.642
US	Persons employed, GVA	3	No	No	OLS	0.918	5 211.698	1 529.439

Note: NACE sector C26 for CA, JP and US for the predictor of Persons employed.

Table A1.e. Description of the estimation models for GVA. ICT total services, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	0	Yes	Yes	OLS	0.893	123.316	144.453
BE	Persons employed, GVA	0	Yes	No	OLS	0.606	292.726	309.482
BG	Persons employed, GVA	0	Yes	No	OLS	0.977	37.160	100.560
CY	Persons employed, GVA	0	Yes	No	OLS	0.975	9.781	1.519
CZ	Persons employed, GVA	3	No	Yes	OLS	0.990	51.121	22.296
DE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.861	1 492.805	851.684
DK	Persons employed	3	No	No	OLS	0.272	242.699	286.182
EE	Persons employed	0	Yes	Yes	OLS	0.721	30.178	142.447
EL	Persons employed, GVA	1	No	No	OLS	0.964	112.300	15.769
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.901	385.131	82.636
FI	Persons employed, GVA	2	Yes	No	OLS	0.936	99.244	342.031
FR	Persons employed	Step dummy from 2010	No	No	OLS	0.234	1 927.897	2 010.140
HR	Persons employed, GVA	1	Yes	No	OLS	0.926	24.313	4.085
HU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.815	88.724	24.615
IE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.971	479.568	287.920
IT	Persons employed, GVA	2	No	Yes	OLS	0.924	595.654	479.531
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.926	15.984	13.441
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.897	48.231	81.033
LV	Persons employed, GVA	0	Yes	Yes	OLS	0.940	16.152	38.001
MT	Persons employed, GVA	2	Yes	Yes	OLS	0.968	9.391	17.656
NL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.619	706.539	84.010
PL	Persons employed, GVA	2	Yes	Yes	OLS	0.885	242.690	213.336
PT	Persons employed, GVA	2	Yes	No	OLS	0.922	66.922	108.160
RO	Persons employed, GVA	1	Yes	No	OLS	0.990	62.141	280.464
SE	Persons employed	1	Yes	No	OLS	0.307	981.411	1 259.012
SI	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.814	21.279	8.628
SK	Persons employed, GVA	1	Yes	No	OLS	0.892	43.585	83.651
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.976**	**1 722.224**	**2 271.075**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.967**	**2 809.730**	**3 548.742**

Table A1.f. Description of the estimation models for GVA. ICT trade industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.703	59.198	75.604
BE	Persons employed, GVA	2	Yes	No	OLS	0.579	169.464	230.692
BG	Persons employed, GVA	3	No	No	OLS	0.701	8.238	6.542
CY	Persons employed, GVA	3	No	No	OLS	0.491	3.820	1.014
CZ	Persons employed, GVA	1	Yes	Yes	OLS	0.660	24.207	32.864
DE	Persons employed, GVA	3	No	Yes	OLS	0.382	638.293	406.887
DK	Persons employed, GVA	3	No	No	OLS	0.531	50.011	11.785
EE	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.374	6.654	4.345
EL	Persons employed, GVA	3	No	No	OLS	0.947	36.199	23.833
ES	Persons employed, GVA	3	No	No	OLS	0.694	118.208	202.695
FI	Persons employed, GVA	3	No	Yes	OLS	0.726	40.485	68.539
FR	Persons employed	3	No	Yes	OLS	0.587	268.291	299.712
HR	Persons employed, GVA	2	Yes	No	OLS	0.613	10.359	27.399
HU	Persons employed, GVA	3	No	Yes	OLS	0.639	22.665	4.365
IE	Persons employed, GVA	2	Yes	No	OLS	0.505	296.161	587.744
IT	Persons employed, GVA	3	No	Yes	OLS	0.593	304.555	156.615
LT	Persons employed, GVA	2	Yes	Yes	OLS	0.684	5.933	19.078
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.828	31.648	78.273
LV	Persons employed, GVA	0	Yes	No	OLS	0.648	9.261	36.783
MT	Persons employed, GVA	3	No	No	OLS	0.842	1.725	8.902
NL	Persons employed, GVA	3	No	Yes	OLS	0.739	335.980	44.197
PL	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.464	87.806	62.640
PT	Persons employed, GVA	2	Yes	No	OLS	0.716	34.751	42.630
RO	GVA	2	Yes	Yes	OLS	0.777	32.961	61.869
SE	Persons employed, GVA	2	Yes	No	OLS	0.783	64.884	241.016
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.326	8.061	14.298
SK	Persons employed, GVA	3	No	No	OLS	0.588	17.185	26.794
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.201**	**1 557.842**	**1 061.563**
EU28	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.537**	**1 794.047**	**1 011.413**

Table A1.g. Description of the estimation models for GVA. ICT services industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.962	65.449	28.289
BE	Persons employed, GVA	0	Yes	No	OLS	0.914	115.995	71.261
BG	Persons employed, GVA	0	Yes	No	OLS	0.980	34.342	99.433
CY	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.993	5.221	7.280
CZ	Persons employed, GVA	3	No	Yes	OLS	0.993	40.364	104.802
DE	Persons employed, GVA	0	Yes	Yes	OLS	0.901	1 230.011	819.497
DK	Persons employed, GVA	3	No	Yes	OLS	0.894	93.495	57.925
EE	Persons employed, GVA	0	Yes	Yes	OLS	0.991	5.304	6.166
EL	Persons employed, GVA	1	No	No	OLS	0.949	110.003	68.990
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.936	272.136	97.043
FI	Persons employed, GVA	0	Yes	No	OLS	0.958	75.462	455.013
FR	Persons employed	Step dummy from 2010	No	No	OLS	0.206	1 771.077	1 477.813
HR	Persons employed, GVA	3	No	Yes	OLS	0.928	23.236	19.078
HU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.805	90.186	17.126
IE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.994	213.723	176.059
IT	Persons employed, GVA	2	Yes	No	OLS	0.978	320.015	304.580
LT	GVA	Step dummy from 2010	No	Yes	OLS	0.944	13.205	3.503
LU	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.885	37.069	17.377
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.953	13.159	2.399
MT	Persons employed, GVA	2	Yes	No	OLS	0.976	7.776	10.142
NL	Persons employed, GVA	0	Yes	No	OLS	0.984	106.336	72.130
PL	Persons employed, GVA	3	No	Yes	OLS	0.875	239.053	105.612
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.966	40.029	48.015
RO	Persons employed, GVA	0	Yes	No	OLS	0.979	86.376	318.219
SE	Persons employed, GVA	3	No	Yes	OLS	0.955	238.344	598.802
SI	Persons employed, GVA	0	Yes	No	OLS	0.834	18.254	29.237
SK	Persons employed, GVA	1	Yes	No	OLS	0.863	47.060	48.327
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.966**	**1 970.853**	**1 852.811**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.973**	**2 355.032**	**2 657.911**
UK	Persons employed, GVA	0	Yes	No	OLS	0.986	780.943	1 047.713
AU	Persons employed, GVA	0	Yes	Yes	OLS	0.889	727.821	660.677
CA	Persons employed, GVA	0	Yes	No	OLS	0.951	519.052	197.127
JP	Persons employed, GVA	3	No	No	OLS	0.996	1 167.676	477.719
KR	Persons employed, GVA	0	Yes	No	OLS	0.997	183.655	402.860
TW	GVA	0	Yes	Yes	OLS	0.995	70.320	64.760
US	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.977	7 033.933	3 086.586

Table A1.h. Description of the estimation models for GVA. IT services (Telecommunications), PREDICT 2022

Country	Predictors	Estimation method

	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend		Adjusted R^2 for the model of the whole period	RMSE$_{9519}$ (Estimation for the whole period)	RMSE$_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	3	No	No	OLS	0.710	108.110	102.319
BE	Persons employed, GVA	1	Yes	Yes	OLS	0.661	136.214	53.280
BG	Persons employed, GVA	3	No	No	OLS	0.809	65.425	7.104
CY	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.320	18.639	20.842
CZ	Persons employed	3	No	No	OLS	0.252	165.233	62.309
DE	Persons employed, GVA	3	No	No	OLS	0.539	1 809.999	1 244.325
DK	Persons employed, GVA	3	No	No	OLS	0.623	117.395	17.669
EE	Persons employed, GVA	3	No	No	OLS	0.219	14.571	3.978
EL	Persons employed, GVA	1	Yes	No	OLS	0.849	168.388	47.137
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.832	316.865	636.960
FI	Persons employed, GVA	3	No	Yes	OLS	0.915	73.677	22.285
FR	Persons employed, GVA	3	No	Yes	OLS	0.788	640.342	201.302
HR	Persons employed, GVA	3	No	Yes	OLS	0.887	25.044	2.573
HU	Persons employed, GVA	3	No	No	OLS	0.720	83.006	28.102
IE	Persons employed, GVA	3	No	No	OLS	0.501	231.090	260.333
IT	Persons employed	3	No	No	OLS	0.650	905.675	755.374
LT	Persons employed, GVA	1	No	Yes	OLS	0.794	20.501	35.059
LU	Persons employed, GVA	3	No	Yes	OLS	0.821	40.232	6.799
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.875	13.812	25.340
MT	Persons employed, GVA	0	Yes	No	OLS	0.852	8.081	8.056
NL	Persons employed, GVA	3	No	No	OLS	0.771	257.260	146.575
PL	Persons employed, GVA	0	No	Yes	OLS	0.740	223.979	299.692
PT	Persons employed, GVA	3	No	Yes	OLS	0.873	55.437	45.905
RO	Persons employed, GVA	3	No	Yes	OLS	0.549	201.243	460.612
SE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.424	228.195	201.978
SI	Persons employed, GVA	3	No	Yes	OLS	0.798	14.056	15.394
SK	Persons employed, GVA	3	No	Yes	OLS	0.468	36.827	76.173
EU27_2020	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.792**	**3 236.686**	**4 221.808**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.787**	**3 915.434**	**4 819.118**
UK	Persons employed	2	Yes	No	OLS	0.311	2 441.845	2 223.868
AU	Persons employed, GVA	1	Yes	No	OLS	0.897	326.097	319.557
CA	Persons employed, GVA	3	No	Yes	OLS	0.943	362.181	301.853
JP	Persons employed, GVA	3	No	Yes	OLS	0.993	748.734	570.057
KR	Persons employed, GVA	1	No	No	OLS	1.000	0.064	0.056
TW	Persons employed, GVA	0	Yes	Yes	OLS	0.962	94.758	133.627
US	Persons employed, GVA	2	Yes	Yes	OLS	0.889	7 082.547	3 908.752

Note: NACE sector J61 for CA, JP and US for the predictor Persons employed. NACE sector J61 for JP, KR and US for the predictor GVA.

Table A1.i. Description of the estimation models for GVA. IC services (Computer and related activities), PREDICT 2022

Country	Predictors	Estimation method

	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend		Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	0	Yes	Yes	OLS	0.793	103.952	96.834
BE	Persons employed, GVA	2	Yes	Yes	OLS	0.855	123.616	84.485
BG	Persons employed, GVA	0	Yes	Yes	OLS	0.828	64.915	173.670
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.910	18.415	23.882
CZ	Persons employed, GVA	0	Yes	Yes	OLS	0.966	71.352	329.272
DE	Persons employed, GVA	0	Yes	Yes	OLS	0.688	1 339.788	962.553
DK	Persons employed, GVA	2	Yes	No	OLS	0.475	190.097	20.071
EE	Persons employed, GVA	0	Yes	Yes	OLS	0.959	10.950	18.087
EL	Persons employed, GVA	1	No	No	OLS	0.476	85.903	17.167
ES	Persons employed, GVA	0	Yes	Yes	OLS	0.667	333.544	460.647
FI	Persons employed, GVA	0	Yes	Yes	OLS	0.678	144.893	427.265
FR	Persons employed	Step dummy from 2010	No	No	OLS	0.526	1 055.715	506.861
HR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.520	27.746	31.667
HU	Persons employed, GVA	0	Yes	Yes	OLS	0.827	41.477	44.384
IE	Persons employed, GVA	3	No	No	OLS	0.979	399.280	577.221
IT	Persons employed	2	Yes	No	OLS	0.538	626.391	690.245
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.865	17.175	41.416
LU	Persons employed, GVA	0	Yes	Yes	OLS	0.457	49.936	32.961
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.824	18.026	25.294
MT	Persons employed, GVA	2	Yes	No	OLS	0.879	11.034	13.833
NL	Persons employed, GVA	3	No	Yes	OLS	0.818	286.108	206.726
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.749	247.403	297.701
PT	Persons employed, GVA	0	Yes	Yes	OLS	0.916	45.009	156.097
RO	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.880	175.796	131.815
SE	Persons employed, GVA	2	Yes	Yes	OLS	0.915	315.052	430.130
SI	Persons employed, GVA	0	Yes	Yes	OLS	0.859	10.916	20.847
SK	Persons employed, GVA	3	No	Yes	OLS	0.744	57.935	18.310
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.893**	**2 456.196**	**6 618.227**
EU28	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.905**	**2 914.519**	**8 570.212**
UK	Persons employed, GVA	0	Yes	No	OLS	0.914	1 162.253	1 615.742
AU	Persons employed, GVA	0	Yes	Yes	OLS	0.771	641.499	1 190.547
CA	Persons employed, GVA	1	Yes	Yes	OLS	0.871	367.373	1.623
JP	Persons employed, GVA	3	No	Yes	OLS	0.990	957.416	623.321
KR	Persons employed, GVA	0	Yes	No	OLS	0.991	158.852	435.471
TW	GVA	0	Yes	Yes	OLS	0.883	127.737	179.139
US	Persons employed, GVA	1	Yes	Yes	OLS	0.942	6 724.367	9 381.865

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A1.j. Description of the estimation models for GVA. Media and content Sector, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.408	53.280	12.615
BE	Persons employed, GVA	3	No	Yes	OLS	0.461	74.044	38.086
BG	Persons employed, GVA	3	No	No	OLS	0.727	18.422	69.941
CY	Persons employed, GVA	2	No	No	OLS	0.476	6.014	0.139
CZ	Persons employed, GVA	1	Yes	Yes	OLS	0.720	40.311	109.167
DE	Persons employed, GVA	1	No	Yes	OLS	0.497	974.508	757.132
DK	Persons employed, GVA	2	Yes	No	OLS	0.324	90.897	73.067
EE	Persons employed, GVA	2	Yes	No	OLS	0.731	4.612	0.734
EL	Persons employed, GVA	1	No	Yes	OLS	0.797	115.977	50.643
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.515	254.770	107.687
FI	Persons employed, GVA	2	Yes	Yes	OLS	0.856	73.395	445.657
FR	Persons employed, GVA	2	Yes	No	OLS	0.153	432.820	295.108
HR	Persons employed, GVA	3	No	Yes	OLS	0.960	7.115	2.716
HU	Persons employed, GVA	3	No	Yes	OLS	0.602	64.469	10.115
IE	Persons employed, GVA	3	No	No	OLS	0.486	150.941	150.216
IT	Persons employed, GVA	2	Yes	No	OLS	0.770	294.367	383.381
LT	Persons employed, GVA	3	No	Yes	OLS	0.726	8.437	3.330
LU	Persons employed, GVA	1	Yes	No	OLS	0.196	32.994	9.292
LV	Persons employed, GVA	3	No	Yes	OLS	0.819	7.895	4.994
MT	Persons employed, GVA	3	No	No	OLS	0.628	4.424	11.732
NL	Persons employed, GVA	2	Yes	No	OLS	0.567	92.946	78.974
PL	Persons employed, GVA	3	No	Yes	OLS	0.858	131.187	163.910
PT	Persons employed, GVA	3	No	Yes	OLS	0.684	29.572	31.467
RO	GVA	3	No	No	OLS	0.878	53.561	285.067
SE	Persons employed, GVA	2	Yes	Yes	OLS	0.777	220.239	543.752
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.303	20.911	27.546
SK	Persons employed, GVA	1	No	Yes	OLS	0.644	37.356	30.608
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.573**	**1 729.113**	**631.592**
EU28	**Persons employed, GVA**	**3**	**No**	**Yes**	**OLS**	**0.797**	**1 935.237**	**779.260**
UK	Persons employed, GVA	2	Yes	No	OLS	0.940	635.056	1 013.847
AU	Persons employed, GVA	0	Yes	No	OLS	0.853	268.644	162.291
CA	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.837	245.939	1.648
JP	Persons employed, GVA	1	No	No	OLS	0.864	1 484.567	953.747
KR	Persons employed, GVA	0	Yes	Yes	OLS	0.953	146.693	415.430
TW	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.807	64.127	62.528
US	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.884	6 724.804	3 211.375

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A1.k. Description of the estimation models for GVA. Retail sale sector, PREDICT 2022

Country	Predictors	Estimation method

	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend		Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	3	No	Yes	OLS	0.778	11.977	4.061
BE	Persons employed, GVA	2	Yes	Yes	OLS	0.995	16.258	546.823
BG	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.587	3.893	5.720
CY	Persons employed, GVA	2	Yes	No	OLS	0.463	0.343	0.655
CZ	Persons employed, GVA	0	Yes	Yes	OLS	0.693	17.855	47.523
DE	Persons employed, GVA	2	Yes	Yes	OLS	0.378	620.846	943.508
DK	Persons employed, GVA	0	Yes	Yes	OLS	0.455	15.571	26.662
EE	Persons employed, GVA	3	No	No	OLS	0.659	3.208	10.294
EL	Persons employed, GVA	1	Yes	Yes	OLS	0.833	4.121	19.501
ES	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.182	51.989	13.677
FI	Persons employed, GVA	3	No	Yes	OLS	0.286	6.069	4.957
FR	Persons employed, GVA	2	Yes	No	OLS	0.615	119.898	290.721
HR	Persons employed, GVA	3	No	No	OLS	0.842	1.162	0.365
HU	Persons employed, GVA	0	Yes	Yes	OLS	0.811	5.225	26.226
IE	Persons employed, GVA	3	No	No	OLS	0.674	31.824	23.299
IT	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.538	116.590	50.796
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.499	6.523	13.615
LU	Persons employed, GVA	3	No	No	OLS	0.424	8.192	14.436
LV	Persons employed, GVA	3	Yes	No	OLS	0.730	4.651	11.244
MT	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.287	6.560	1.628
NL	Persons employed, GVA	0	Yes	Yes	OLS	0.356	89.675	157.230
PL	Persons employed, GVA	3	No	Yes	OLS	0.641	74.430	104.523
PT	Persons employed, GVA	3	No	Yes	OLS	0.506	2.621	5.041
RO	Persons employed, GVA	Step dummy from 2010	Yes	No	OLS	0.735	34.335	120.535
SE	Persons employed, GVA	2	Yes	Yes	OLS	0.662	29.292	74.042
SI	Persons employed, GVA	3	No	Yes	OLS	0.769	5.458	6.870
SK	Persons employed, GVA	2	No	No	OLS	0.446	17.452	8.879
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.512**	**831.401**	**1 992.657**
EU28	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.512**	**972.302**	**1 948.265**
UK	Persons employed, GVA	2	Yes	No	OLS	0.580	592.469	164.977
AU	Persons employed, GVA	3	No	Yes	OLS	0.778	57.982	113.000
CA	Persons employed, GVA	0	No	No	OLS	0.383	62.971	49.146
JP	*Model not estimated because the dependent variable is not available for the Retail sale sector*							
KR	Persons employed, GVA	0	Yes	Yes	OLS	0.541	149.029	156.673
TW	Persons employed, GVA	1	Yes	No	OLS	0.902	26.186	44.583
US	Persons employed, GVA	0	Yes	Yes	OLS	0.897	2 157.440	5 253.767

Note: NACE sectors G47 for JP and G4791 for CA and US for the predictor Persons employed. NACE sector G47 for JP and US for the predictor GVA.

Table A2.a. Description of the estimation models for Employment. Total ICT sector (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	2	Yes	No	OLS	0.700	2.199	1.185
BE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.627	2.614	0.523
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.642	1.860	1.058
CY	Persons employed, GVA	3	No	Yes	OLS	0.806	0.185	0.768
CZ	Persons employed, GVA	1	No	No	OLS	0.275	4.190	1.336
DE	Persons employed, GVA	3	No	Yes	OLS	0.752	15.685	23.326
DK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.588	2.036	1.252
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.366	0.846	1.199
EL	Persons employed, GVA	3	No	No	OLS	0.784	1.741	1.692
ES	Persons employed, GVA	1	Yes	No	OLS	0.568	8.715	1.322
FI	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.690	2.706	0.502
FR	Persons employed, GVA	3	No	No	OLS	0.700	11.445	26.642
HR	Persons employed, GVA	2	Yes	Yes	OLS	0.570	2.585	5.038
HU	Persons employed, GVA	0	No	No	OLS	0.046	8.465	3.410
IE	Persons employed, GVA	3	No	No	OLS	0.845	2.307	0.945
IT	Persons employed, GVA	3	No	Yes	OLS	0.636	9.020	2.283
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.509	1.365	2.034
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.691	0.222	0.132
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.773	0.700	0.986
MT	Persons employed, GVA	2	Yes	No	OLS	0.725	0.264	0.399
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.898	4.234	1.867
PL	Persons employed, GVA	0	Yes	No	OLS	0.380	9.705	12.716
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.706	1.484	2.469
RO	Persons employed, GVA	2	Yes	No	OLS	0.650	8.949	8.568
SE	Persons employed	3	No	No	OLS	0.830	3.789	0.646
SI	Persons employed, GVA	0	Yes	No	OLS	0.020	0.638	0.555
SK	Persons employed, GVA	3	No	Yes	OLS	0.584	1.997	1.118
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**Yes**	**OLS**	**0.754**	**47.852**	**56.358**
EU28	**Persons employed, GVA**	**1**	**Yes**	**Yes**	**OLS**	**0.755**	**53.245**	**35.182**

Table A2.b. Description of the estimation models for Employment. Total ICT sector (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	2	Yes	No	OLS	0.719	1.975	0.853
BE	Persons employed, GVA	3	No	No	OLS	0.726	1.915	1.226
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.755	1.552	0.845
CY	Persons employed, GVA	3	No	Yes	OLS	0.840	0.162	0.771
CZ	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.585	3.028	2.304
DE	Persons employed, GVA	3	No	Yes	OLS	0.765	13.168	16.734
DK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.559	1.798	1.346
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.384	0.825	1.163
EL	Persons employed, GVA	2	Yes	No	OLS	0.794	1.543	1.737
ES	Persons employed, GVA	3	No	No	OLS	0.570	7.595	1.740
FI	Persons employed	0	No	No	OLS	0.592	2.773	0.813
FR	Persons employed, GVA	3	No	No	OLS	0.574	11.901	20.371
HR	Persons employed, GVA	2	Yes	Yes	OLS	0.588	2.504	5.034
HU	Persons employed, GVA	3	No	Yes	OLS	0.472	6.460	3.108
IE	Persons employed, GVA	3	No	Yes	OLS	0.885	2.080	0.702
IT	Persons employed, GVA	3	No	Yes	OLS	0.543	9.665	2.334
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.460	1.399	2.290
LU	Persons employed, GVA	3	No	Yes	OLS	0.755	0.159	0.034
LV	Persons employed	2	Yes	Yes	OLS	0.745	0.743	1.013
MT	Persons employed, GVA	3	No	Yes	OLS	0.768	0.231	0.139
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.915	3.098	3.129
PL	Persons employed, GVA	0	Yes	No	OLS	0.394	9.647	14.141
PT	GVA	0	Yes	Yes	OLS	0.807	1.151	3.021
RO	Persons employed, GVA	2	Yes	No	OLS	0.610	9.135	8.434
SE	Persons employed	3	No	No	OLS	0.833	3.408	0.544
SI	Persons employed, GVA	3	No	No	OLS	0.150	0.585	0.460
SK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.435	2.038	0.688
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**Yes**	**OLS**	**0.695**	**48.461**	**39.709**
EU28	**Persons employed, GVA**	**1**	**Yes**	**Yes**	**OLS**	**0.712**	**52.939**	**25.931**
UK	GVA	3	No	Yes	OLS	0.316	20.528	5.181
AU	Persons employed, GVA	3	No	Yes	OLS	0.481	13.868	5.515
CA	Persons employed, GVA	0	Yes	Yes	OLS	0.369	9.129	12.848
JP	Persons employed, GVA	1	No	No	OLS	0.976	10.308	3.492
KR	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.235	23.992	33.698
TW	Persons employed, GVA	2	No	Yes	OLS	0.737	16.233	16.376
US	Persons employed, GVA	3	No	Yes	OLS	0.988	19.714	4.647

Note: NACE sectors C26+J for CA, JP and US for the predictor of Persons employed.

Table A2.c. Description of the estimation models for Employment. ICT manufacturing (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	Yes	OLS	0.937	0.527	0.042
BE	Persons employed, GVA	3	No	Yes	OLS	0.784	0.527	0.208
BG	Persons employed, GVA	0	Yes	Yes	OLS	0.422	0.621	0.695
CY	Persons employed, GVA	1	Yes	No	OLS	0.831	0.017	0.033
CZ	Persons employed, GVA	3	No	Yes	OLS	0.768	1.238	0.310
DE	Persons employed, GVA	2	No	No	OLS	0.802	4.144	1.670
DK	Persons employed, GVA	1	No	No	OLS	0.328	0.559	0.131
EE	Persons employed, GVA	3	No	No	OLS	0.412	0.318	0.133
EL	Persons employed, GVA	3	No	Yes	OLS	0.341	0.489	0.104
ES	Persons employed	3	No	No	OLS	0.792	1.735	0.461
FI	Persons employed, GVA	2	No	No	OLS	0.409	1.826	0.062
FR	Persons employed, GVA	2	Yes	No	OLS	0.760	2.311	4.736
HR	Persons employed, GVA	1	Yes	No	OLS	0.879	0.150	0.448
HU	Persons employed, GVA	3	No	No	OLS	0.391	6.185	1.593
IE	Persons employed, GVA	3	No	Yes	OLS	0.750	1.509	0.572
IT	Persons employed, GVA	3	No	Yes	OLS	0.693	1.853	0.315
LT	Persons employed, GVA	3	No	Yes	OLS	0.892	0.312	0.160
LU	Persons employed, GVA	1	No	Yes	OLS	0.019	0.056	0.008
LV	Persons employed, GVA	3	No	Yes	OLS	0.553	0.098	0.026
MT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.306	0.228	0.066
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.561	0.743	0.392
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.651	2.321	3.704
PT	Persons employed, GVA	0	Yes	Yes	OLS	0.653	0.409	0.895
RO	Persons employed, GVA	3	No	No	OLS	0.748	3.077	0.540
SE	Persons employed, GVA	3	No	No	OLS	0.887	1.508	1.072
SI	Persons employed, GVA	2	Yes	No	OLS	0.399	0.294	0.296
SK	Persons employed, GVA	2	No	Yes	OLS	0.276	1.128	0.192
EU27_2020	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.684**	**15.007**	**10.022**
EU28	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.678**	**17.808**	**12.262**

Table A2.d. Description of the estimation models for Employment. ICT manufacturing (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	Yes	OLS	0.937	0.527	0.042
BE	Persons employed, GVA	3	No	Yes	OLS	0.784	0.527	0.208
BG	Persons employed, GVA	0	Yes	Yes	OLS	0.414	0.616	0.693
CY	Persons employed, GVA	1	Yes	No	OLS	0.839	0.015	0.030
CZ	Persons employed, GVA	3	No	Yes	OLS	0.773	1.219	0.364
DE	Persons employed, GVA	2	No	No	OLS	0.798	4.115	1.670
DK	Persons employed, GVA	1	No	No	OLS	0.329	0.559	0.131
EE	Persons employed, GVA	3	No	No	OLS	0.412	0.318	0.133
EL	Persons employed, GVA	3	No	Yes	OLS	0.343	0.488	0.105
ES	Persons employed	3	No	No	OLS	0.792	1.735	0.461
FI	Persons employed, GVA	2	No	No	OLS	0.409	1.827	0.063
FR	Persons employed, GVA	2	Yes	No	OLS	0.761	2.302	4.763
HR	Persons employed, GVA	1	Yes	No	OLS	0.879	0.149	0.448
HU	Persons employed, GVA	3	No	No	OLS	0.391	6.185	1.587
IE	Persons employed, GVA	3	No	Yes	OLS	0.751	1.486	0.547
IT	Persons employed, GVA	3	No	Yes	OLS	0.702	1.816	0.240
LT	Persons employed, GVA	3	No	Yes	OLS	0.892	0.312	0.164
LU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.075	0.048	0.008
LV	Persons employed, GVA	3	No	Yes	OLS	0.553	0.098	0.026
MT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.306	0.228	0.066
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.557	0.752	0.376
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.649	2.332	3.661
PT	Persons employed, GVA	0	Yes	Yes	OLS	0.653	0.409	0.895
RO	Persons employed, GVA	3	No	No	OLS	0.749	3.074	0.540
SE	Persons employed, GVA	3	No	No	OLS	0.887	1.506	1.068
SI	Persons employed, GVA	2	Yes	No	OLS	0.399	0.294	0.296
SK	Persons employed, GVA	2	No	Yes	OLS	0.281	1.121	0.187
EU27_2020	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.683**	**14.943**	**9.899**
EU28	**Persons employed, GVA**	**2**	**No**	**No**	**OLS**	**0.677**	**17.728**	**12.165**
UK	Persons employed, GVA	3	No	Yes	OLS	0.694	3.227	1.890
AU	Persons employed, GVA	3	No	No	OLS	0.282	3.281	0.693
CA	Persons employed, GVA	0	No	Yes	OLS	0.098	3.487	1.769
JP	Persons employed, GVA	3	No	No	OLS	0.974	7.594	3.252
KR	Persons employed, GVA	3	No	No	OLS	0.451	14.067	7.532
TW	Persons employed, GVA	2	No	Yes	OLS	0.767	14.471	18.778
US	Persons employed, GVA	1	No	Yes	OLS	0.978	8.474	8.870

Note: NACE sector C26 for CA, JP and US for the predictor of Persons employed.

Table A2.e. Description of the estimation models for Employment. ICT total services, Predict 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	GVA	1	Yes	No	OLS	0.478	2.124	1.505
BE	Persons employed, GVA	3	No	No	OLS	0.860	1.272	0.300
BG	Persons employed, GVA	1	Yes	No	OLS	0.799	1.391	0.571
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.897	0.129	0.221
CZ	Persons employed, GVA	3	No	Yes	OLS	0.869	1.245	0.376
DE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.707	11.823	2.601
DK	Persons employed, GVA	0	No	No	OLS	0.748	1.284	0.343
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.597	0.631	1.684
EL	Persons employed, GVA	3	No	No	OLS	0.833	1.456	0.541
ES	Persons employed, GVA	3	No	No	OLS	0.835	4.636	0.763
FI	Persons employed, GVA	0	Yes	No	OLS	0.923	0.880	0.448
FR	Persons employed, GVA	0	Yes	Yes	OLS	0.935	4.318	7.531
HR	Persons employed, GVA	0	Yes	No	OLS	0.994	0.294	0.493
HU	Persons employed	3	No	Yes	OLS	0.896	1.590	0.751
IE	Persons employed, GVA	0	No	No	OLS	0.882	1.254	1.340
IT	Persons employed	Step dummy from 2010	No	Yes	OLS	0.864	5.490	1.992
LT	Persons employed, GVA	3	No	Yes	OLS	0.771	0.983	0.424
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.923	0.107	0.074
LV	Persons employed, GVA	1	Yes	No	OLS	0.925	0.382	0.240
MT	Persons employed, GVA	1	Yes	No	OLS	0.802	0.161	0.256
NL	Persons employed, GVA	3	No	Yes	OLS	0.951	2.659	2.273
PL	Persons employed	Step dummy from 2010	No	Yes	OLS	0.919	3.149	0.867
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.886	0.896	0.303
RO	Persons employed, GVA	1	Yes	No	OLS	0.907	3.635	2.263
SE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.927	1.619	1.562
SI	Persons employed, GVA	3	No	No	OLS	0.821	0.187	0.025
SK	Persons employed, GVA	1	Yes	Yes	OLS	0.795	1.145	0.208
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.907**	**22.646**	**14.711**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**No**	**OLS**	**0.927**	**21.832**	**10.501**

Table A2.f. Description of the estimation models for Employment. ICT trade industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	1	Yes	No	OLS	0.379	0.442	0.630
BE	Persons employed, GVA	1	No	No	OLS	0.194	1.054	0.313
BG	Persons employed, GVA	3	No	Yes	OLS	0.646	0.400	0.216
CY	Persons employed, GVA	3	No	No	OLS	0.574	0.041	0.018
CZ	Persons employed, GVA	3	No	No	OLS	0.513	0.364	0.112
DE	Persons employed, GVA	2	No	No	OLS	0.544	7.715	3.392
DK	Persons employed, GVA	3	Yes	Yes	OLS	0.676	0.538	0.678
EE	Persons employed, GVA	3	No	No	OLS	0.595	0.066	0.036
EL	Persons employed, GVA	2	Yes	No	OLS	0.646	0.647	0.424
ES	Persons employed	2	Yes	Yes	OLS	0.730	1.955	2.758
FI	Persons employed, GVA	3	No	No	OLS	0.692	0.350	0.427
FR	Persons employed, GVA	2	Yes	No	OLS	0.605	2.618	6.679
HR	Persons employed, GVA	2	Yes	No	OLS	0.792	0.075	0.114
HU	Persons employed, GVA	2	No	No	OLS	0.468	0.431	0.134
IE	Persons employed, GVA	0	No	No	OLS	0.041	1.015	0.376
IT	Persons employed, GVA	1	No	No	OLS	0.445	3.707	0.596
LT	Persons employed, GVA	2	Yes	No	OLS	0.542	0.130	0.132
LU	Persons employed, GVA	2	Yes	No	OLS	0.727	0.056	0.060
LV	Persons employed, GVA	3	No	No	OLS	0.756	0.151	0.078
MT	Persons employed, GVA	1	Yes	Yes	OLS	0.627	0.087	0.216
NL	Persons employed, GVA	2	Yes	Yes	OLS	0.607	1.754	1.826
PL	Persons employed, GVA	3	No	No	OLS	0.516	0.726	1.460
PT	Persons employed	3	No	No	OLS	0.746	0.382	0.172
RO	Persons employed, GVA	3	No	Yes	OLS	0.680	0.555	0.219
SE	Persons employed	0	No	No	OLS	0.017	0.799	0.741
SI	Persons employed, GVA	2	Yes	No	OLS	0.522	0.052	0.043
SK	Persons employed, GVA	3	No	No	OLS	0.745	0.657	0.277
EU27_2020	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**No**	**OLS**	**0.395**	**12.781**	**10.768**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**No**	**OLS**	**0.263**	**13.741**	**0.885**

Table A2.g. Description of the estimation models for Employment. ICT services industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.950	0.589	0.288
BE	Persons employed, GVA	3	No	No	OLS	0.970	0.508	0.577
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.884	1.069	0.338
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.938	0.096	0.263
CZ	Persons employed, GVA	3	No	Yes	OLS	0.896	1.061	0.311
DE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.800	9.449	3.060
DK	Persons employed, GVA	0	No	No	OLS	0.830	0.952	0.376
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.592	0.629	1.562
EL	Persons employed, GVA	3	No	Yes	OLS	0.886	1.113	0.829
ES	Persons employed, GVA	3	No	Yes	OLS	0.823	3.973	2.126
FI	Persons employed, GVA	3	No	Yes	OLS	0.960	0.590	0.315
FR	Persons employed, GVA	0	Yes	No	OLS	0.931	3.937	4.489
HR	Persons employed, GVA	0	Yes	No	OLS	0.989	0.395	0.323
HU	Persons employed, GVA	3	No	Yes	OLS	0.878	1.793	0.800
IE	Persons employed, GVA	1	Yes	No	OLS	0.976	0.616	1.274
IT	GVA	2	No	No	OLS	0.585	8.376	1.930
LT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.760	0.968	0.560
LU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.938	0.076	0.031
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.945	0.330	0.493
MT	Persons employed, GVA	3	No	No	OLS	0.950	0.068	0.142
NL	Persons employed, GVA	0	No	No	OLS	0.976	1.528	0.614
PL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.915	3.268	3.038
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.960	0.507	0.503
RO	Persons employed, GVA	1	Yes	No	OLS	0.924	3.188	1.990
SE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.942	1.399	1.118
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.763	0.210	0.130
SK	Persons employed, GVA	2	No	No	OLS	0.911	0.632	0.070
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.889**	**23.131**	**7.531**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**No**	**OLS**	**0.945**	**17.928**	**5.899**
UK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.857	8.459	3.108
AU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.317	15.233	11.163
CA	Persons employed, GVA	0	Yes	Yes	OLS	0.411	7.519	12.177
JP	Persons employed, GVA	3	No	Yes	OLS	0.996	2.405	1.585
KR	Persons employed, GVA	3	No	No	OLS	0.852	6.661	1.233
TW	Persons employed, GVA	2	Yes	Yes	OLS	0.686	2.009	1.755
US	Persons employed, GVA	3	No	Yes	OLS	0.985	16.328	6.490

Table A2.h. Description of the estimation models for Employment. IT services (Telecommunications), PREDICT 2022

Country	Predictors	Estimation method

	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend		Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	3	No	Yes	OLS	0.564	0.498	0.575
BE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.488	0.776	0.635
BG	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.355	0.743	0.656
CY	Persons employed, GVA	3	No	Yes	OLS	0.711	0.045	0.103
CZ	GVA	1	Yes	No	OLS	0.198	1.154	1.018
DE	GVA	3	No	Yes	OLS	0.655	4.959	3.119
DK	Persons employed, GVA	1	Yes	No	OLS	0.446	0.659	0.356
EE	Persons employed, GVA	3	No	Yes	OLS	0.300	0.437	0.364
EL	GVA	2	No	No	OLS	0.312	1.400	0.894
ES	Persons employed, GVA	2	Yes	Yes	OLS	0.725	1.951	2.290
FI	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.668	0.514	0.256
FR	Persons employed, GVA	3	Yes	Yes	OLS	0.465	2.421	3.179
HR	GVA	2	Yes	No	OLS	0.579	0.915	2.493
HU	Persons employed, GVA	3	No	Yes	OLS	0.389	1.365	0.170
IE	Persons employed, GVA	2	No	Yes	OLS	0.855	0.684	0.197
IT	Persons employed, GVA	3	No	Yes	OLS	0.706	1.899	0.570
LT	Persons employed, GVA	3	No	No	OLS	0.545	0.747	0.474
LU	Persons employed, GVA	1	Yes	No	OLS	0.473	0.050	0.121
LV	Persons employed, GVA	3	No	No	OLS	0.865	0.313	0.309
MT	Persons employed, GVA	3	No	No	OLS	0.576	0.108	0.294
NL	Persons employed, GVA	3	No	Yes	OLS	0.806	2.008	2.032
PL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.832	2.303	1.037
PT	Persons employed, GVA	3	No	Yes	OLS	0.725	0.359	0.113
RO	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.725	4.832	0.175
SE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.096	1.164	0.303
SI	GVA	2	Yes	Yes	OLS	0.526	0.123	0.025
SK	Persons employed, GVA	3	No	No	OLS	0.585	0.435	0.117
EU27_2020	**Persons employed, GVA**	**2**	**Yes**	**Yes**	**OLS**	**0.782**	**14.567**	**37.488**
EU28	**Persons employed, GVA**	**2**	**Yes**	**Yes**	**OLS**	**0.802**	**15.653**	**38.382**
UK	Persons employed, GVA	1	Yes	Yes	OLS	0.370	5.922	0.580
AU	Persons employed, GVA	3	No	No	OLS	0.509	6.190	6.074
CA	Persons employed, GVA	3	No	No	OLS	0.397	4.435	2.769
JP	GVA	3	Yes	Yes	OLS	0.387	7.030	13.572
KR	Persons employed, GVA	3	No	Yes	OLS	0.367	8.433	0.963
TW	Persons employed, GVA	3	No	Yes	OLS	0.776	1.695	3.408
US	Persons employed, GVA	3	No	Yes	OLS	0.803	22.269	14.007

Note: NACE sector J61 for CA, JP and US for the predictor Persons employed. NACE sector J61 for JP, KR and US for the predictor GVA.

Table A2.i. Description of the estimation models for Employment. IC services (Computer and related activities), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.905	0.677	0.533
BE	Persons employed, GVA	3	No	Yes	OLS	0.870	0.860	0.045
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.932	0.917	1.285
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.872	0.133	0.219
CZ	Persons employed, GVA	3	No	No	OLS	0.711	1.606	0.536
DE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.688	9.099	2.298
DK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.769	0.919	0.752
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.659	0.469	1.576
EL	Persons employed, GVA	3	No	No	OLS	0.695	1.626	1.089
ES	Persons employed, GVA	1	Yes	No	OLS	0.819	3.301	4.158
FI	Persons employed, GVA	1	Yes	Yes	OLS	0.953	0.512	0.157
FR	Persons employed, GVA	0	Yes	Yes	OLS	0.943	3.304	12.328
HR	Persons employed, GVA	2	Yes	No	OLS	0.955	0.417	0.302
HU	Persons employed, GVA	2	Yes	Yes	OLS	0.813	1.980	1.052
IE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.876	0.935	1.005
IT	Persons employed	3	No	Yes	OLS	0.912	3.263	3.523
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.510	1.263	0.913
LU	Persons employed, GVA	1	Yes	Yes	OLS	0.920	0.088	0.086
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.813	0.404	1.047
MT	Persons employed, GVA	1	Yes	No	OLS	0.733	0.123	0.033
NL	Persons employed, GVA	3	No	Yes	OLS	0.897	2.062	1.296
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.870	3.739	2.507
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.892	0.859	1.057
RO	Persons employed, GVA	2	Yes	Yes	OLS	0.802	2.759	0.955
SE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.915	1.568	0.831
SI	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.725	0.204	0.075
SK	Persons employed, GVA	3	No	No	OLS	0.760	0.955	0.099
EU27_2020	**Persons employed, GVA**	**Step dummy from 2010**	**Yes**	**No**	**OLS**	**0.755**	**27.588**	**46.460**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**Yes**	**No**	**OLS**	**0.824**	**25.718**	**39.309**
UK	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.747	9.352	2.634
AU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.083	13.169	3.541
CA	Persons employed, GVA	0	Yes	Yes	OLS	0.485	6.814	11.503
JP	Persons employed, GVA	3	No	Yes	OLS	0.996	2.161	1.707
KR	Persons employed, GVA	0	No	No	OLS	0.543	9.436	1.323
TW	Persons employed, GVA	1	No	No	OLS	0.609	2.290	0.912
US	Persons employed, GVA	1	No	Yes	OLS	0.912	27.657	20.241

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A2.j. Description of the estimation models for Employment. Media and content sector, PREDICT 2022

Country	Predictors

	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend	Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	3	No	No	OLS	0.712	0.349	0.089
BE	Persons employed, GVA	3	No	No	OLS	0.655	0.302	0.504
BG	Persons employed, GVA	3	No	Yes	OLS	0.870	0.690	0.244
CY	Persons employed, GVA	2	Yes	Yes	OLS	0.756	0.077	0.168
CZ	Persons employed, GVA	3	No	No	OLS	0.840	0.641	0.068
DE	Persons employed, GVA	3	No	No	OLS	0.701	6.792	1.221
DK	Persons employed, GVA	3	No	No	OLS	0.694	0.622	0.351
EE	Persons employed, GVA	3	No	No	OLS	0.665	0.281	0.379
EL	Persons employed, GVA	0	Yes	Yes	OLS	0.719	1.192	1.282
ES	Persons employed, GVA	2	Yes	No	OLS	0.694	3.884	3.013
FI	Persons employed, GVA	3	No	Yes	OLS	0.508	0.504	0.267
FR	Persons employed, GVA	3	No	Yes	OLS	0.692	2.546	6.077
HR	Persons employed, GVA	3	No	No	OLS	0.973	0.182	0.016
HU	Persons employed, GVA	1	No	Yes	OLS	0.213	1.816	0.768
IE	Persons employed, GVA	1	Yes	No	OLS	0.795	0.543	1.685
IT	Persons employed, GVA	1	Yes	No	OLS	0.494	2.162	4.121
LT	Persons employed, GVA	3	No	Yes	OLS	0.469	0.789	0.194
LU	Persons employed, GVA	3	No	No	OLS	0.641	0.050	0.025
LV	Persons employed, GVA	1	No	No	OLS	0.687	0.349	0.189
MT	Persons employed, GVA	2	Yes	No	OLS	0.541	0.059	0.081
NL	Persons employed, GVA	3	No	Yes	OLS	0.469	1.162	0.369
PL	Persons employed, GVA	3	No	Yes	OLS	0.637	2.815	1.588
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.592	0.458	0.866
RO	Persons employed, GVA	3	No	No	OLS	0.522	1.843	0.674
SE	Persons employed, GVA	3	No	Yes	OLS	0.602	1.075	0.813
SI	Persons employed, GVA	1	Yes	Yes	OLS	0.698	0.127	0.047
SK	Persons employed, GVA	0	No	No	OLS	0.114	0.641	0.100
EU27_2020	**GVA**	**1**	**Yes**	**No**	**OLS**	**0.491**	**24.978**	**9.378**
EU28	**GVA**	**3**	**No**	**No**	**OLS**	**0.489**	**27.416**	**12.285**
UK	Persons employed, GVA	2	Yes	No	OLS	0.315	6.958	11.291
AU	Persons employed, GVA	3	No	No	OLS	0.509	6.297	6.772
CA	Persons employed, GVA	2	Yes	No	OLS	0.541	3.085	3.417
JP	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.920	1.825	2.814
KR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.309	5.945	0.626
TW	Persons employed, GVA	3	No	No	OLS	0.670	1.846	2.873
US	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.764	19.407	2.807

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A2.k. Description of the estimation models for Employment. Retail sale sector, PREDICT 2022

Country	Predictors

	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend	Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA	3	No	Yes	OLS	0.630	0.209	0.099
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.855	0.205	1.497
BG	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.886	0.156	0.178
CY	Persons employed, GVA	1	Yes	Yes	OLS	0.589	0.014	0.007
CZ	Persons employed, GVA	0	Yes	Yes	OLS	0.356	0.952	0.577
DE	Persons employed, GVA	0	Yes	Yes	OLS	0.525	7.342	7.322
DK	GVA	0	Yes	Yes	OLS	0.465	0.327	0.125
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.766	0.061	0.184
EL	Persons employed, GVA	3	No	Yes	OLS	0.739	0.126	0.187
ES	Persons employed, GVA	3	No	Yes	OLS	0.502	0.922	0.497
FI	Persons employed, GVA	1	Yes	Yes	OLS	0.632	0.117	0.276
FR	Persons employed, GVA	1	Yes	No	OLS	0.360	5.636	2.170
HR	Persons employed, GVA	0	Yes	Yes	OLS	0.437	0.093	0.054
HU	Persons employed, GVA	3	No	Yes	OLS	0.805	0.363	0.828
IE	Persons employed, GVA	1	Yes	No	OLS	0.456	0.111	0.230
IT	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.575	1.089	2.260
LT	Persons employed, GVA	1	Yes	Yes	OLS	0.707	0.210	0.332
LU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.466	0.030	0.031
LV	Persons employed, GVA	3	No	No	OLS	0.655	0.239	0.029
MT	Persons employed, GVA	3	No	Yes	OLS	0.909	0.019	0.027
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.716	1.053	0.356
PL	Persons employed, GVA	3	No	Yes	OLS	0.533	2.443	1.303
PT	GVA	3	No	Yes	OLS	0.607	0.167	0.336
RO	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.859	0.758	2.490
SE	Persons employed, GVA	3	No	Yes	OLS	0.879	0.200	0.166
SI	Persons employed, GVA	3	No	No	OLS	0.239	0.117	0.225
SK	Persons employed, GVA	3	No	Yes	OLS	0.666	0.204	0.082
EU27_2020	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.772**	**10.756**	**17.756**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.673**	**16.472**	**5.687**
UK	Persons employed, GVA	2	Yes	No	OLS	0.540	8.393	7.286
AU	Persons employed, GVA	3	No	No	OLS	0.533	1.471	2.963
CA	Persons employed, GVA	0	No	No	OLS	0.988	0.130	0.086
JP	*Model not estimated because the dependent variable is not available for the Retail sale sector*							
KR	Persons employed	3	No	Yes	OLS	0.801	2.042	7.771
TW	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.499	0.491	0.341
US	Persons employed, GVA	2	Yes	No	OLS	0.760	8.523	10.977

Note: NACE sectors G47 for JP and G4791 for CA and US for the predictor Persons employed. NACE sector G47 for JP and US for the predictor GVA.

Table A3.a. Description of the estimation models for Hours Worked. Total ICT sector (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.655	5.017	3.542
BE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.633	4.278	1.924
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.669	3.023	1.919
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.801	0.337	1.338
CZ	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.425	7.103	3.425
DE	Persons employed, GVA	3	No	No	OLS	0.761	24.217	29.055
DK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.512	4.537	0.819
EE	Persons employed, GVA	2	Yes	No	OLS	0.544	3.467	5.327
EL	Persons employed, GVA	2	Yes	No	OLS	0.533	5.199	2.107
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.473	17.015	4.559
FI	Persons employed, GVA	1	No	No	OLS	0.663	5.252	1.202
FR	Persons employed, GVA	3	No	Yes	OLS	0.536	25.102	58.340
HR	Persons employed	Step dummy from 2010	No	Yes	OLS	0.045	8.082	5.419
HU	Persons employed, GVA	3	No	No	OLS	0.511	10.824	2.706
IE	Persons employed, GVA	3	No	No	OLS	0.833	4.831	0.934
IT	Persons employed, GVA	3	No	Yes	OLS	0.593	20.156	4.690
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.336	3.353	4.161
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.623	0.430	0.110
LV	Persons employed, GVA	2	Yes	Yes	OLS	0.460	2.234	3.066
MT	Persons employed, GVA	0	Yes	No	OLS	0.165	1.719	1.170
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.802	9.540	1.796
PL	Persons employed, GVA	3	No	No	OLS	0.410	19.979	14.213
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.712	2.707	3.275
RO	Persons employed, GVA	2	Yes	No	OLS	0.672	15.395	10.977
SE	Persons employed, GVA	1	No	No	OLS	0.632	10.536	1.977
SI	Persons employed, GVA	3	No	No	OLS	0.050	1.157	1.201
SK	Persons employed, GVA	2	No	No	OLS	0.401	4.141	1.320
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.756**	**95.770**	**87.774**
EU28	**Persons employed**	**1**	**Yes**	**No**	**OLS**	**0.647**	**129.625**	**27.935**

Table A3.b. Description of the estimation models for Hours Worked. Total ICT sector (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	No	OLS	0.673	4.713	2.970
BE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.635	3.709	2.793
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.751	2.668	1.555
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.840	0.293	1.348
CZ	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.428	6.798	3.570
DE	Persons employed, GVA	1	Yes	Yes	OLS	0.675	23.813	31.433
DK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.546	3.642	0.823
EE	Persons employed, GVA	2	Yes	No	OLS	0.548	3.410	5.295
EL	Persons employed, GVA	3	No	No	OLS	0.657	3.764	1.634
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.402	15.950	0.101
FI	Persons employed, GVA	1	No	No	OLS	0.657	4.770	1.487
FR	Persons employed, GVA	3	No	Yes	OLS	0.407	25.179	48.047
HR	Persons employed	Step dummy from 2010	No	Yes	OLS	0.041	8.123	5.562
HU	Persons employed, GVA	3	No	No	OLS	0.499	11.243	2.473
IE	Persons employed, GVA	3	No	No	OLS	0.867	4.445	0.327
IT	Persons employed, GVA	3	No	Yes	OLS	0.522	20.219	2.809
LT	Persons employed, GVA	0	Yes	Yes	OLS	0.298	3.381	4.790
LU	Persons employed, GVA	3	No	Yes	OLS	0.724	0.297	0.089
LV	GVA	1	Yes	Yes	OLS	0.577	1.996	3.113
MT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.208	1.508	1.011
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.856	6.535	4.938
PL	Persons employed, GVA	1	Yes	No	OLS	0.372	20.748	15.907
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.755	2.359	3.880
RO	Persons employed, GVA	2	Yes	No	OLS	0.654	15.304	10.562
SE	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.396	12.437	4.248
SI	Persons employed, GVA	1	Yes	No	OLS	0.040	1.163	1.026
SK	Persons employed, GVA	3	No	No	OLS	0.466	3.375	0.875
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.610**	**110.065**	**69.237**
EU28	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.602**	**125.655**	**28.873**
UK	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.488	38.135	17.775
AU	Persons employed	3	No	Yes	OLS	0.597	23.639	14.419
CA	Persons employed, GVA	3	No	Yes	OLS	0.416	18.114	24.650
JP	Persons employed, GVA	3	No	Yes	OLS	0.883	51.186	58.744
KR	Persons employed, GVA	3	No	Yes	OLS	0.625	59.740	58.729
TW	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.465	59.879	48.342
US	Persons employed, GVA	3	No	No	OLS	0.959	75.148	48.842

Note: NACE sectors C26+J for CA, JP and US for the predictor of Persons employed.

Table A3.c. Description of the estimation models for Hours Worked. ICT manufacturing (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	2	No	Yes	OLS	0.899	1.189	0.138
BE	Persons employed, GVA	3	No	Yes	OLS	0.791	0.830	0.271
BG	Persons employed, GVA	2	Yes	Yes	OLS	0.824	0.650	1.297
CY	Persons employed, GVA	1	Yes	No	OLS	0.872	0.027	0.055
CZ	Persons employed, GVA	2	No	Yes	OLS	0.737	2.096	0.926
DE	Persons employed, GVA	3	No	Yes	OLS	0.859	6.037	7.921
DK	Persons employed, GVA	3	No	No	OLS	0.690	0.625	0.546
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.576	1.376	0.170
EL	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.344	1.061	1.135
ES	Persons employed, GVA	3	No	Yes	OLS	0.825	2.819	1.063
FI	Persons employed, GVA	3	No	No	OLS	0.499	2.831	0.150
FR	Persons employed, GVA	3	No	No	OLS	0.703	4.030	8.445
HR	Persons employed, GVA	2	Yes	No	OLS	0.858	0.336	0.697
HU	Persons employed, GVA	3	No	No	OLS	0.385	10.689	0.890
IE	Persons employed, GVA	3	No	Yes	OLS	0.700	3.050	1.294
IT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.266	4.872	0.506
LT	Persons employed, GVA	3	No	Yes	OLS	0.835	0.764	0.232
LU	Persons employed, GVA	1	No	Yes	OLS	0.037	0.094	0.016
LV	Persons employed, GVA	3	No	No	OLS	0.552	0.206	0.045
MT	Persons employed, GVA	3	No	Yes	OLS	0.593	0.354	0.061
NL	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.493	1.377	0.790
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.568	5.301	6.758
PT	Persons employed, GVA	0	Yes	Yes	OLS	0.654	0.724	1.646
RO	Persons employed, GVA	3	No	No	OLS	0.702	6.402	0.375
SE	Persons employed, GVA	3	No	No	OLS	0.904	2.259	1.228
SI	Persons employed, GVA	2	Yes	No	OLS	0.399	0.454	0.550
SK	Persons employed, GVA	3	No	Yes	OLS	0.330	1.913	0.399
EU27_2020	**Persons employed**	**3**	**No**	**No**	**OLS**	**0.661**	**33.301**	**17.219**
EU28	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.702**	**35.314**	**15.617**

Table A3.d. Description of the estimation models for Hours Worked. ICT manufacturing (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	2	No	Yes	OLS	0.899	1.189	0.138
BE	Persons employed, GVA	3	No	Yes	OLS	0.791	0.829	0.270
BG	Persons employed, GVA	2	Yes	Yes	OLS	0.814	0.655	1.289
CY	Persons employed, GVA	1	Yes	No	OLS	0.876	0.024	0.049
CZ	Persons employed, GVA	2	No	Yes	OLS	0.737	2.088	0.949
DE	Persons employed, GVA	3	No	Yes	OLS	0.862	5.872	7.692
DK	Persons employed, GVA	3	No	No	OLS	0.691	0.625	0.539
EE	Persons employed, GVA	2	Yes	Yes	OLS	0.576	1.376	0.169
EL	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.338	1.066	1.123
ES	Persons employed, GVA	3	No	Yes	OLS	0.825	2.819	1.063
FI	Persons employed, GVA	3	No	No	OLS	0.499	2.832	0.152
FR	Persons employed, GVA	3	No	No	OLS	0.705	4.006	8.469
HR	Persons employed, GVA	2	Yes	No	OLS	0.859	0.335	0.697
HU	Persons employed, GVA	3	No	No	OLS	0.385	10.690	0.880
IE	Persons employed, GVA	3	No	Yes	OLS	0.700	3.010	1.245
IT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.267	4.831	0.507
LT	Persons employed, GVA	3	No	Yes	OLS	0.835	0.764	0.244
LU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.087	0.081	0.018
LV	Persons employed, GVA	3	No	No	OLS	0.552	0.206	0.045
MT	Persons employed, GVA	3	No	Yes	OLS	0.593	0.354	0.061
NL	Persons employed	1	No	Yes	OLS	0.650	1.153	0.966
PL	Persons employed, GVA	0	Yes	Yes	OLS	0.566	5.327	6.674
PT	Persons employed, GVA	0	Yes	Yes	OLS	0.654	0.724	1.646
RO	Persons employed, GVA	3	No	No	OLS	0.702	6.397	0.374
SE	Persons employed, GVA	3	No	No	OLS	0.904	2.255	1.228
SI	Persons employed, GVA	2	Yes	No	OLS	0.399	0.454	0.550
SK	Persons employed, GVA	3	No	Yes	OLS	0.336	1.900	0.390
EU27_2020	**Persons employed**	**3**	**No**	**No**	**OLS**	**0.660**	**33.180**	**17.286**
EU28	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.701**	**35.159**	**15.482**
UK	Persons employed, GVA	1	No	Yes	OLS	0.470	8.137	4.540
AU	Persons employed, GVA	3	No	No	OLS	0.314	6.208	1.573
CA	Persons employed, GVA	0	No	No	OLS	0.147	6.860	3.772
JP	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.837	44.319	19.116
KR	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.349	40.220	64.866
TW	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.476	56.428	45.083
US	Persons employed, GVA	3	No	Yes	OLS	0.927	28.683	44.031

Note: NACE sector C26 for CA, JP and US for the predictor of Persons employed.

Table A3.e. Description of the estimation models for Hours Worked. ICT total services, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	0	Yes	No	OLS	0.816	2.787	1.767
BE	Persons employed, GVA	0	Yes	No	OLS	0.878	1.991	0.456
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.765	2.534	0.785
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.843	0.285	0.539
CZ	Persons employed, GVA	1	Yes	No	OLS	0.697	4.085	1.505
DE	Persons employed, GVA	3	No	Yes	OLS	0.672	19.763	13.875
DK	Persons employed, GVA	3	No	No	OLS	0.778	2.399	1.543
EE	Persons employed, GVA	3	No	Yes	OLS	0.694	2.250	2.494
EL	Persons employed	3	No	No	OLS	0.497	4.947	1.598
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.662	11.665	2.068
FI	Persons employed, GVA	0	No	No	OLS	0.898	1.845	0.446
FR	Persons employed, GVA	3	No	Yes	OLS	0.839	12.544	26.135
HR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.893	2.628	3.387
HU	Persons employed, GVA	3	No	Yes	OLS	0.810	4.317	4.200
IE	Persons employed, GVA	1	No	No	OLS	0.875	2.910	4.278
IT	Persons employed, GVA	3	No	Yes	OLS	0.865	11.386	2.740
LT	Persons employed, GVA	1	Yes	No	OLS	0.673	2.678	1.573
LU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.816	0.284	0.018
LV	Persons employed, GVA	2	Yes	No	OLS	0.796	1.306	1.605
MT	Persons employed, GVA	1	Yes	No	OLS	0.242	1.606	0.967
NL	Persons employed, GVA	2	No	Yes	OLS	0.873	6.827	6.760
PL	Persons employed, GVA	3	No	No	OLS	0.591	14.972	3.944
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.815	2.129	1.515
RO	Persons employed	3	No	No	OLS	0.922	5.838	1.178
SE	Persons employed, GVA	3	No	No	OLS	0.834	4.599	3.360
SI	Persons employed, GVA	2	Yes	No	OLS	0.575	0.542	0.806
SK	Persons employed, GVA	3	No	No	OLS	0.666	2.509	0.980
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.873**	**51.333**	**34.414**
EU28	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.855**	**60.784**	**7.620**

Table A3.f. Description of the estimation models for Hours Worked. ICT trade industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	3	No	Yes	OLS	0.699	0.550	0.425
BE	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.284	1.622	2.732
BG	Persons employed, GVA	3	No	Yes	OLS	0.653	0.668	0.415
CY	Persons employed, GVA	3	No	No	OLS	0.485	0.084	0.047
CZ	Persons employed, GVA	2	Yes	No	OLS	0.250	0.814	1.207
DE	Persons employed, GVA	2	No	No	OLS	0.573	12.069	5.301
DK	GVA	1	No	No	OLS	0.283	1.298	0.643
EE	Persons employed, GVA	3	No	No	OLS	0.728	0.122	0.080
EL	Persons employed, GVA	3	No	No	OLS	0.708	1.268	1.181
ES	Persons employed, GVA	2	No	No	OLS	0.755	3.462	2.081
FI	Persons employed, GVA	2	No	No	OLS	0.515	0.803	0.804
FR	Persons employed, GVA	3	No	No	OLS	0.733	3.767	12.150
HR	Persons employed, GVA	3	No	Yes	OLS	0.806	0.158	0.295
HU	Persons employed, GVA	2	Yes	No	OLS	0.452	0.826	0.354
IE	Persons employed, GVA	2	No	No	OLS	0.646	1.162	0.872
IT	Persons employed, GVA	1	No	No	OLS	0.474	7.455	1.955
LT	Persons employed, GVA	2	Yes	No	OLS	0.599	0.267	0.373
LU	Persons employed, GVA	3	No	Yes	OLS	0.594	0.119	0.079
LV	Persons employed, GVA	3	No	No	OLS	0.758	0.323	0.053
MT	Persons employed, GVA	1	Yes	No	OLS	0.616	0.172	0.437
NL	Persons employed, GVA	2	Yes	No	OLS	0.372	3.976	2.340
PL	Persons employed, GVA	2	Yes	No	OLS	0.407	1.766	3.712
PT	Persons employed, GVA	3	No	No	OLS	0.704	0.865	0.278
RO	Persons employed, GVA	3	No	Yes	OLS	0.638	1.078	0.409
SE	Persons employed, GVA	3	No	Yes	OLS	0.297	1.464	1.326
SI	Persons employed, GVA	3	No	Yes	OLS	0.666	0.070	0.050
SK	Persons employed	3	No	No	OLS	0.698	1.369	0.590
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.656**	**17.451**	**15.338**
EU28	**Persons employed, GVA**	**0**	**No**	**No**	**OLS**	**0.142**	**29.881**	**4.597**

Table A3.g. Description of the estimation models for Hours Worked. ICT services industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.789	2.832	1.181
BE	Persons employed, GVA	2	Yes	Yes	OLS	0.945	1.203	1.187
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.840	2.123	0.799
CY	Persons employed, GVA	3	No	Yes	OLS	0.884	0.238	0.606
CZ	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.724	3.766	0.447
DE	Persons employed, GVA	1	Yes	Yes	OLS	0.783	15.161	14.675
DK	Persons employed, GVA	3	No	No	OLS	0.828	1.903	1.329
EE	Persons employed, GVA	3	No	Yes	OLS	0.703	2.187	2.253
EL	Persons employed, GVA	0	Yes	Yes	OLS	0.652	3.494	0.210
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.713	9.036	1.186
FI	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.940	1.301	0.643
FR	Persons employed, GVA	3	Yes	Yes	OLS	0.801	12.503	19.236
HR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.884	2.758	3.260
HU	Persons employed, GVA	3	No	Yes	OLS	0.791	4.715	4.546
IE	Persons employed, GVA	1	Yes	No	OLS	0.956	1.834	2.139
IT	Persons employed, GVA	1	No	No	OLS	0.920	7.658	5.303
LT	Persons employed, GVA	1	Yes	No	OLS	0.677	2.577	1.602
LU	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.879	0.187	0.090
LV	Persons employed, GVA	0	Yes	No	OLS	0.751	1.469	1.550
MT	Persons employed, GVA	1	Yes	No	OLS	0.281	1.386	0.502
NL	Persons employed, GVA	0	No	No	OLS	0.943	3.828	0.820
PL	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.576	15.849	2.105
PT	Persons employed, GVA	0	Yes	No	OLS	0.822	1.958	0.566
RO	Persons employed, GVA	1	Yes	No	OLS	0.923	5.657	0.959
SE	Persons employed, GVA	3	No	No	OLS	0.832	4.470	1.527
SI	Persons employed, GVA	2	Yes	No	OLS	0.639	0.500	0.914
SK	Persons employed, GVA	3	No	No	OLS	0.830	1.427	0.535
EU27_2020	**Persons employed, GVA**	**3**	**No**	**No**	**OLS**	**0.901**	**41.917**	**25.241**
EU28	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.918**	**42.796**	**37.015**
UK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.805	21.712	7.533
AU	Persons employed, GVA	2	Yes	Yes	OLS	0.661	20.937	16.080
CA	Persons employed, GVA	3	No	No	OLS	0.492	14.348	24.080
JP	Persons employed, GVA	3	No	Yes	OLS	0.914	26.154	32.720
KR	Persons employed, GVA	3	No	Yes	OLS	0.378	51.852	21.154
TW	Persons employed, GVA	Step dummy from 2010	Yes	No	OLS	0.314	6.534	5.662
US	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.962	54.843	28.401

Table A3.h. Description of the estimation models for Hours Worked. IT services (Telecommunications), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	0	No	No	OLS	0.247	1.498	2.013
BE	Persons employed, GVA	3	No	No	OLS	0.609	1.140	0.641
BG	Persons employed, GVA	3	No	Yes	OLS	0.360	1.326	1.228
CY	Persons employed, GVA	1	Yes	No	OLS	0.343	0.163	0.188
CZ	Persons employed, GVA	3	No	No	OLS	0.520	1.963	3.027
DE	Persons employed	3	No	No	OLS	0.618	8.153	2.302
DK	Persons employed, GVA	1	No	No	OLS	0.560	1.135	0.277
EE	Persons employed, GVA	3	No	No	OLS	0.674	1.560	0.783
EL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.268	2.451	0.221
ES	Persons employed, GVA	3	No	No	OLS	0.528	5.025	4.056
FI	Persons employed, GVA	2	No	No	OLS	0.656	0.799	0.610
FR	Persons employed, GVA	2	Yes	No	OLS	0.544	3.463	3.752
HR	Persons employed, GVA	2	Yes	Yes	OLS	0.928	0.716	1.609
HU	Persons employed, GVA	2	No	Yes	OLS	0.640	2.239	0.858
IE	Persons employed, GVA	3	No	No	OLS	0.763	1.648	0.549
IT	Persons employed, GVA	3	No	No	OLS	0.808	3.077	1.357
LT	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.315	1.936	1.095
LU	Persons employed, GVA	2	Yes	Yes	OLS	0.418	0.101	0.236
LV	Persons employed, GVA	3	No	No	OLS	0.779	0.854	0.970
MT	Persons employed, GVA	1	Yes	No	OLS	0.292	0.515	0.199
NL	Persons employed, GVA	1	No	Yes	OLS	0.814	2.881	3.668
PL	Persons employed, GVA	2	No	Yes	OLS	0.797	6.038	0.452
PT	Persons employed, GVA	3	No	Yes	OLS	0.676	0.741	0.192
RO	Persons employed, GVA	1	Yes	Yes	OLS	0.952	3.739	4.488
SE	Persons employed, GVA	3	No	No	OLS	0.685	1.089	1.223
SI	Persons employed, GVA	3	No	Yes	OLS	0.581	0.203	0.228
SK	Persons employed, GVA	3	No	Yes	OLS	0.672	0.684	0.110
EU27_2020	**Persons employed, GVA**	**1**	**Yes**	**No**	**OLS**	**0.752**	**20.009**	**60.830**
EU28	**Persons employed, GVA**	**2**	**Yes**	**No**	**OLS**	**0.758**	**23.268**	**77.339**
UK	Persons employed, GVA	3	No	Yes	OLS	0.660	9.417	6.086
AU	Persons employed, GVA	3	No	No	OLS	0.528	11.611	7.754
CA	Persons employed, GVA	3	No	No	OLS	0.053	9.927	8.658
JP	Persons employed, GVA	2	Yes	No	OLS	0.524	13.657	12.556
KR	Persons employed, GVA	3	No	Yes	OLS	0.173	21.803	16.739
TW	Persons employed, GVA	1	Yes	Yes	OLS	0.739	3.782	5.709
US	Persons employed, GVA	2	Yes	Yes	OLS	0.833	38.363	61.116

Note: NACE sector J61 for CA, JP and US for the predictor Persons employed. NACE sector J61 for JP, KR and US for the predictor GVA.

Table A3.i. Description of the estimation models for Hours Worked. IC services (Computer and related activities), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	1	Yes	No	OLS	0.810	2.330	1.766
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.848	1.627	0.819
BG	Persons employed, GVA	1	Yes	Yes	OLS	0.922	1.599	1.877
CY	Persons employed, GVA	3	No	Yes	OLS	0.855	0.259	0.356
CZ	Persons employed, GVA	3	No	Yes	OLS	0.753	2.940	1.317
DE	Persons employed, GVA	0	Yes	Yes	OLS	0.678	14.177	12.960
DK	Persons employed, GVA	3	No	No	OLS	0.728	1.880	1.480
EE	Persons employed, GVA	1	Yes	No	OLS	0.367	1.940	3.787
EL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.496	3.430	0.531
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.672	8.184	5.988
FI	Persons employed, GVA	0	Yes	No	OLS	0.935	1.134	0.868
FR	Persons employed, GVA	2	Yes	Yes	OLS	0.826	10.803	20.617
HR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.869	1.509	1.584
HU	Persons employed, GVA	2	Yes	Yes	OLS	0.780	4.109	4.984
IE	Persons employed, GVA	0	Yes	No	OLS	0.822	2.593	1.003
IT	Persons employed, GVA	3	No	Yes	OLS	0.931	5.784	4.487
LT	Persons employed, GVA	1	Yes	Yes	OLS	0.607	2.647	0.859
LU	Persons employed, GVA	0	Yes	No	OLS	0.883	0.186	0.200
LV	GVA	2	Yes	Yes	OLS	0.619	1.131	2.067
MT	Persons employed, GVA	3	No	Yes	OLS	0.916	0.337	0.875
NL	Persons employed, GVA	2	No	Yes	OLS	0.815	4.744	4.459
PL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.739	10.198	2.320
PT	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.816	2.051	1.098
RO	Persons employed, GVA	2	Yes	Yes	OLS	0.766	5.501	1.898
SE	Persons employed, GVA	3	No	No	OLS	0.827	4.228	2.904
SI	Persons employed, GVA	3	No	Yes	OLS	0.556	0.455	0.704
SK	Persons employed, GVA	3	No	No	OLS	0.698	1.800	0.244
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.898**	**34.209**	**91.823**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.858**	**45.664**	**81.735**
UK	Persons employed, GVA	Step dummy from 2010	No	No	AR(1)	0.667	25.112	13.643
AU	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.147	26.390	11.457
CA	Persons employed, GVA	3	No	Yes	OLS	0.536	12.300	17.347
JP	Persons employed, GVA	3	No	Yes	OLS	0.913	21.570	14.813
KR	Persons employed, GVA	3	No	Yes	OLS	0.287	45.155	8.280
TW	Persons employed, GVA	0	No	No	OLS	0.467	5.327	3.391
US	Persons employed, GVA	3	No	Yes	OLS	0.937	52.372	39.830

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A3.j. Description of the estimation models for Hours Worked. Media and content sector, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA	2	No	No	OLS	0.637	1.005	0.191
BE	Persons employed, GVA	2	Yes	No	OLS	0.412	0.588	0.926
BG	Persons employed, GVA	3	No	Yes	OLS	0.871	1.215	0.392
CY	Persons employed, GVA	2	Yes	Yes	OLS	0.576	0.198	0.094
CZ	Persons employed, GVA	3	No	Yes	OLS	0.863	1.091	0.344
DE	Persons employed, GVA	2	Yes	Yes	OLS	0.895	5.606	6.259
DK	Persons employed, GVA	3	No	Yes	OLS	0.656	0.826	1.104
EE	Persons employed, GVA	2	No	Yes	OLS	0.412	1.457	2.014
EL	Persons employed	3	No	No	OLS	0.507	2.982	4.626
ES	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.634	6.885	6.040
FI	Persons employed, GVA	0	Yes	Yes	OLS	0.037	0.935	0.400
FR	Persons employed, GVA	2	Yes	Yes	OLS	0.486	5.199	8.084
HR	Persons employed, GVA	3	No	No	OLS	0.951	0.522	0.645
HU	Persons employed, GVA	1	Yes	Yes	OLS	0.269	3.235	2.363
IE	Persons employed, GVA	1	Yes	Yes	OLS	0.686	1.104	1.961
IT	Persons employed, GVA	2	Yes	No	OLS	0.589	3.465	6.576
LT	Persons employed, GVA	3	No	No	OLS	0.591	1.628	0.999
LU	Persons employed, GVA	3	No	No	OLS	0.703	0.089	0.020
LV	Persons employed, GVA	0	No	No	OLS	0.554	0.822	0.515
MT	Persons employed, GVA	1	Yes	Yes	OLS	0.337	0.191	0.086
NL	Persons employed, GVA	3	No	No	OLS	0.745	1.380	0.562
PL	Persons employed, GVA	3	No	Yes	OLS	0.605	5.691	7.326
PT	Persons employed, GVA	3	No	Yes	OLS	0.745	0.693	1.324
RO	Persons employed, GVA	3	No	Yes	OLS	0.529	3.663	1.935
SE	Persons employed, GVA	3	No	Yes	OLS	0.332	1.687	1.438
SI	Persons employed, GVA	3	No	No	OLS	0.545	0.246	0.060
SK	Persons employed, GVA	1	Yes	No	OLS	0.188	1.056	0.342
EU27_2020	**Persons employed, GVA**	**0**	**Yes**	**Yes**	**OLS**	**0.650**	**27.004**	**46.566**
EU28	**Persons employed, GVA**	**0**	**Yes**	**No**	**OLS**	**0.447**	**36.957**	**40.298**
UK	Persons employed, GVA	3	No	No	OLS	0.638	10.950	34.196
AU	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.354	14.925	5.728
CA	Persons employed	2	Yes	No	OLS	0.381	6.889	2.035
JP	Persons employed, GVA	3	No	No	OLS	0.548	8.782	2.080
KR	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	-0.244	25.246	1.192
TW	GVA	2	Yes	Yes	OLS	0.254	5.040	4.753
US	Persons employed, GVA	3	No	No	OLS	0.815	40.773	9.802

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A3.k. Description of the estimation models for Hours Worked. Retail sale sector, PREDICT 2022

Country	Predictors

	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend	Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed	2	Yes	Yes	OLS	0.327	0.586	0.682
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.847	0.311	2.222
BG	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.874	0.282	0.276
CY	Persons employed, GVA	1	Yes	No	OLS	0.591	0.027	0.014
CZ	Persons employed, GVA	3	No	Yes	OLS	0.824	1.030	2.544
DE	Persons employed, GVA	0	Yes	Yes	OLS	0.550	9.945	10.616
DK	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.665	0.275	0.070
EE	Persons employed, GVA	3	No	Yes	OLS	0.575	0.150	0.123
EL	Persons employed, GVA	2	Yes	Yes	OLS	0.703	0.315	0.672
ES	Persons employed, GVA	1	Yes	Yes	OLS	0.346	1.943	0.244
FI	Persons employed, GVA	3	No	Yes	OLS	0.660	0.180	0.425
FR	Persons employed, GVA	1	Yes	No	OLS	0.368	9.305	5.797
HR	GVA	3	No	Yes	OLS	0.631	0.219	0.110
HU	Persons employed, GVA	2	Yes	Yes	OLS	0.859	0.642	3.336
IE	Persons employed, GVA	1	Yes	No	OLS	0.425	0.192	0.390
IT	Persons employed, GVA	3	No	Yes	OLS	0.627	1.813	3.891
LT	Persons employed, GVA	2	Yes	Yes	OLS	0.852	0.302	0.862
LU	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.318	0.079	0.091
LV	Persons employed, GVA	3	No	No	OLS	0.683	0.489	0.025
MT	Persons employed, GVA	3	No	Yes	OLS	0.792	0.069	0.070
NL	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.474	2.552	1.968
PL	Persons employed, GVA	3	No	Yes	OLS	0.617	4.411	2.477
PT	Persons employed	0	Yes	Yes	OLS	0.410	0.424	0.664
RO	Persons employed, GVA	0	Yes	Yes	OLS	0.812	1.708	5.202
SE	Persons employed, GVA	3	No	Yes	OLS	0.880	0.436	0.250
SI	Persons employed, GVA	3	No	No	OLS	0.234	0.177	0.290
SK	Persons employed, GVA	3	No	Yes	OLS	0.693	0.351	0.167
EU27_2020	**Persons employed, GVA**	**Step dummy from 2010**	**No**	**Yes**	**OLS**	**0.805**	**15.580**	**21.002**
EU28	**Persons employed, GVA**	**3**	**No**	**Yes**	**OLS**	**0.570**	**30.476**	**24.042**
UK	Persons employed, GVA	2	Yes	No	OLS	0.537	13.826	9.774
AU	Persons employed, GVA	3	No	No	OLS	0.541	2.208	4.582
CA	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.987	0.199	0.194
JP	*Model not estimated because the dependent variable is not available for the Retail sale sector*							
KR	Persons employed, GVA	0	Yes	Yes	OLS	0.551	8.205	22.557
TW	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.592	0.967	0.331
US	Persons employed, GVA	1	Yes	No	OLS	0.838	11.401	12.537

Note: NACE sectors G47 for JP and G4791 for CA and US for the predictor Persons employed. NACE sector G47 for JP and US for the predictor GVA.

Table A4.a. Description of the estimation models for BERD. Total ICT sector (comprehensive definition), PREDICT 2022

Country	Predictors

	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend	Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.713	63.942	149.261
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.756	63.826	204.671
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.278	10.728	4.859
CY	Persons employed, GVA	3	No	Yes	OLS	0.925	0.999	4.538
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.742	14.251	32.185
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	No	No	OLS	0.225	326.843	244.446
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.335	76.266	46.926
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.630	6.731	23.254
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.563	20.637	10.679
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.751	46.088	91.709
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.881	77.459	187.056
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.224	265.340	98.525
HR	Persons employed, GVA	Step dummy from 2010	Yes	Yes	OLS	0.519	6.493	19.810
HU	Persons employed, GVA	3	No	Yes	OLS	0.904	10.849	25.171
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.544	56.248	149.957
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.172	131.190	108.302
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.457	5.791	2.428
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.539	4.266	5.098
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.356	1.490	0.941
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.553	1.084	0.605
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.701	96.296	16.615
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.915	20.624	72.830
PT	Persons employed, GVA	Step dummy from 2010	Yes	Yes	OLS	0.591	25.979	30.043
RO	Persons employed, GVA	2	Yes	No	OLS	0.552	12.836	16.839
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.574	151.693	129.347
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.153	8.502	10.729
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.801	3.323	7.282
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.472**	**617.821**	**1 285.868**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.509**	**799.942**	**1 473.398**

Table A4.b. Description of the estimation models for BERD. Total ICT sector (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors C+J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.718	62.979	148.233
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.744	64.323	200.871
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.295	10.627	4.775
CY	Persons employed, GVA	3	No	Yes	OLS	0.925	1.000	4.537
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.742	14.125	34.982
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	No	No	OLS	0.224	326.860	243.592
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.301	72.592	8.422
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.639	6.594	23.403
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.585	20.375	5.020
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.664	47.898	91.782
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.876	79.440	188.367
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.408	253.853	261.253
HR	Persons employed, GVA	Step dummy from 2010	Yes	Yes	OLS	0.522	6.387	19.170
HU	Persons employed, GVA	3	No	Yes	OLS	0.892	11.264	23.442
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.499	53.222	167.563
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.170	128.678	116.396
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.464	5.627	1.245
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.539	4.229	4.835
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.325	1.495	0.944
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.526	1.107	0.772
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.729	87.906	23.057
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.921	19.831	72.246
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.577	25.911	20.864
RO	Persons employed, GVA	2	Yes	No	OLS	0.550	12.847	17.188
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.571	151.045	132.849
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.179	8.392	10.763
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.771	3.544	6.141
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.460**	**630.678**	**1 414.647**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**2**	**Yes**	**Yes**	**OLS**	**0.537**	**774.430**	**1 641.150**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.682	240.418	96.602
AU	Persons employed, GVA	2	Yes	Yes	OLS	0.279	136.708	26.272
CA	Persons employed, GVA	2	Yes	Yes	OLS	0.631	250.516	261.044
JP	Persons employed, GVA	2	No	No	OLS	0.692	1 939.787	244.584
KR	Persons employed, GVA	3	No	Yes	OLS	0.630	840.580	1 333.759
TW	Persons employed, GVA	1	Yes	Yes	OLS	0.825	194.623	466.411
US	Persons employed, GVA	1	Yes	Yes	OLS	0.786	3 741.122	5 082.538

Note: NACE sectors C26+J for CA, JP and US for the predictor of Persons employed.

Table A4.c. Description of the estimation models for BERD. ICT manufacturing (comprehensive definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.766	57.109	108.442
BE	Persons employed, GVA	3	No	Yes	OLS	0.836	29.078	41.445
BG	GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.866	0.953	7.116
CY	Persons employed, GVA	3	No	No	OLS	0.749	0.010	0.005
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.718	3.594	9.033
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	No	Yes	OLS	0.382	269.629	164.051
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.630	12.350	2.180
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.741	1.416	4.477
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.812	4.450	1.398
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.879	13.610	6.160
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.912	66.452	47.889
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.576	128.044	179.276
HR	Persons employed, GVA	0	Yes	Yes	OLS	0.181	8.062	11.186
HU	GVA	2	Yes	No	OLS	0.690	4.654	1.727
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.734	27.888	87.303
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.462	60.998	48.932
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.567	2.346	1.075
LU	GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.855	0.283	0.172
LV	GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.590	0.473	1.365
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.239	1.115	0.387
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.899	33.944	53.043
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.955	3.462	36.254
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.861	2.492	2.409
RO	Persons employed, GVA	2	Yes	No	OLS	0.809	1.602	1.521
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.532	207.506	47.147
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.653	2.587	7.859
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.760	0.896	0.583
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**Yes**	**OLS**	**0.426**	**515.195**	**982.138**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**Yes**	**OLS**	**0.532**	**520.491**	**927.061**

Table A4.d. Description of the estimation models for BERD. ICT manufacturing (operational definition), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector C)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.766	57.109	108.442
BE	Persons employed, GVA	3	No	Yes	OLS	0.836	29.078	41.445
BG	GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.866	0.953	7.116
CY	Persons employed, GVA	3	No	No	OLS	0.819	0.014	0.001
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.718	3.594	9.006
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	No	Yes	OLS	0.382	269.644	163.616
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.629	12.374	2.190
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.741	1.416	4.477
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.812	4.450	1.398
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.879	13.610	6.160
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.912	66.452	47.889
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.576	128.044	179.276
HR	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.163	8.062	9.757
HU	GVA	2	Yes	No	OLS	0.690	4.654	1.727
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.733	27.869	87.246
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.462	61.010	48.959
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.567	2.346	1.075
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.739	0.312	0.196
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.574	0.441	1.369
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.239	1.115	0.387
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.899	33.989	52.970
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.955	3.462	36.254
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.861	2.492	2.409
RO	Persons employed, GVA	2	Yes	No	OLS	0.809	1.602	1.521
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.532	207.492	47.093
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.653	2.587	7.859
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.760	0.896	0.583
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**Yes**	**OLS**	**0.427**	**514.971**	**980.470**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**Yes**	**OLS**	**0.533**	**520.135**	**925.411**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.588	82.420	52.077
AU	Persons employed, GVA	2	Yes	No	OLS	0.170	30.927	25.217
CA	Persons employed, GVA	3	No	No	OLS	0.813	150.314	38.375
JP	Persons employed, GVA	2	No	No	OLS	0.730	1 568.601	387.556
KR	Persons employed, GVA	Step dummy from 2010	No	No	OLS	0.636	783.898	644.140
TW	Persons employed, GVA	1	Yes	Yes	OLS	0.789	206.172	427.881
US	Persons employed, GVA	2	Yes	No	OLS	0.778	3 012.324	1 958.267

Note: NACE sector C26 for CA, JP and US for the predictor of Persons employed.

Table A4.e. Description of the estimation models for BERD. ICT total services, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.255	28.977	27.579
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.770	48.526	215.760
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.338	10.127	7.909
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.669	2.103	3.124
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.756	12.659	36.182
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.458	156.060	250.974
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.524	66.188	40.723
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.577	6.126	8.661
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.631	15.397	9.865
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.657	58.426	85.036
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.367	29.374	25.869
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.581	152.943	158.248
HR	Persons employed, GVA	3	No	No	OLS	0.629	5.685	6.349
HU	Persons employed, GVA	3	No	Yes	OLS	0.892	11.648	23.887
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	AR(1)	0.402	37.816	51.060
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.449	81.741	52.684
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.674	4.222	12.185
LU	GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.493	4.537	4.769
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.568	1.110	1.777
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.688	0.719	0.261
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.258	90.756	5.660
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.880	22.266	58.602
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.542	27.765	17.184
RO	Persons employed, GVA	2	Yes	No	OLS	0.630	11.148	27.798
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.938	60.857	217.480
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.574	4.362	6.987
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.912	2.050	8.084
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.452**	**474.102**	**655.648**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.651**	**423.549**	**622.830**

Table A4.f. Description of the estimation models for BERD. ICT trade industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.274	2.634	7.646
BE	Persons employed, GVA	3	No	Yes	OLS	0.817	2.216	6.397
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.694	0.289	0.223
CY	GVA	2	Yes	No	OLS	0.909	0.003	0.003
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.945	0.398	2.830
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.333	1.546	1.149
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.696	15.408	26.857
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.943	0.105	0.560
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.635	4.607	7.397
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.931	6.388	1.656
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.984	0.635	4.539
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.939	18.893	68.668
HR	Persons employed, GVA	3	No	No	OLS	0.994	0.041	0.925
HU	Persons employed, GVA	3	No	No	OLS	0.842	0.715	1.653
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.943	9.065	3.751
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.979	2.492	1.034
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.920	0.202	1.820
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.859	0.053	0.098
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	AR(1)	0.605	0.086	0.075
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.960	0.030	0.144
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.850	10.624	19.158
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.468	3.197	3.147
PT	GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.988	1.999	0.366
RO	Persons employed, GVA	3	No	No	OLS	0.914	0.123	0.432
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.710	2.066	4.726
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.844	0.276	0.230
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.752	0.413	0.934
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**No**	**OLS**	**0.803**	**45.243**	**46.548**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**No**	**OLS**	**0.644**	**75.003**	**146.127**

Table A4.g. Description of the estimation models for BERD. ICT services industries, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.283	27.727	27.703
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.752	49.339	212.118
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.343	10.125	8.341
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.668	2.105	3.103
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.759	12.458	39.096
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.456	155.953	250.714
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.515	62.875	14.955
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.583	6.021	9.823
EL	Persons employed; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.671	14.787	5.775
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.632	52.506	89.013
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.412	28.234	29.173
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.505	179.958	197.484
HR	Persons employed, GVA	3	No	No	OLS	0.618	5.677	5.383
HU	Persons employed, GVA	3	No	Yes	OLS	0.879	12.127	22.195
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.502	32.383	76.140
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.456	78.735	59.200
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.690	3.691	9.449
LU	GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.495	4.483	4.501
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.191	1.474	1.217
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.675	0.709	0.118
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.425	75.307	26.197
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.898	20.585	56.653
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.546	27.105	22.921
RO	Persons employed, GVA	2	Yes	No	OLS	0.631	11.138	27.874
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.937	60.974	219.474
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.602	4.157	6.756
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.920	1.945	7.053
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.462**	**465.021**	**690.219**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**0**	**Yes**	**No**	**OLS**	**0.638**	**432.034**	**776.258**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.732	167.088	57.636
AU	Persons employed, GVA	0	Yes	Yes	OLS	0.195	122.031	10.698
CA	GVA	0	Yes	Yes	OLS	0.036	269.932	184.192
JP	Persons employed, GVA	3	No	Yes	OLS	0.908	250.629	132.772
KR	Persons employed, GVA	3	No	Yes	OLS	0.441	92.816	122.250
TW	GVA	3	No	Yes	OLS	0.813	13.586	7.127
US	Persons employed, GVA	0	Yes	No	OLS	0.701	1 906.179	2 979.406

Table A4.h. Description of the estimation models for BERD. IT services (Telecommunications), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.793	2.317	2.419
BE	Persons employed, GVA	3	No	Yes	OLS	0.684	24.394	38.959
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.318	1.241	0.275
CY	Persons employed, GVA	3	No	No	OLS	0.826	0.069	0.054
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.886	1.559	10.474
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.620	101.009	42.130
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	No	No	OLS	0.440	16.662	3.753
EE	GVA; GFCF Int. Prop. (Total)	2	No	Yes	OLS	0.590	1.768	2.992
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.674	5.495	0.924
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.638	44.562	14.258
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	2	No	Yes	OLS	0.409	8.053	2.946
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.735	79.857	87.268
HR	Persons employed, GVA	3	No	No	OLS	0.821	3.626	0.196
HU	Persons employed, GVA	2	Yes	Yes	OLS	0.974	1.854	18.719
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.929	2.544	1.286
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.634	91.315	27.280
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.937	1.209	1.807
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.778	0.966	1.555
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.999	0.021	0.635
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.165	0.096	0.075
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.816	18.217	4.689
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.763	7.688	19.955
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.625	19.763	33.588
RO	Persons employed, GVA	3	No	No	OLS	0.916	0.860	0.677
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.905	0.990	1.434
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.909	0.586	0.618
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.917	0.052	0.055
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**No**	**OLS**	**0.659**	**206.427**	**270.885**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**No**	**OLS**	**0.735**	**200.647**	**148.622**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	No	No	OLS	0.691	100.111	49.187
AU	Persons employed, GVA	1	No	No	OLS	0.407	60.003	8.059
CA	Persons employed, GVA	3	No	No	OLS	0.666	36.888	31.127
JP	Persons employed, GVA	2	No	Yes	OLS	0.798	339.744	105.210
KR	GVA	3	No	Yes	OLS	0.534	55.079	34.633
TW	Persons employed, GVA	Step dummy from 2010	No	Yes	OLS	0.511	7.017	11.235
US	Persons employed, GVA	3	No	No	OLS	0.644	324.145	211.196

Note: NACE sector J61 for CA, JP and US for the predictor Persons employed. NACE sector J61 for JP, KR and US for the predictor GVA.

Table A4.i. Description of the estimation models for BERD. IC services (Computer and related activities), PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.308	26.650	23.104
BE	Persons employed, GVA	0	Yes	Yes	OLS	0.832	33.983	149.209
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.352	9.465	7.322
CY	Persons employed, GVA	0	Yes	Yes	OLS	0.661	2.114	3.039
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.784	11.735	28.274
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.527	104.959	353.758
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.489	59.734	18.871
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.567	5.500	13.687
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.661	14.471	6.325
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.571	42.195	94.261
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.349	27.276	24.798
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.516	99.708	136.770
HR	Persons employed, GVA	Step dummy from 2010	No	Yes	AR(1)	0.348	4.650	3.240
HU	Persons employed, GVA	2	Yes	Yes	OLS	0.848	10.564	17.424
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.476	37.395	73.590
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.722	71.359	153.643
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.926	1.157	4.611
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.653	3.377	1.442
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.375	1.184	1.733
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.668	0.707	0.329
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.517	58.323	6.724
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.862	23.327	69.185
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.577	11.852	7.798
RO	Persons employed, GVA	3	No	No	OLS	0.506	11.367	27.124
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.936	61.520	215.682
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.626	3.450	6.322
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.914	2.026	7.044
EU27_2020	**Persons employed; GFCF Int. Prop. (Total)**	**0**	**Yes**	**Yes**	**OLS**	**0.702**	**331.634**	**799.231**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**2**	**Yes**	**Yes**	**OLS**	**0.781**	**321.541**	**610.065**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	Yes	OLS	0.274	189.921	38.075
AU	Persons employed, GVA	2	Yes	Yes	OLS	0.379	94.507	18.943
CA	Persons employed, GVA	1	Yes	Yes	OLS	0.576	193.274	191.662
JP	Persons employed, GVA	3	No	Yes	OLS	0.481	283.968	169.979
KR	Persons employed, GVA	3	No	Yes	OLS	0.506	76.957	63.347
TW	Persons employed	3	No	Yes	OLS	0.729	14.445	6.868
US	Persons employed, GVA	0	Yes	No	OLS	0.642	2 035.779	2 922.802

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A4.j. Description of the estimation models for BERD. Media and content sector, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sector J)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.478	1.001	2.615
BE	Persons employed, GVA	3	No	Yes	OLS	0.748	2.271	2.515
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.884	0.127	0.501
CY	*Model not estimated because the dependent variable is equal to zero the whole period*							
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.458	0.128	0.113
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.601	6.254	2.380
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.854	2.726	0.926
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.970	0.142	1.832
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.417	1.063	1.223
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	2	No	No	OLS	0.608	13.021	5.136
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.848	3.505	2.512
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.800	7.023	3.088
HR	Persons employed, GVA	1	Yes	Yes	OLS	0.868	0.006	0.005
HU	GVA	2	Yes	No	OLS	0.526	0.375	0.439
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.621	0.780	1.461
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.911	3.561	3.459
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.891	0.160	0.198
LU	*Model not estimated because the dependent variable is equal to zero the whole period*							
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.731	0.083	0.357
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.990	0.002	0.005
NL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.634	4.696	1.656
PL	GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.203	1.694	1.108
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	No	Yes	OLS	0.451	1.242	0.249
RO	Persons employed, GVA	0	Yes	Yes	OLS	0.979	0.009	0.200
SE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.169	13.985	7.128
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.978	0.433	0.164
SK	*Model not estimated because the dependent variable is equal to zero most of the period*							
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**No**	**OLS**	**0.476**	**30.431**	**6.779**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**Yes**	**OLS**	**0.724**	**53.212**	**71.380**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.906	29.067	8.809
AU	Persons employed, GVA	3	No	No	OLS	0.575	10.676	2.161
CA	GVA	0	Yes	Yes	OLS	0.012	28.683	17.500
JP	Persons employed, GVA	3	No	No	OLS	0.561	33.029	20.034
KR	Persons employed, GVA	0	Yes	Yes	OLS	0.190	12.979	13.977
TW	Persons employed, GVA	3	No	Yes	OLS	0.384	0.957	1.184
US	Persons employed, GVA	0	Yes	Yes	OLS	0.926	1 001.937	6 397.363

Note: Difference of the NACE sectors J- J61 for CA, JP and US for the predictor Persons employed. Difference of the NACE sectors J- J61 for JP, KR and US for the predictor GVA.

Table A4.k. Description of the estimation models for BERD. Retail sale sector, PREDICT 2022

Country	Predictors				Estimation method	Adjusted R^2 for the model of the whole period	$RMSE_{9519}$ (Estimation for the whole period)	$RMSE_{1819}$ (Out of sample prediction)
	National Accounts variables (NACE sectors G_I)	Dummies for the years 1995-2017	Dummies for the years 2018, 2019	Trend				
AT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.631	36.994	2.792
BE	Persons employed, GVA	1	Yes	Yes	OLS	0.577	34.514	7.694
BG	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	Yes	OLS	0.488	0.484	1.406
CY	Persons employed, GVA	3	No	No	OLS	0.970	0.005	0.001
CZ	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.638	3.270	4.895
DE	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.941	12.552	32.164
DK	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.572	22.836	30.811
EE	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.786	0.262	0.585
EL	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.583	6.602	9.699
ES	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.734	16.143	15.650
FI	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.741	5.505	5.316
FR	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.930	79.025	142.601
HR	Persons employed, GVA	3	No	No	OLS	0.999	0.014	0.682
HU	Persons employed, GVA	3	No	Yes	OLS	0.899	7.469	7.064
IE	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.592	9.799	16.486
IT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.210	62.766	44.978
LT	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	Yes	OLS	0.406	1.079	2.443
LU	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.955	0.352	1.251
LV	Persons employed, GVA; GFCF Int. Prop. (Total)	0	Yes	No	OLS	0.201	0.146	0.255
MT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.884	0.401	1.057
NL	GVA; GFCF Int. Prop. (Total)	Step dummy from 2010	No	No	OLS	0.291	83.146	18.992
PL	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.946	4.909	9.361
PT	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	Yes	OLS	0.654	4.776	9.053
RO	Persons employed, GVA	3	No	No	OLS	0.741	1.685	0.725
SE	GVA; GFCF Int. Prop. (Total)	3	No	No	OLS	0.915	27.756	32.791
SI	Persons employed, GVA; GFCF Int. Prop. (Total)	2	Yes	No	OLS	0.836	0.810	2.943
SK	Persons employed, GVA; GFCF Int. Prop. (Total)	1	Yes	No	OLS	0.749	0.752	1.451
EU27_2020	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**Yes**	**OLS**	**0.919**	**231.890**	**804.429**
EU28	**Persons employed, GVA; GFCF Int. Prop. (Total)**	**3**	**No**	**Yes**	**OLS**	**0.885**	**300.196**	**858.165**
UK	Persons employed, GVA; GFCF Int. Prop. (Total)	3	No	Yes	OLS	0.227	79.154	120.264
AU	Persons employed, GVA	3	No	No	OLS	0.714	2.822	5.452
CA	Persons employed	1	Yes	No	OLS	-0.133	0.113	0.085
JP	*Model not estimated because the dependent variable is not available for the Retail sale sector*							
KR	Persons employed, GVA	3	No	Yes	OLS	0.483	44.006	87.575
TW	Persons employed, GVA	3	No	Yes	OLS	0.849	1.122	3.409
US	Persons employed, GVA	1	Yes	Yes	OLS	0.996	106.650	2 314.934

Note: NACE sectors G47 for JP and G4791 for CA and US for the predictor Persons employed. NACE sector G47 for JP and US for the predictor GVA.

References

Andreou, E., E. Ghysels and A. Kourtellos (2011). “Forecasting with mixed-frequency data” in Clements, M. P., and Hendry, D. F. (eds.). Oxford Handbook of Economic Forecasting. Oxford University Press, pp. 225–246.

Arellano, M. and Bond, S. (1991). “Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations”. Review of Economic Studies, 58, pp. 277-297.

Bánbura, M., D. Giannone, and L. Reichlin (2011). “Nowcasting,” in Oxford Handbook on Economic Forecasting, ed. by M. P. Clements, and D. F. Hendry, pp. 63–90. Oxford University Press.

Blundell, R., and S. Bond (1998): “Initial conditions and moment restrictions in dynamic panel data models”. Journal of Econometrics 87: 115–143

Boivin, J. and S. Ng (2005): “Understanding and comparing factor-based forecasts”, International Journal of Central Banking, 1(3).

Castle, J.L., D.F. Hendry and O.I. Kitov (2013). Forecasting and Nowcasting Macroeconomic Variables: A Methodological Overview, in Handbook on Rapid Estimates, United Nations Statistics Division.

Dernis, H. (2007). “Nowcasting patent indicators”, STI Working Paper 2007/3. DTSI/DOC(2007)3. OECD.

Eurostat (1994). "NABS. Nomenclature for the analysis and comparison of scientific programmes and budgets". ISBN 92-826-8480-6. Luxembourg.

Eurostat (2008). "Comparison between NABS 2007 and NABS 1992". October 2008. Luxembourg.

Eurostat (2010). “Methods for Nowcasting patent data”, Patent Statistics Working Paper. Eurostat December 21st, 2010. Available at: https://circabc.europa.eu/sd/a/215a3a3e-2c8a-44ca-acb9-5455096d6ac6/2011-12-Revised%20Patent%20nowcast.pdf.

Eurostat (2012). Glossary on Rapid Estimates. Eurostat: Statistics Explained. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Category:Rapid_estimates_glossary

Eurostat (2020). ICT specialists in employment. Eurostat metadata. Available at: https://ec.europa.eu/eurostat/cache/metadata/en/isoc_skslf_esms.htm

Ghysels, E., Sinko, A., and Valkanov, R. (2007). “MIDAS regressions: Further results and new directions”, Econometric Reviews, 26, 53–90

International Labour Organization (ILO, 2007). "Report for the Meeting of Experts on Labour Statistics: Updating the International Standard Classification of Occupations". Geneva.

Mas, M., E. Benages, Fernández de Guevara, J. and L. Hernández (2016). “A proposal for disentangling publicly funded R&D (GBARD) by industry”. SPINTAN Working Paper Series 23.

Mas, Robledo and Pérez (2012). “ICT sector definition transition from NACE Rev. 1.1 to NACE Rev. 2: A methodological note”. JRC Science and Policy Report No.25690. Institute for Prospective Technological Studies, Seville.

OECD (2002). Frascati Manual – Proposed Standard Practice for Surveys on Research and Experimental Development. Sixth edition, Paris.

OECD (2006). “Information Economy – Sector definitions based on the International Standard Industry Classification (ISIC 4)”. Working Party on Indicators for the Information Society. DSTI/ICCP/11S(2006)2/FINAL. OECD, Paris.

OECD (2007). “Information Economy – Sector definitions based on the International Standard Industry Classification (ISIC 4)”. Working Party on Indicators for the Information Society. DSTI/ICCP/11S(2006)2/FINAL. OECD, Paris.

OECD (2011). "Guide to measuring the Information Society". ISBN 978-92-64-09598-4. http://www.oecd.org/sti/measuring-infoeconomy/guide

OECD (2015). "Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities", OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264239012-en

OECD (2015). "Proposal for an Eurostat-OECD definition of ICT Specialists". Working Party on Indicators for the Information Society. DSTI/ICCP/IIS(2015)7/REV1. http://ec.europa.eu/eurostat/cache/metadata/Annexes/isoc_skslf_esms_an1.pdf

Sabadash, A. (2013). ICT Employment Statistics in Europe: Measurement Methodology. JRC Technical Report No.26123.

List of Definitions

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

BERD intensity: BERD/GDP.

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.

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

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

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 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), and 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, 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).

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
EU28:	Former European Union (aggregate of the 28 countries between 2013 and 2020)
EU27_2020:	European Union aggregate with 27 Member States from 2020 (without United Kingdom)
EUR:	Euros
Eurostat:	Statistical Office of the European Communities
FTE:	Full-time equivalent
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
NA	National Accounts
NABS	Nomenclature for the Analysis and Comparison of Scientific Budgets and Programmes
NACE:	Statistical classification of economic activities in the European Community
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

List of Tables and Figures

List of Correspondence Tables

List of Regression Tables

KJ-NA-31174-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
joint-research-centre.ec.europa.eu

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

EU Science

Publications Office
of the European Union

doi:10.2760/33739

ISBN 978-92-76-55603-9