



The 2008 European e-Business Readiness Index

Stefano Tarantola, William Castaings

EUR 23770 EN - 2009

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JRC 50478

EUR 23770 EN
ISSN 1018-5593

Luxembourg: Office for Official Publications of the European Communities

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Printed in Italy

The 2008 European e-Business Readiness Index

Stefano Tarantola and William Castaings

Abstract: This report shows the scores of the 2008 e-business readiness index for European enterprises. The 2008 e-business readiness index, evaluated using data from the 2007 ICT enterprise survey carried out by Eurostat, is a useful mechanism for comparing e-business adoption and use by firms in the various European countries. The e-business readiness index measures the ICT adoption by enterprises using 6 indicators and measures ICT use by enterprises using another 6 indicators. The report describes the 12 benchmark indicators and the data coverage. The index obtained with the 2007 data is compared with the index calculated from previous years. The trends of the benchmark indicators are analysed and the robustness of the index scores among countries is tested to assess the significance of country rankings.

Further information: http://ec.europa.eu/enterprise/ict/policy/ebi/index_en.htm

Keywords: ICT, e-business, enterprises, benchmark indicators, eEurope2005, i2010

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Executive Summary

This report describes the results of the e-business readiness index for European firms, using data from the 2007 European enterprise survey on Information Society Statistics, as collected by National Statistical Institutes and verified by Eurostat. The index is made of two core dimensions: *adoption of ICT* by business, and *use of ICT* by business. Since the 2004 pilot exercise, the index has proven to be a useful tool for gauging sectoral and country progress and a useful mechanism for benchmarking e-business readiness.

Enterprises in many countries have made significant progress during the observation period ranging from 2004 to 2007.

Although quantitatively the country scores are much lower for *use of ICT* than *adoption of ICT*, the pattern of country performance for the category *use of ICT* is globally similar to that of *adoption*. Denmark confirms its leading position and the top ranks are still occupied by other Nordic countries (Sweden, Finland, Norway) together with the Netherlands, Germany and Belgium. Together with the Mediterranean Member States, most of the states from Eastern Europe, which joined the EU recently (2004 and 2007), are still in the developing stage of their e-business environment. On the other hand, Malta, Slovenia, Slovakia, Czech Republic and Estonia, who joined the EU in 2004, reach a relatively fair level of *adoption* and *use*.

Due to lack of resources we could not quantify the e-business index for the various industry sectors and company sizes. We refer to the 2007 report for the latest figures available.

1. INTRODUCTION

Information and communication technologies (ICT) are a powerful driver for economy-wide productivity, growth and jobs. ICT adoption and use by enterprises has an important impact on the business processes, organisations, performance and competitiveness of enterprises. The benchmarking of the readiness to take up e-business is an important issue. This is well reflected in the yearly Economist Intelligence Unit's (EIU) e-readiness studies¹ and in the global reports of the Bridges – organisation².

This is the fifth yearly report on the e-business readiness index. The previous reports were conducted in 2004, 2005, 2006 and 2007 (Nardo *et al*, 2004; Pennoni *et al.*, 2005; Castaings *et al.*, 2007; Castaings *et al.*, 2008)

In this report the index (we will refer to it as composite indicator (CI) from now on) is used to track progress of European enterprises in *adoption* and *use* of ICT tools. One CI for *adoption* and one for *use* of ICT are calculated. CIs are aggregate measures that are obtained as weighted combinations of selected indicators. They are increasingly used by media and policy makers to communicate information on the progress of countries or regions in various policy fields.

The CI obtained with the 2007 data is compared with the CIs calculated from previous years. The trends of the benchmark indicators are analysed and the robustness of the index scores among countries is tested to assess the significance of country rankings.

This document contains an introductory section (section 2) with a description of the component indicators and the data coverage. Section 3 describes the main findings for the categories *adoption* and *use of ICT*. A detailed analysis of the results and the examination of the trends with respect to previous years are given in section 4. Finally, in section 5 the robustness of the CI scores is tested to assess the significance of country rankings.

¹ Please see: EIU & IBM 2007 report: http://www.eiu.com/site_info.asp?info_name=eiu_2007_e_readiness_rankings&rf=0

² Bridges – organisation <http://www.bridges.org/>

BASIC INDICATORS AND DATA COVERAGE

1.1. Data sources and component indicators

The e-business readiness index is one of the policy indicators selected by the Council Resolution of 28 January 2003 (5197/03) of the European Union to monitor progress in the implementation of the eEurope 2005 Action Plan (COM(2002) 263 final).

The European enterprise survey on Information Society Statistics aims to produce harmonised and comparable yearly statistics on *adoption* and *use of ICT* by European enterprises. The indicators for the CI are grouped into two categories: six indicators in the group *adoption of ICT by business* and six indicators in the group *use of ICT by business*. The raw data for the twelve indicators are expressed as percentages: eleven indicators are percentages of enterprises and one indicator (*a4*) is percentage of employees (see Tables 1 Table and 2).

Table 1. 2008 e-business readiness index: list of indicators for *adoption of ICT*

<i>Adoption of ICT: basic indicators</i>	<i>Code</i>
Percentage of enterprises that use Internet	<i>a1</i>
Percentage of enterprises that have web/home page	<i>a2</i>
Percentage of enterprises that use at least two 2 security facilities at the time of the survey	<i>a3</i>
Percentage of total number of persons employees using computer with their normal work routine	<i>a4</i>
Percentage of enterprises having broadband connection to internet	<i>a5</i>
Percentage of enterprises with LAN and using an Intranet and Extranet	<i>a6</i>

Table 2. 2008 e-business readiness index: list of indicators for *use of ICT*

<i>Use of ICT: basic indicators</i>	<i>Code</i>
Percentage of enterprises that have purchased products / services via the internet, EDI ³ or any other computer mediated network where these are >1% of total purchases	<i>b1</i>
Percentage of enterprises that have received orders via the internet, EDI or any other computer mediated network where these are >1% of total turnover	<i>b2</i>
Percentage of enterprises whose IT systems for managing orders or purchases are linked automatically with other internal IT systems	<i>b3</i>
Percentage enterprises whose IT systems are linked automatically to IT systems of suppliers or customers outside their enterprise group	<i>b4</i>

³ Electronic Data Interchange

Percentage of enterprises with Internet access using the internet for banking and financial services	<i>b5</i>
Percentage of enterprises that have sold products to other enterprises via a presence on specialised internet market places	<i>b6</i>

For a thorough description of the steps underlying the development of a CI the reader is referred to the OECD/JRC handbook (Nardo et al, 2008). Here, the component indicators are aggregated using a participatory weighing scheme involving a panel of national representatives. Weights were assigned to the indicators according to the “budget allocation scheme”, which consists in asking each expert in the panel to distribute 100 *points* proportionally to the relevance of the indicator for measuring e-readiness. The set of weights given in Table 3 represents the average of weights provided by twelve national representatives of the e-BSN⁴. Although the table presents rounded values (which do not sum up to one), all available digits were used for the calculations.

Table 3 Average budget allocation weights for the different index components

<i>a1</i>	<i>a2</i>	<i>a3</i>	<i>a4</i>	<i>a5</i>	<i>a6</i>
0.18	0.16	0.10	0.16	0.21	0.20
<i>b1</i>	<i>b2</i>	<i>b3</i>	<i>b4</i>	<i>b5</i>	<i>b6</i>
0.17	0.17	0.21	0.21	0.12	0.13

Using the *nc* basic indicators (denoted by I_k , $k=1, \dots, nc$) and the corresponding weights (denoted by w_k , $k=1, \dots, nc$) for the aggregation, the value of the composite indicator CI (either *adoption* or *use*) is given by a linear aggregation rule:

$$CI = \sum_{k=1}^{nc} w_k I_k$$

The explanatory power of the index depends on the availability and quality of the data (this year only a few missing values are present). The index is a valuable tool to identify the progress made by enterprises and consequently should guide policy-makers to help European enterprises.

1.2. The data set

The data used throughout the analysis⁵ refer to the European businesses of different sizes and sectors of economic activity covered by the 2007 Community Survey on ICT Usage and e-Commerce in Enterprises. The survey includes indicators for the EU27 as well as Norway (member of the European Free Trade Association - EFTA). The model survey was developed by Eurostat in close collaboration with Member States. From the results obtained, aggregates (mostly binomial proportions) were compiled by the National Statistical Institutes (NSI) of the Member States for the total population and for different breakdowns defined by 2 background variables: the main economic activity of the enterprise (NACE groupings) and the number of persons employed (size categories).

⁴ The European e-Business Support Network is a network of decision-makers and public policy experts established by the European Commission. http://ec.europa.eu/enterprise/e-bsn/index_en.html

⁵ as available from Eurostat in October 2008 at URL: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=2973.64549069.2973_64554066&_dad=portal&_schema=PORTAL

Table 4 provides an overview of the percentage of available data from 2003 to 2007 at the country level. To give an idea, a single indicator missing for a given country represents a drop of approximately 8% in data availability. The measure is highlighted in red for countries that did not participate in the community survey, in orange when the data sets were not delivered on time. The provided values reflect data availability during the various JRC e-business readiness analyses. Since some values were provided afterwards or removed for inconsistency, this does not exactly reflect the current state of the Eurostat database.

All EU27 countries are considered in the current analysis. Iceland did not provide data and therefore is not included in the calculation of the CI this year. Denmark, France, Greece and Luxembourg did not provide a complete dataset but the missing values were imputed using multi-linear regression. Only the explaining variables featuring important correlations with the missing component were considered. The obtained results lead to a consistent temporal trend.

Table 4. Data availability (in %) for 2003, 2004, 2005, 2006 and 2007 survey

Member state	Code	2003	2004	2005	2006	2007
Austria	AT	100	100	100	100	100
Belgium	BE	100	100	100	100	100
Bulgaria	BG	0	100	0	100	100
Cyprus	CY	0	100	100	100	100
Czech republic	CZ	75	83	100	100	100
Denmark	DK	100	100	100	100	92
Estonia	EE	0	92	100	100	100
Finland	FI	100	100	100	100	100
France	FR	50	0	0	100	83
Germany	DE	75	100	100	100	100
Greece	EL	100	100	100	100	83
Hungary	HU	0	92	92	100	100
Iceland	IS	100	0	0	100	0
Ireland	IE	100	100	100	100	100
Italy	IT	100	92	100	92	100
Latvia	LV	0	100	100	100	100
Lithuania	LT	0	100	100	100	100
Luxembourg	LU	100	100	92	92	92
Malta	MT	67	0	92	0	100
Netherlands	NL	100	100	100	100	100
Norway	NO	100	100	100	100	100
Poland	PL	0	100	100	100	100
Portugal	PT	100	100	92	83	100
Romania	RO	0	83	0	100	100
Slovakia	SK	0	100	100	83	100
Slovenia	SI	0	100	100	100	100
Spain	ES	100	100	100	100	100
Sweden	SE	100	92	100	100	100
United Kingdom	UK	67	75	100	100	100
Total	29	15	26	25	28	28

2. MAIN FINDINGS

The e-business index is presented as a weighted average of the component indicators by considering the budget allocation weights. This report is about the ICT Adoption and Use of enterprises. Therefore, whenever only the name of a country is used in the report, this should always be interpreted as referring to a survey sample of enterprises of that country.

2.1. Country scores and rankings

The scores and rankings the *adoption* and *use of ICT* (see Table 5) provide a relative gauge of e-business progress in 28 countries (27 European Union Member States and Norway).

Table 5 2008 e-Business Readiness ICT Adoption and Use – Scores and rankings according to the budget allocation weights

ICT Adoption	Score	Rank	ICT Use	Score	Rank
Finland	79.50	1	Denmark	40.79	1
Sweden	77.10	2	Netherlands	37.81	2
Denmark	75.18	3	Germany	37.39	3
Germany	73.92	4	Norway	36.00	4
Belgium	73.23	5	Luxembourg	35.39	5
Netherlands	72.56	6	Belgium	35.09	6
Norway	72.47	7	Austria	34.54	7
Luxembourg	69.61	8	Sweden	34.49	8
France	68.44	9	Ireland	34.27	9
United Kingdom	68.35	10	United Kingdom	33.64	10
Austria	68.26	11	Finland	31.26	11
Malta	67.49	12	Malta	29.37	12
Slovakia	66.56	13	France	27.18	13
Ireland	66.52	14	Greece	26.31	14
Slovenia	66.20	15	Slovenia	26.22	15
Czech Republic	64.49	16	Italy	25.86	16
Spain	64.24	17	Portugal	25.63	17
Estonia	61.78	18	Czech Republic	24.05	18
Italy	61.68	19	Slovakia	23.62	19
Greece	59.19	20	Spain	22.67	20
Portugal	58.16	21	Lithuania	22.54	21
Cyprus	54.91	22	Estonia	22.19	22
Poland	54.19	23	Cyprus	20.29	23
Hungary	53.81	24	Poland	19.32	24
Lithuania	52.36	25	Romania	14.52	25
Latvia	47.45	26	Latvia	14.35	26
Bulgaria	42.91	27	Hungary	14.08	27
Romania	36.79	28	Bulgaria	10.67	28
EU27	65.22		EU27	28.52	

Although quantitatively the country scores are much lower for *use* than *adoption*, the patterns of country performance for the two categories are globally similar. Northern European countries steadily occupy the top ranks and have consistently done so for the last 3 years. The leading position of Denmark for *use of ICT* is really outstanding. Small differences in scores are observed among groups of countries and this stresses the need for a robustness analysis (see section 4). Together with the Mediterranean Member States, most of the states from Eastern Europe are still in the developing stage of their e-business environment.

An appraisal of the variability of the scores calculated over all countries for *adoption* and *use* is given by the probability density estimates in Figure 1. The obtained curves, estimated using Gaussian kernels, represent non-parametric smooth estimates of CI country scores. These curves are not truncated, therefore some values can fall outside the [0, 1] range, and are not necessarily symmetric. This asymmetry is more pronounced for *adoption of ICT* for which the distributions are characterised by a negative skew (elongated tail at the left). This means that there is an important group of countries lagging behind for *Adoption of ICT*, while the performances are quite balanced across countries for *Use of ICT*.

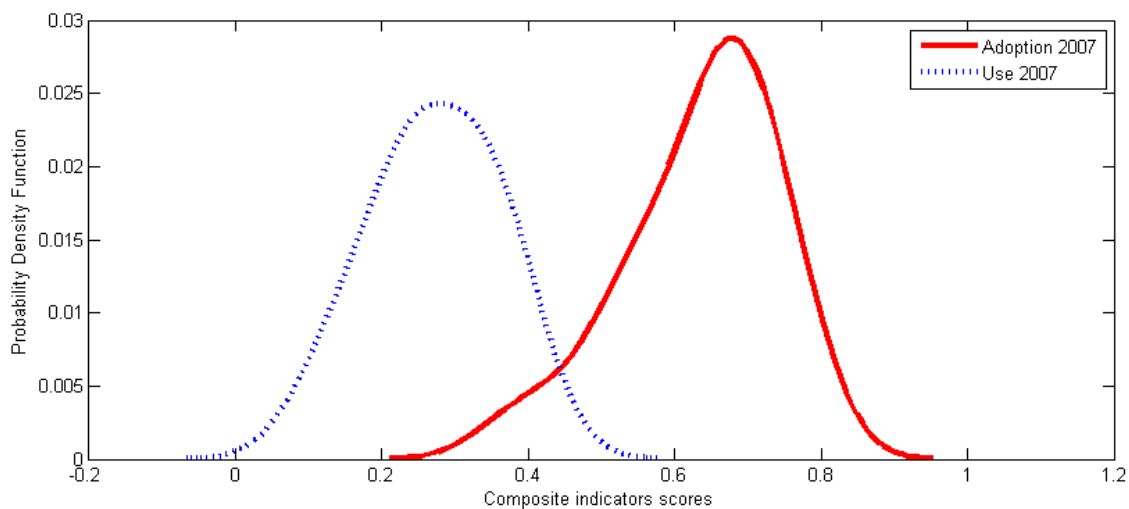


Figure 1 Probability density estimates for CI country scores

2.2. Relation between ICT Adoption and Use

A graphical representation of *adoption* versus *use of ICT* scores for the 28 countries and for the EU27 aggregate is provided in Figure 2. The correspondence between country codes and country names is given by Table 4. With respect to the EU27 aggregate, the plane is split in 4 zones that categorize the performances of the countries with respect to the EU27 average. Since the correlation between *adoption* and *use* scores is relevant ($r = 0.88$), most of the countries lie along the diagonal depicting a positive correlation. Most of the time good performances in *adoption* are coming along with a satisfactory level of *use*. With respect to the EU27 average, Greece and Portugal can be distinguished for their efficiency in using ICT infrastructures given the investments made (still below the EU average yet). Together with Spain and Italy they are the only countries from the former EU15 which are still below the European average for both *adoption* and *use*. The countries were visually grouped in 4 clusters (see Figure 2) depending on their relative position with respect to the EU27 aggregate. We

did not apply methods of cluster analysis as the outcomes are critically sensitive to the key features of the clustering algorithms (such as distance measure and predefined thresholds).

Apart from the Netherlands, Germany and Belgium, the group of leading countries (cluster 1) is essentially composed of Nordic countries. The second cluster contains countries that are consistently above the European average for both *adoption* and *use*. The third group of average performing countries includes some members of the former EU15 (France, Spain, Greece, Italy and Portugal), and the most advanced new member states like Malta, Slovenia, Slovakia, Check Republic and Estonia. The fourth cluster is made of new member states which are doing strong investments efforts in order to catch up.

With respect to last year (see Figure 2b for comparison), Portugal has moved from the fourth to the third cluster and Belgium has moved up from the second to the first cluster. On the contrary, France has moved down from the second to the third group passing from above European average to below average for *use of ICT*. Note that Slovakia has invested considerably and is now above European average for *adoption*.

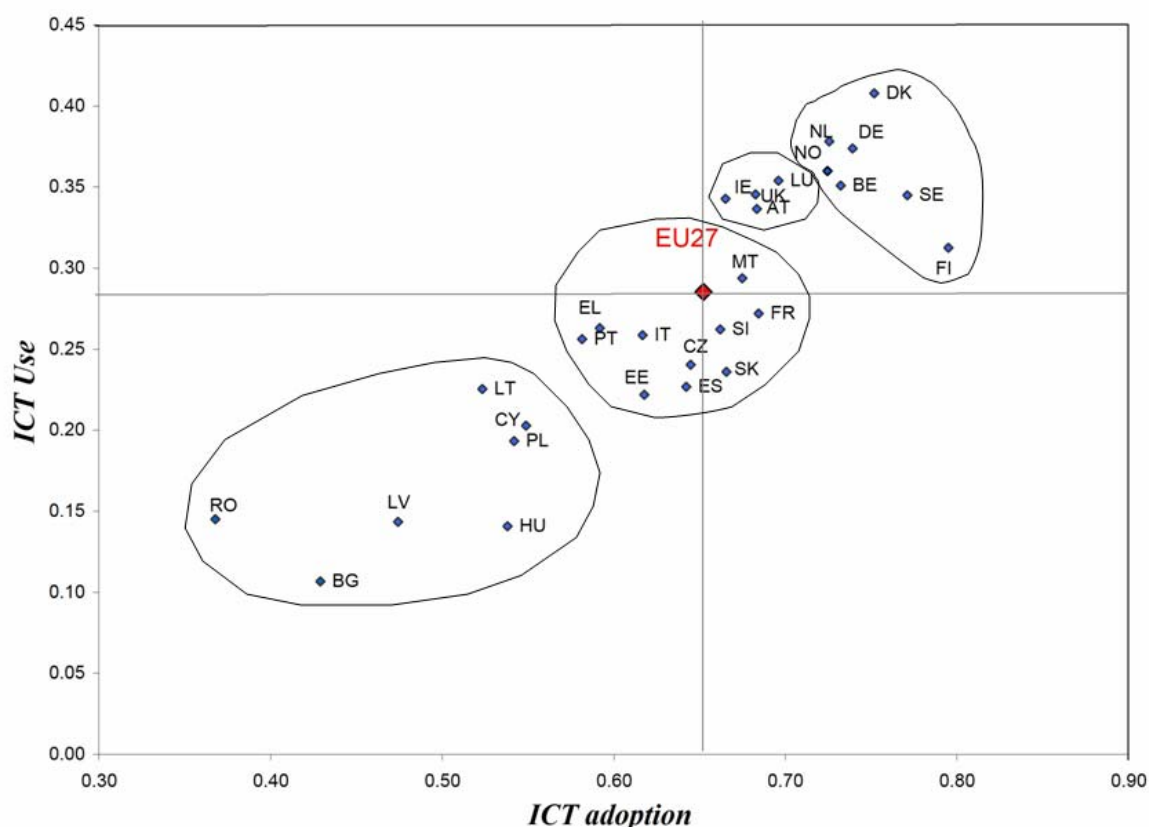


Figure 2: 2008 dataset. *Adoption* vs. *use* scores using the budget allocation weighting scheme. The red diamond indicates the EU27 aggregate

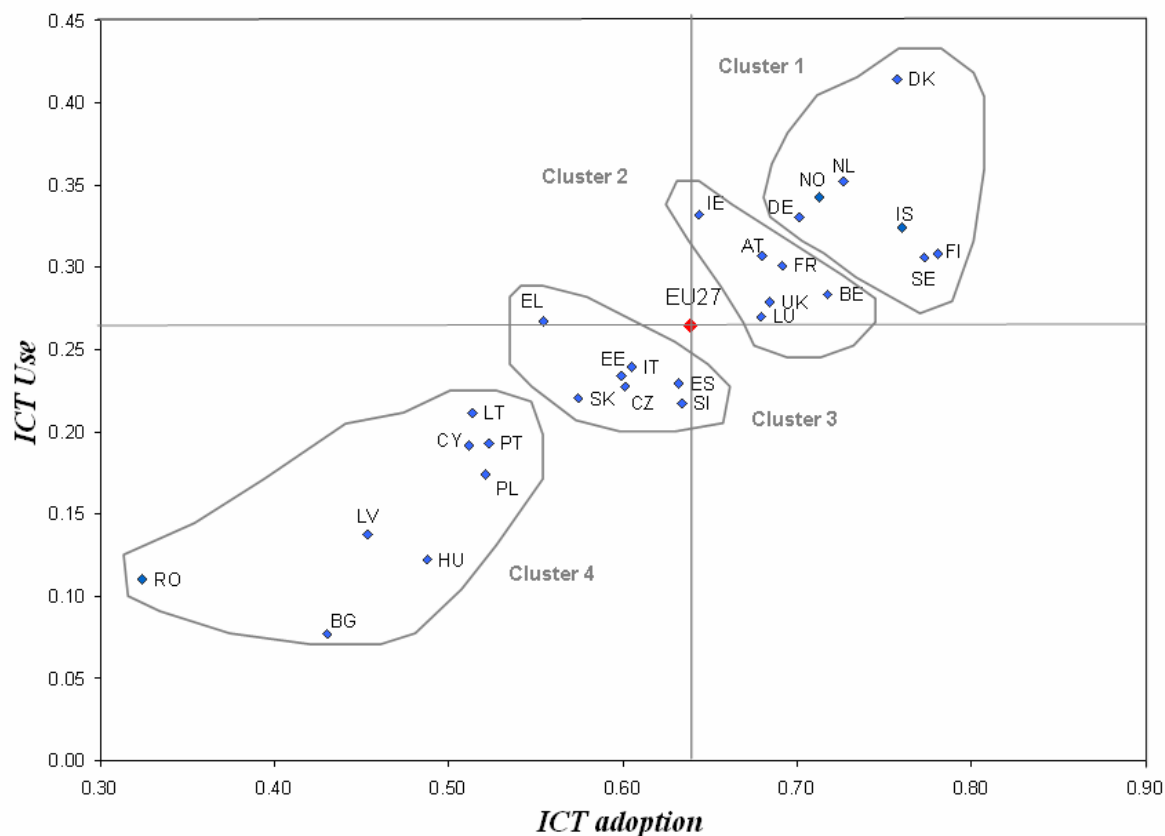


Figure 2b: 2007 dataset. *Adoption* vs. *use* scores using the budget allocation weighting scheme. The red diamond indicates the EU27 aggregate

3. TREND IN ICT ADOPTION AND USE

In order to analyse the trend in *adoption* and *use*, the results of the previous ICT enterprise surveys were used. Since some changes in the database for earlier surveys can be identified only when new data become available, the e-business index for 2003, 2004, 2005 and 2006 were re-calculated using the latest updated version of the Eurostat database (instead of using the values published in previous JRC e-business readiness reports). The imputation of missing values for 2003, 2004, 2005 and 2006 is also carried out using multi-linear regression. In case of inconsistent temporal trend for a given country, an additional correction was made using the values observed for the other surveys.

3.1. Analysis of the overall trend

The temporal shift of the distributions toward larger scores (Figure 3) is very clear for *adoption* yet still moderate for *use*.

The analysis of the distribution of *adoption* scores shows that in spite of a few countries that keep investing at the same pace of 2006, those who were lagging behind in 2006 are now progressively catching up. In other words, the variance of the distribution is getting narrower though the level of asymmetry is growing with respect to previous years.

Note how the variance of the distribution of *use* is growing with respect to previous years due to a shift towards larger scores of its right tail, while the left tail remains essentially at the same scores. This means that in spite of countries improving their usage of ICT tools, other countries persist at low performance levels. In other words, it seems that the progress made in *adoption* by low performing countries does not yet come along with the reduction of inequalities as regard to *use*.

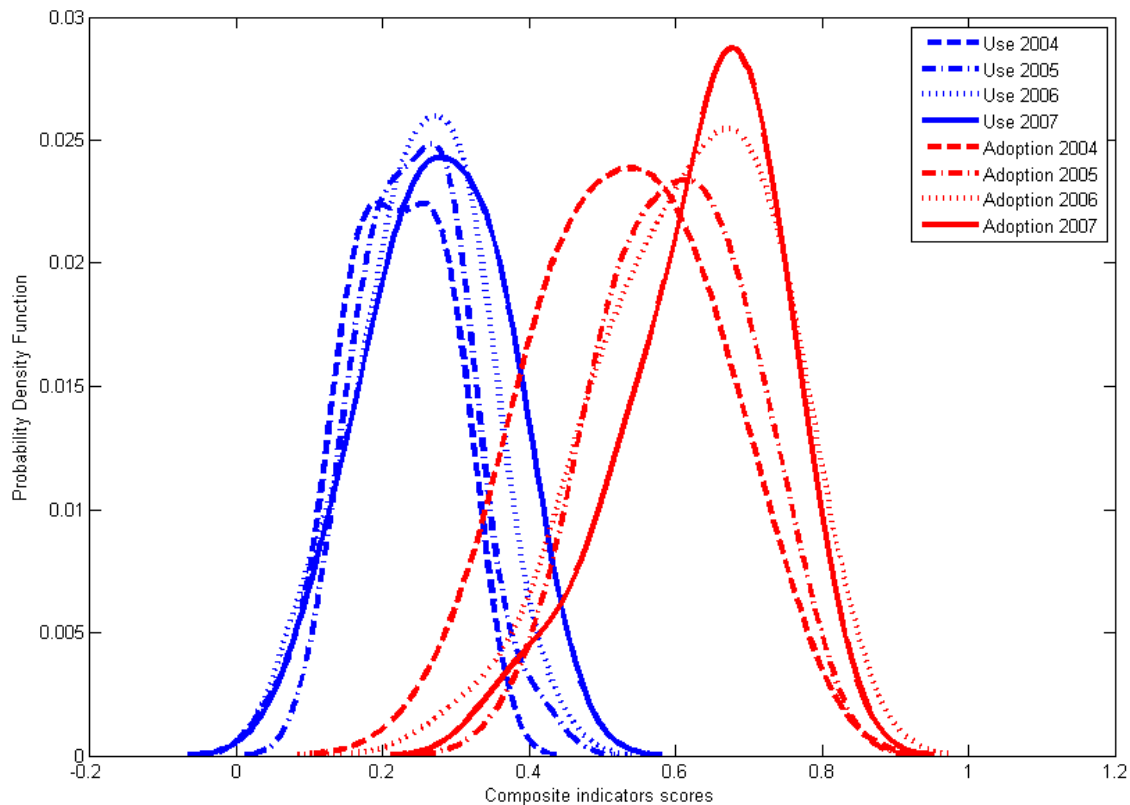


Figure 3 Probability density estimates (using normal kernel functions) for the country scores in 2004, 2005, 2006 and 2007

3.2. Analysis of the overall trend for specific indicators

The overall trend for the e-business index is mainly driven by the temporal evolution of some of its component indicators, which is examined in this section. The temporal evolutions are examined in terms of the probability densities for the country scores.

As indicated by the consensus budget allocations weights, the component *a5* (percentage of enterprises having broadband connection to internet) is a very important driver for e-business readiness. The analysis of Figure 4 reveals a positive remarkable trend for the probability density function of *a5*. This trend is also characterised by a reduction in inequalities (reduction of the variance).

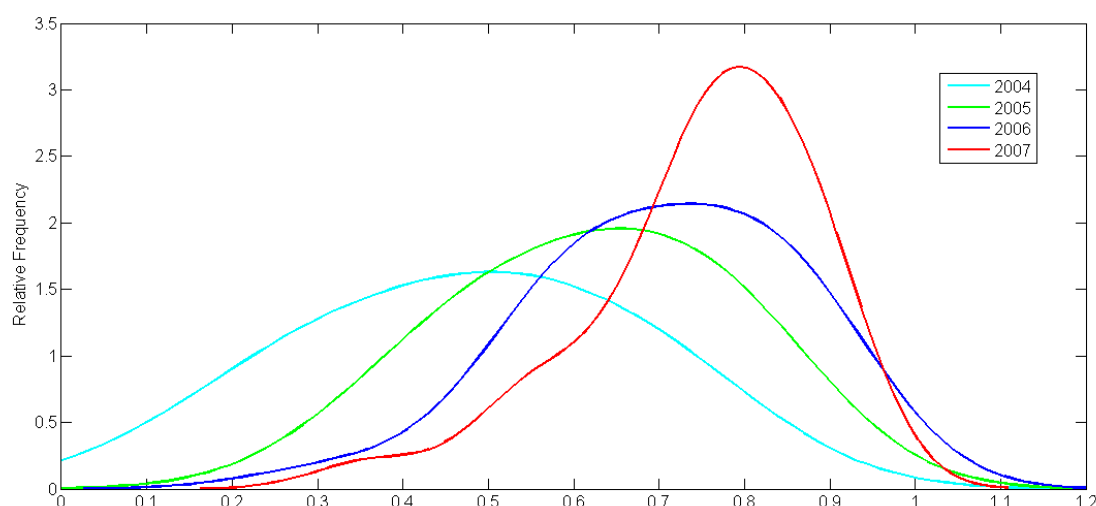


Figure 4 Evolution of the probability density function for indicator $a5$ (percentage of enterprises having broadband connection to internet)

This is a perfect illustration showing that both growth and cohesion can be achieved for specific aspects of e-business. Unfortunately, this ideal evolution is not generalized, yet often progress is achieved by a small group of leaders.

Figure 5 shows indicator $a3$, percentage of enterprises that use at least two security facilities. Note that, in spite of the progress made by most countries till 2006, during the latest year the performance has not improved at all. This is not a good sign, especially for countries with low scores, which should show a constant improvement. One would expect the distribution in Figure 5 to shrink with time towards larger scores, yet no cohesion has been attained between 2006 and 2007 in such case.

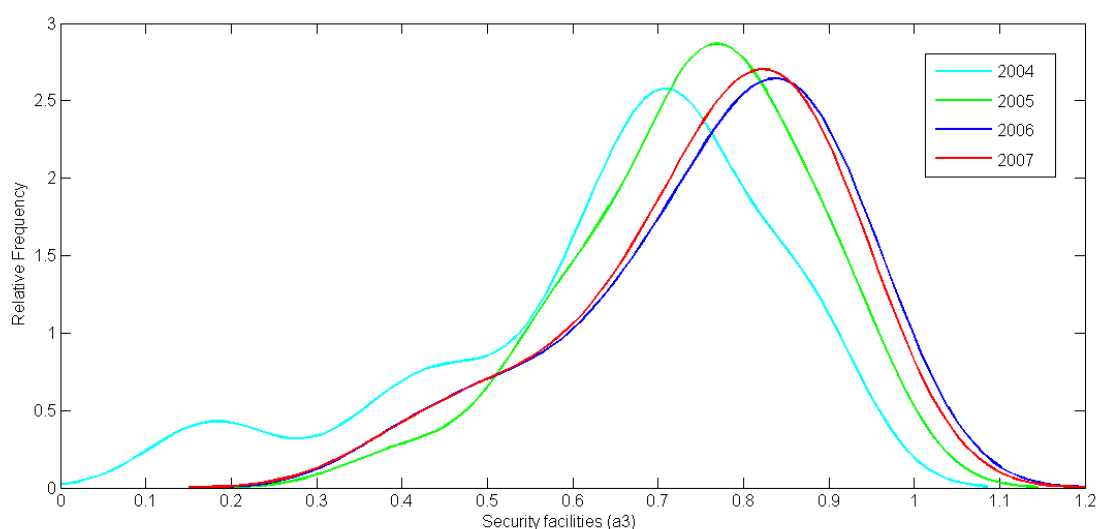


Figure 5 Evolution of the probability density function for the indicator $a3$ (percentage of enterprises that use at least two security facilities)

Figure 6 shows indicator $b5$, percentage of enterprises with Internet access using the internet for banking and financial services. Contrarily to indicator $a3$, this indicator shows a continuous positive trend since 2004. Between 2006 and 2007 the dynamics is good. The bimodal distribution in 2007

indicates the formation of a group of lagging countries, which have made not enough progress in this indicator. The other countries have progressed at a difference pace.

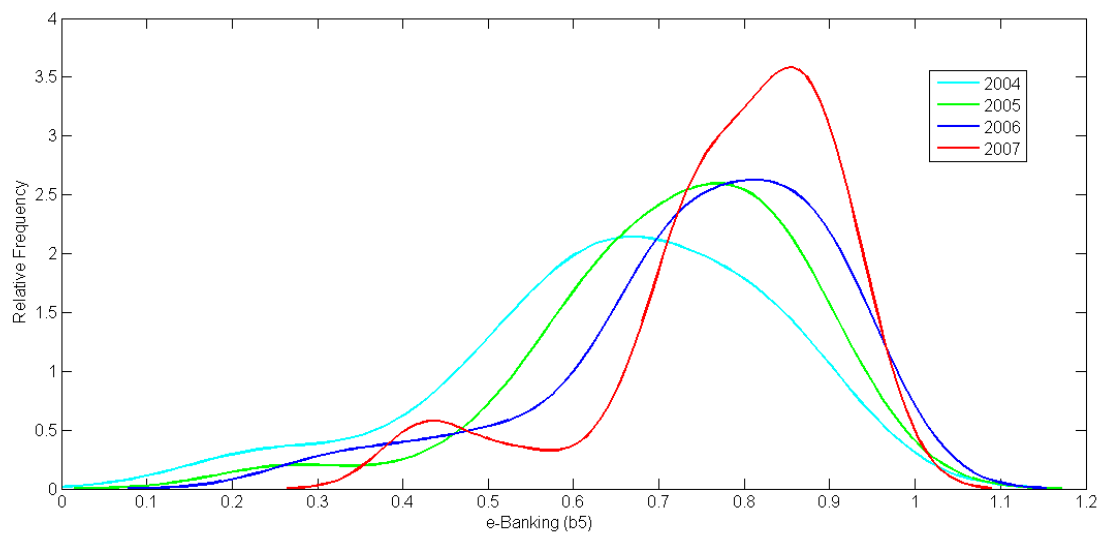


Figure 6 Evolution of the probability density function for the indicator b5 (percentage of enterprises with Internet access using the internet for banking and financial services)

4. ROBUSTNESS ANALYSIS

The e-business index scores are affected by uncertainty which is partly due to the experts preferences in the assignment of weights, and partly to the imputation process for some missing values. In order to quantify the uncertainty due to weights, we select the experts at random and evaluate the index using the average sets of weights obtained. The uncertainty due to the imputation of missing values is not addressed in the current paper.

In the robustness analysis (Saisana et al., 2005), each country is characterised by a cloud of points in the *adoption vs. use* plane. The results obtained for the four clusters are given in Figures 7-10. In each cluster there is substantial amount of overlapping between country scores. This overlapping is more pronounced in the second and third clusters for which country scores lie in similar intervals.

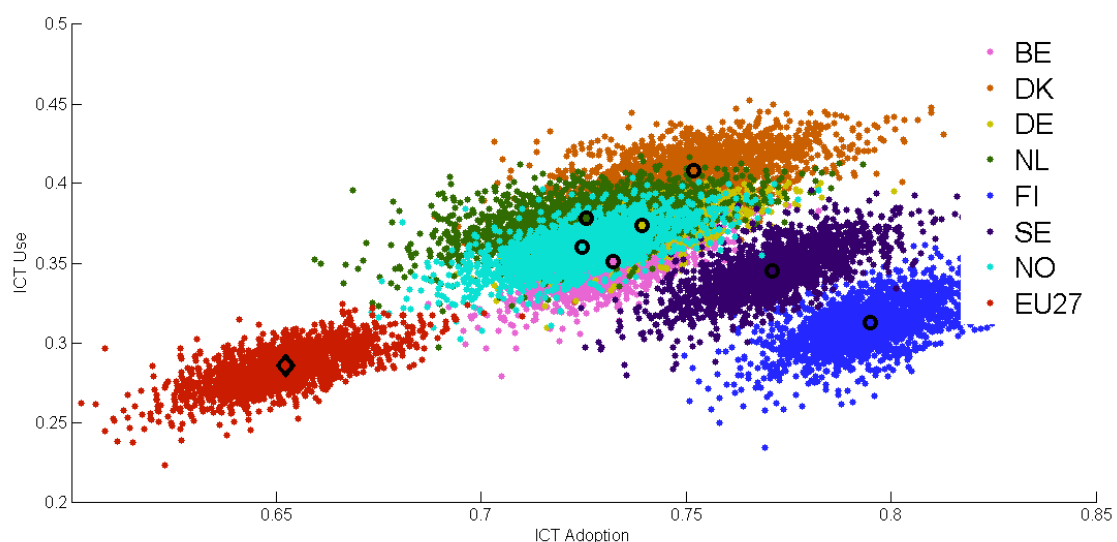


Figure 7 Uncertainty analysis for the countries of cluster 1

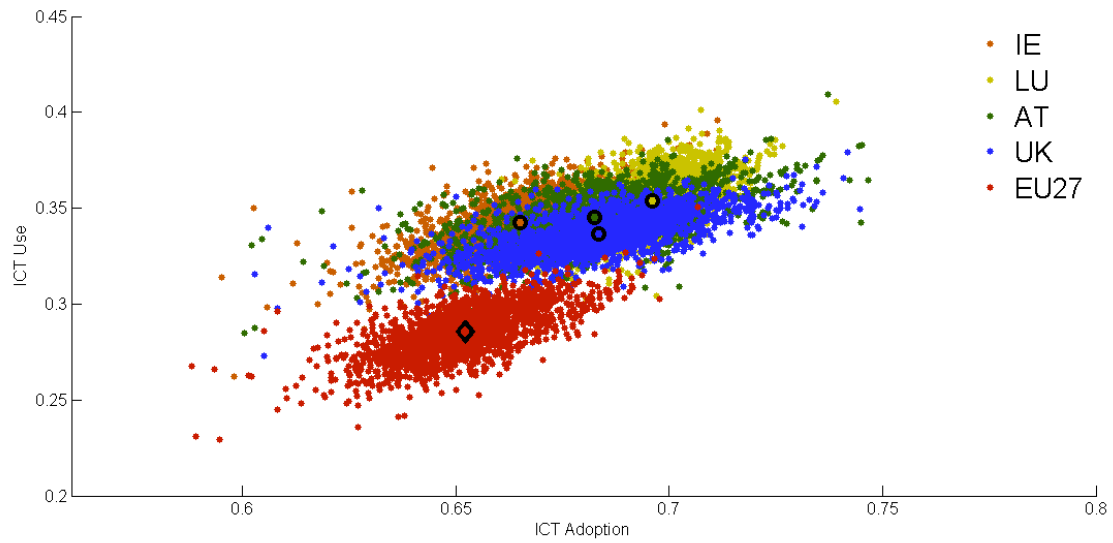


Figure 8 Uncertainty analysis for the countries of cluster 2

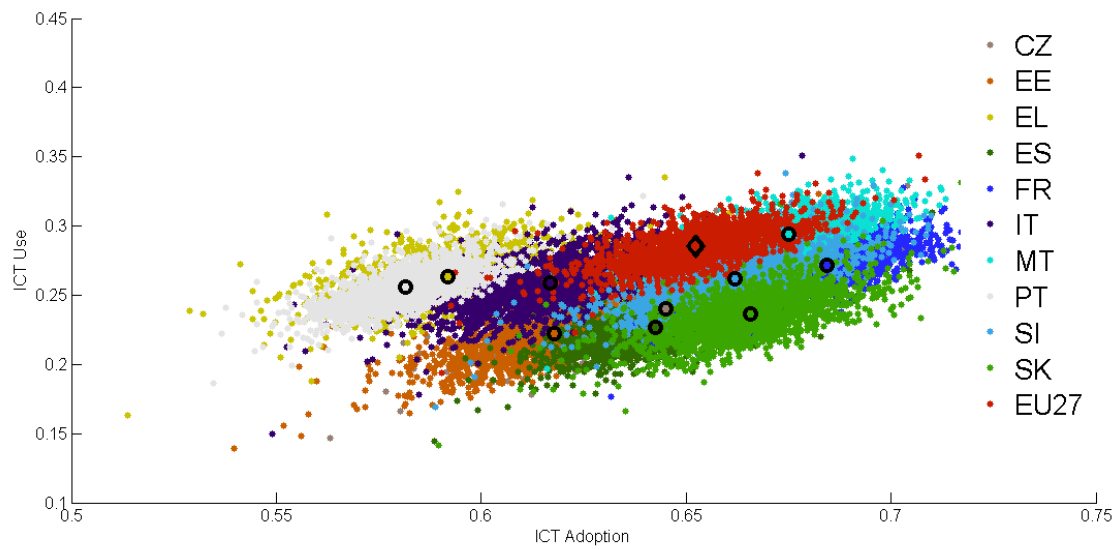


Figure 9 Uncertainty analysis for the countries of cluster 3

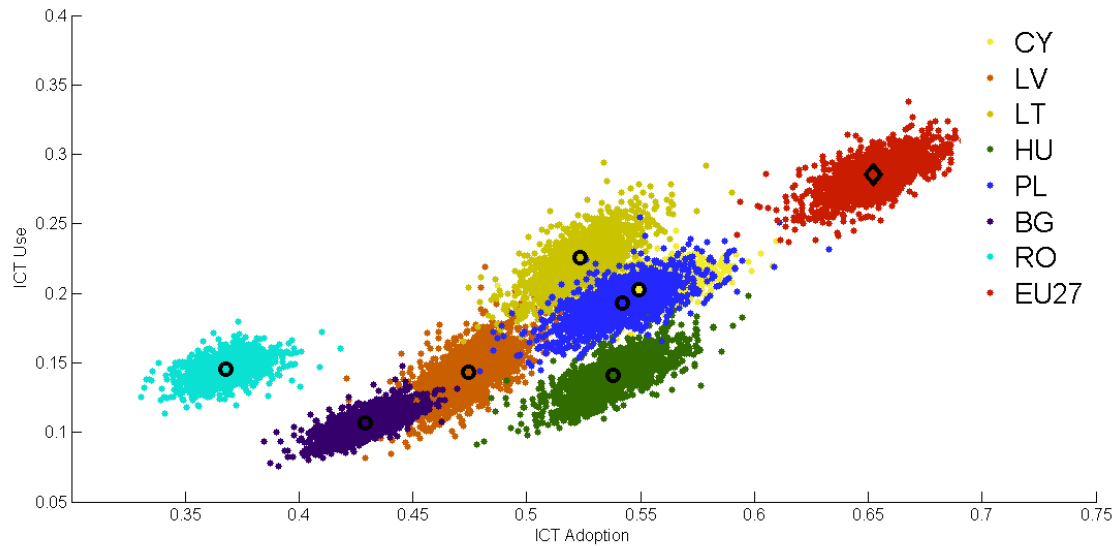


Figure 10 Uncertainty analysis for the countries of cluster 4

The analysis within the cluster of the top performing countries shows that, for *adoption*, in the presence of uncertainty in the weights, Finland is more advanced than Belgium, Denmark, Germany and The Netherlands, as the projections of the clouds on the *adoption* axis do not overlap. On the other hand, the same projections for Finland and Sweden partially overlap on the *adoption* axis so, in spite of the results of Table 5, the presence of uncertainty in the weights does not allow us to conclude that Finland performs better than Sweden in *adoption*.

The leading position of Denmark in *use* can be shared with The Netherlands and Germany, given that the projections of the clouds on the y-axis for these three countries partially overlap. Similar conclusions can be obtained by analysing the projections onto the y-axis for other selected countries and clusters in Figures 8, 9 and 10.

CONCLUSIONS

The 2008 European e-business readiness index, evaluated using data from the 2007 European enterprise survey, is a useful mechanism for comparing e-business *adoption* and *use* by firms in the various European countries.

We used statistical techniques (i) to impute missing data from the Enterprise survey, (ii) to investigate the performance and trends of European countries on the e-business index, and (iii) to test the robustness of the index to the weights proposed by the e-BSN experts. In particular, the analysis of the probability density function across countries has proven useful to assess variability and trends.

Although quantitatively the country scores are much lower for *use of ICT* than *adoption of ICT*, the pattern of country performance for the category *use of ICT* is globally similar to that of *adoption*. Denmark confirms its leading position and the top ranks are still occupied by other Nordic countries (Sweden, Finland, Norway) together with the Netherlands, Germany and Belgium. Together with the Mediterranean Member States, most of the states from Eastern Europe, which joined the EU recently (2004 and 2007), are still in the developing stage of their e-business environment. On the other hand, Malta, Slovenia, Slovakia, Czech Republic and Estonia, who joined the EU in 2004, reach a relatively fair level of *adoption* and *use*.

The components of the e-business readiness index could be revised in the future, as some important elements in the category *adoption* and *use* are currently missing.

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Title: The 2008 European e-Business Readiness Index

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Luxembourg: Office for Official Publications of the European Communities

2009– 22 pp

EUR – Scientific and Technical Research series – ISSN 1018-5593

Abstract

This report shows the scores of the 2008 e-business readiness index for European enterprises. The 2008 e-business readiness index, evaluated using data from the 2007 ICT enterprise survey carried out by Eurostat, is a useful mechanism for comparing e-business adoption and use by firms in the various European countries. The e-business readiness index measures the ICT adoption by enterprises using 6 indicators and measures ICT use by enterprises using another 6 indicators. The report describes the 12 benchmark indicators and the data coverage. The index obtained with the 2007 data is compared with the index calculated from previous years. The trends of the benchmark indicators are analysed and the robustness of the index scores among countries is tested to assess the significance of country rankings.

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