



Knowledge Economy: measures and drivers

Michaela Saisana and Giuseppe Munda

EUR 23486 EN 2008



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JRC 47027

EUR 23486 EN
ISBN 978-92-79-09703-4
ISSN 1018-5593
DOI 10.2788/92075

Luxembourg: Office for Official Publications of the European Communities

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Printed in Italy

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Extended Executive Summary

In the Knowledge-based Economy conceptual framework that was developed by MERIT a total of 115 individual indicators have been selected to measure the sub-dimensions of the KBE. The number of indicators per sub-dimensions varies between 1 and 12. The high number of individual indicators raises the issue of robustness of the ranking obtained by their aggregation into one composite measure. To tackle this issue a sensitivity analysis is a fundamental step of the KEI composite indicator. In particular, in building the KEI composite an innovative methodological assumption has been made, i.e. it is considered as the final composite index the frequency of all rankings obtained by means of all the simulations carried out. This allows us to deal with the criticism, often made to composite indicators that rankings are presented as they were under conditions of certainty while it is well known that this is not true in general terms. Most practitioners compute a composite indicator by a simple weighted summation mathematical model. Sometimes it is acknowledged that the ranking obtained is subject to some uncertainty, but this issue is treated as a kind of mathematical appendix for technical readers, and all policy suggestions are derived under the assumption of the linear aggregation model. Here the ranking presented is the one derived by considering the whole spectrum of uncertainty. It is important to note that this is a peculiar characteristic of the KEI composite.

The scenarios, simulations and indicators developed by the JRC team answer five main research questions:

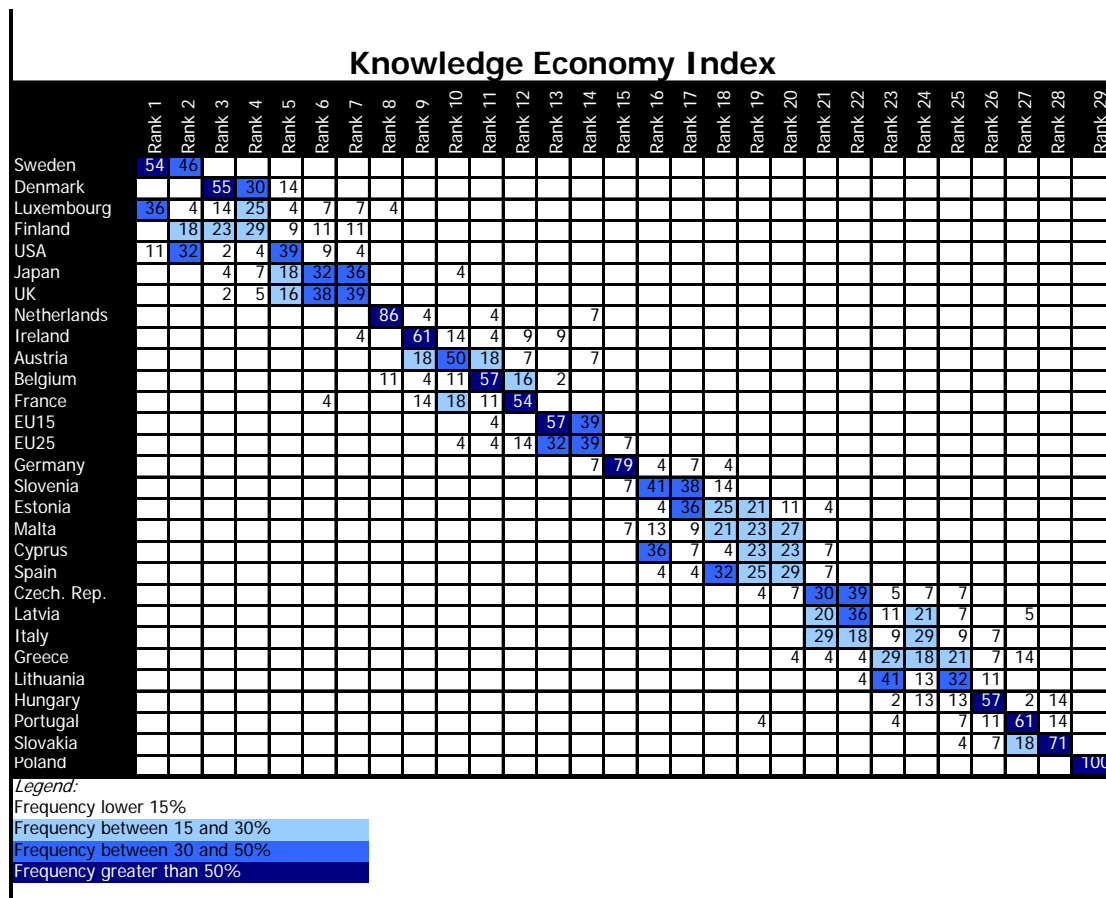
1. Is it possible to measure the knowledge economy?
2. What are the drivers of the knowledge economy?
3. How does knowledge economy relate to other complex dimensions?
4. Is it possible to reduce the total number of individual indicators of KEI conceptual framework without losing any relevant information?
5. Are rankings useful at all for deriving policy suggestions?

1) A multi-modelling approach was applied to weight and further aggregate the sub-dimensions scores into dimensions and finally into a composite indicator. The approach consisted of about **2,000 simulations** (saturated sampling) based on combinations of the:

- imputation method (dataset deriving from either splines or multiple imputation),
- number of sub-dimensions (all 29 sub-dimensions included or one-at-time excluded)
- number of dimensions (all seven dimensions included or one-at-time excluded)
- normalisation of the 29 sub-dimensions scores (z-scores or min-max),
- structure relating the sub-dimensions to the dimensions (preserved or not),
- weighting method (factor analysis, equal weighting, data envelopment analysis),
- aggregation rule (additive, multiplicative, non-compensatory multi-criteria analysis).

Although, this analysis may look very technical in nature, in reality a social component is also present. In fact to consider or not a given dimension, normally has behind a long story of social, political and scientific controversy. Thus to include or exclude a given dimension or a set of indicators means to deal or not with peculiar social concerns and social actors. The *frequency matrix* of a country's rank in each of the seven dimensions and the overall KEI

was calculated across the ~2,000 scenarios. Besides the frequency matrix, the median rank per country was selected for further analysis of the associations between KEI and its main dimensions, or other complex concepts, such as human development. The KEI composite indicator results are the following:



This is a novel approach to the presentation of results of a composite indicator. Our objective here is to synthesize and make explicit the uncertainty contained in the country ranking. For each country it is indicated the percentage of times it was in a given rank in all the 2,000 simulations, one can see that e.g. Poland was 100% of times in the last position, and Sweden 54% of times in the first position and 46% in the second.

A first consideration is that the overall ranking is very stable; in fact considering the whole 2,000 simulations, all countries are clustered unambiguously. No doubt the top performing countries are Sweden, Denmark Luxembourg, Finland and the USA. Then it follows the group Japan, United Kingdom, Netherlands and Ireland (where Japan and UK are slightly better than the other two). Austria, Belgium, France and Germany form the next group (where Germany is slightly worst than all the other three). All the rest of countries can be considered with a bad performance with respect to a knowledge based economy. However, we could still split this class into two subsets: a first one including Slovenia, Estonia, Malta, Cyprus, Spain, the Czech Republic, Latvia, Italy, Greece and Lithuania is a bit better than the worst performing group including Hungary, Portugal, Slovakia and Poland. An interesting result is also that overall both USA and Japan have a better performance than EU 15 and EU 25.

To better understand the influence of the conceptual model used to derive these results, we have computed country rankings by using the subset of individual indicators belonging to

each one of the seven dimensions, thus other seven rankings have been obtained. The objective of this analysis is to check if in some single dimensions, poor performing countries might present an improvement or vice versa, good performance countries a worsening. Of course rankings are obtained again by considering the whole spectrum of uncertainty related to the computations.

Overall, dimensions A1(Production and diffusion of ICT), A2 (Human resources, skills and creativity) and A3 (knowledge production and diffusion) supply rankings correlated with the KEI composite indicator highly. In these three dimensions Finland is always the top country, but Sweden is always very close to it. In the bottom of the ranking we can find both Cyprus and Portugal, but Poland is never too far from the last position. On dimension A1 Italy has a net improvement but it is still far from the top performing countries. The grouping of countries is very similar to the one of the KEI composite (with all the seven dimensions). On the contrary, A4, B1, B2 and C1 produce country rankings with bigger differences. On dimension A4 (Innovation, entrepreneurship and creative destruction), Italy ranks as the bottom country with a very high degree of credibility (frequency= 11% rank 27, 32% rank 28 and 57% rank 29). Also countries like The Netherlands, Belgium, Austria and Germany show a very poor performance. Finland is closer to medium performance countries than to top countries. Spain improves its rank position considerably. Sweden is still a top performing country. Poland improves its performance surely, but it is very volatile (it occupies positions in the range from the 7-th to the 24-th and the frequency it is never higher than 14% in any position).

Taking into account dimension B1 (Economic outputs) only, big surprises exist. Although the bottom countries are very similar to the ones supplied by other dimensions, Greece (5-th position) and Spain (4-th position) are extremely well performing. Cyprus is also improving considerably. Denmark, Finland and Sweden are instead much worse, since they perform as medium countries. The same argument applies to dimension C1 (Internationalisation). The bottom countries are quite robust a part from Cyprus which is performing around the 7-th and 8-th positions. Portugal is in a better position than Finland (which is very volatile but never above the 17-th rank). Denmark and Sweden are between positions 11 and 13. Top performing countries are Luxembourg, Belgium, Austria and the USA. On dimension B2 (Social performance), top countries are Denmark, Sweden, Austria and the Netherlands. Particularly strong is the worsening of Finland which is around the 13-th position. Germany is also performing very badly (frequencies are clustered around positions 22 and 23). Improvements are shown by Hungary, Italy, Portugal and Spain which perform as middle ranked countries.

2) The internal consistency of KEI conceptual framework is synthesised by computing the relationship between the KEI overall ranking and the dimensions and sub-dimensions considered through the Spearman rank correlation coefficients. As a rough first conclusion we could state that overall all dimensions play a role but surely the less influential seems to be the innovation, entrepreneurship and creative destruction dimension. This conclusion is corroborated by a more sophisticated tool i.e. Path Analysis. By using path analysis, the influence of each single dimension on the total ranking can be computed (this influence is divided into a direct effect and an indirect one). Results of the path analysis conclude that all dimensions seem to have a more or less equal impact (the range is between 12 and 18) on the KEI ranking (please note that here only the linear aggregation is used, since path analysis cannot be carried out for the non-compensatory aggregation rule) except dimension A4 (Innovation, entrepreneurship and creative destruction, whose score is 8). The variability is much higher if one looks at the sub-dimension levels (e.g. very low scores can be found for knowledge flows (7) or organizational indicators (2)). We can expect an even higher

variability at the individual indicator level; this is potentially very relevant if one desires reducing the set of indicators of the KEI conceptual framework. The rankings derived by a linear aggregation rule and a non-compensatory one (under the equal weighting within dimension assumption) are highly correlated, although the non-compensatory one appears more stable. Compensability might be an issue for Finland whose position in the non-compensatory ranking is definitely worse than the ones of Sweden, Denmark, Luxembourg, United Kingdom and Japan. The bottom countries are very stable in both rankings. Useful information is also coming from the comparison between the KEI median ranking and the ranking derived by using data envelopment analysis weights. Since these weights are beneficial for the bottom countries, we can state quite safely that even with endogenous weights the bottom countries are no doubt very stable, thus they are very far from being knowledge based economy countries. Regarding the top countries, it is noteworthy the strong top position of Sweden and the fact that Finland, even with its best set of weights, is still worse than Luxembourg, Japan and Denmark. A final observation is about Ireland. This country belongs to the set of more or less good performance countries, but it is never a real top countries, even with its best set of weights, we could thus conclude that according to the KEI conceptual framework and its statistical elaboration, the common perception that Finland and Ireland are the most relevant success stories of knowledge based economies is somewhat misleading.

3) Economic theory tries to take technological change into account by two main theories: *Human capital theory* (whose main foundational principal is the recognition of the role of education and importance of skills people has) and *endogenous growth* (whose main idea is the Schumpeterian concept of accumulation of knowledge due to research and innovation in leading private firms).

First of all, let us try to understand if to be a knowledge based economy is relevant at all for a good overall economic performance. By looking at the relationship between GDP and the KEI median ranking the answer is YES. Except Germany, Italy and Spain which have a high level of GDP per capita without any particular good performance on a KBE, all the other high level GDP countries seem to perform well in the KEI composite (where Luxembourg can be considered an extreme case -probably an outlier-).

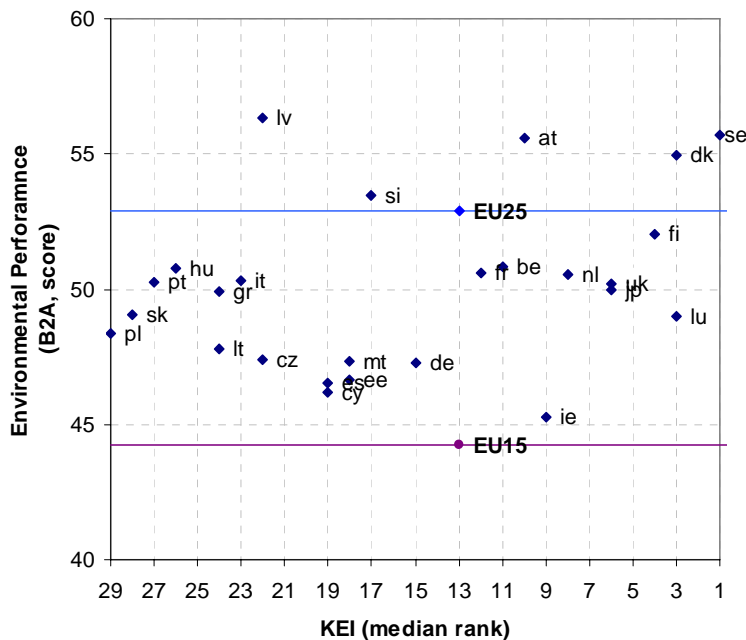
As we already know at the level of dimensions considered in the KEI framework, they all seem to have an influence on the knowledge based economies, thus both economic theories seem to have an influence (since roughly both theoretical models are conceptualized). However, a first result was that the Innovation, entrepreneurship and creative destruction dimension appears not to be very relevant; thus starting challenging the Schumpeterian model. Let us then start by checking if the human capital theory is more relevant in the case of the KEI composite, for doing so we go deeper than the dimensional hierarchical level.

The following conclusions can be drawn from our analysis. While the number of Ph.Ds seems to play a role in explaining the success of a knowledge based economy (all countries with an high number of Ph.Ds, except Portugal, are top countries in the KEI median ranking), the same result does not apply to percentage of working population with a tertiary education (very clear the case of Italy where the number of working population with a tertiary education is extremely high, but the number of Ph.Ds is small). Participation to life long learning seems also to be a success factor, although not for all top countries. In sum, we could state that the human capital theory seems to be corroborated by the KEI results roughly.

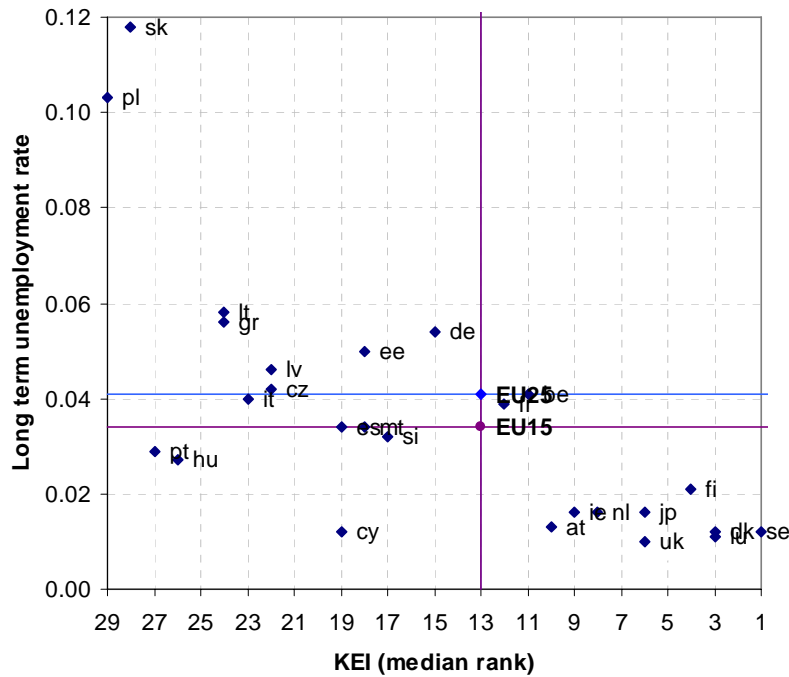
However, if one considers, what probably is the most important Schumpeterian indicator, i.e. Gross domestic expenditure on research and experimental development, the relationship with the KEI median is a clear cut one: countries which invest in research are top countries in a

KBE. Research is a key driver for a KBE surely, thus the endogenous growth idea seems also corroborated.

Let us now look at other concepts embedded in the idea of a knowledge economy. A popular one is *eco-efficiency*. i.e. the idea that advanced economies, such as knowledge based economies, are more environmental friendly since they use less material goods and are more energy efficient in productive activities. Unfortunately, the *Jevons' paradox* teaches us that an increase in efficiency in using a resource leads, in the medium to long term, to an increased consumption of that resource (rather than a decrease). This is a classic example of the co-existence of opposite causal links emerging when considering the same process at different (spatial, temporal) scales. Trade-offs also emerge when considering different attributes of performance or when adopting different disciplinary analyses. Sustainability literature clearly emphasizes that environmental preservation has an economic cost and economic growth has an environmental cost, no escapes from this conflict exists. These arguments seem corroborated by the KEI measure. In fact, as one can see, no clear relationship between environmental performance and a KBE exists.



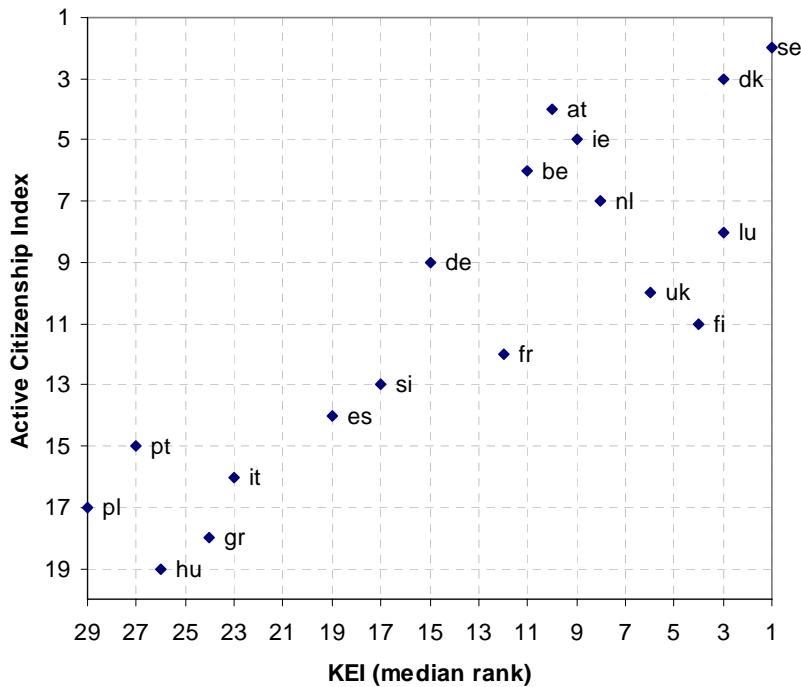
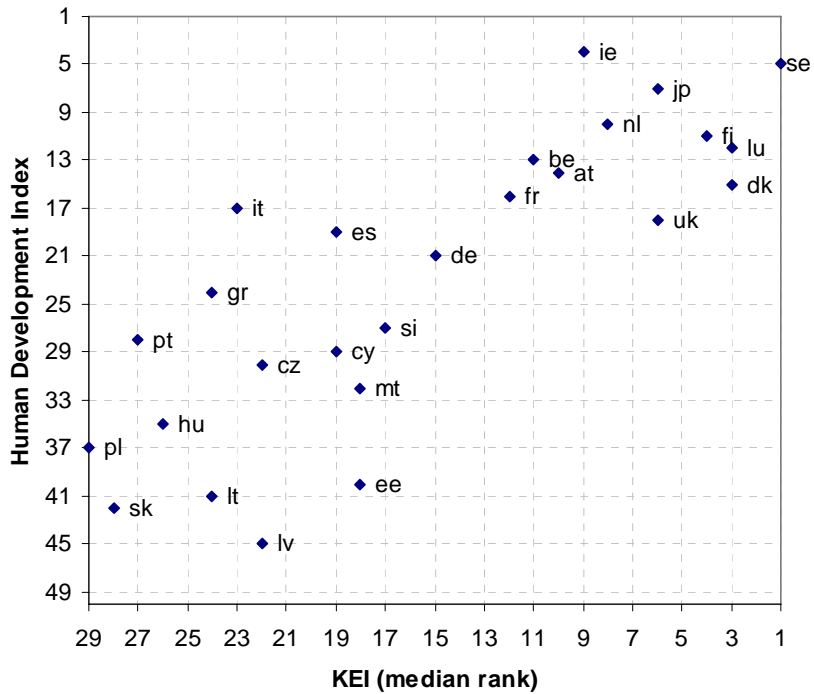
Another interesting aspect of a KBE is unemployment. Job creation can be successfully increased in the short term, by a slowdown of the rate of technological progress. As noted by the Kok report, this is exactly what has recently happened inside the European Union. But in a longer time horizon, this strategy may easily cause the collapse of the economy given that non-specialized low productivity jobs can easily be substituted by lower wage labour in other parts of the world. Thus, in the short term technological progress and job creation are conflicting objectives but they might be compatible in the long period if a right balance (i.e. compromise) between flexibility and employment security is found. If the relationship between long term unemployment rate and the KEI median ranking is displayed, this compatibility between technological progress and job creation seems to be true. All top countries in the KEI measure are presenting an extremely low long term unemployment rate. This aspect of a KBE seems extremely interesting and encouraging.



Another common statement about a KBE is that income distribution inequalities are reduced. This statement appears difficult to corroborate by examining the relationship between the KEI measure and the income distribution inequality. No precise relationship exists and when it seems to exist, in reality might simply be a corroboration of the classical Kuznets curve model, where income distribution inequality is supposed to decrease when GDP increases (one should not forget that KEI and GDP are correlated).

As an external benchmark, we look at the relationship between the KEI composite and the Human Development Index. The relationship found seems again a corroboration of the human capital theories, in fact the correlation between KEI and the HDI is extremely high. A peculiar behaviour is the one of Italy and Spain whose HDI is high but the KEI performance is poor.

In this context a relevant index to use as a final external benchmark might be the Active Citizenship Index. This index produced at JRC by CRELL (Centre for Research on Lifelong Learning) is an attempt to measure a component of the social capital, and thus can be considered as complementary to the human capital measurements, which look more at individual skills. It is interesting to note that this index correlates very much with the KEI median ranking, thus it might open interesting research questions on the importance of the social component in a knowledge based economy.



4) To reduce the number of individual indicators, we first undertook both forward and backward stepwise regression, so as to identify those indicators within a KEI dimension that represent (in a linear fashion) the dimension. We also applied forward/stepwise regression to choose those indicators that represent best the overall KEI rank. We finally crosschecked, using canonical analysis, whether the subset of indicators describes reliably the set of the seven KEI dimensions and the overall KEI. The following 23 indicators (from a total of 115) are proven sufficient to describe 97.4% of the variation in the overall set (KEI and its seven dimensions).

Production and diffusion of ICT (A1)

ICT value-added (% of total business sector value added)

SMEs ordering over the Internet (% of total SMEs)

Individuals using the internet for banking (% total)

Human resources, skills and creativity (A2)

Pisa reading literacy of 15y (average score)

Total researchers (per 1000 labour force in FTE)

Participation in lifelong learning (% of working 25-64y)

Employed in creative occupations (% total)

Knowledge production and diffusion (A3)

BERD performed in service industries (%)

EPO high tech patent applications (per million pop.)

Triadic patent families (per million pop.)

Innovation, entrepreneurship and creative production (A4)

Firm entries (birth rate)

GDP (per capita)

Early-stage venture capital (% GDP)

SMEs reporting non technological change (%)

Economic outputs (B1)

GDP per capita (in PPS)

Real GDP growth rate

Total employment growth

Social performance (B2)

Long term unemployment rate

Hampered in daily activities because of chronic conditions

Rooms per person by tenure status and type of housing

Internationalisation (C1)

Technology balance of payments (% GERD)

Co authorship share on international S&E articles

Foreign PhD students (% total PhD enrolment)

5) A nasty question at this point might be: *is all this effort we have done of any use?* Even if we have very reliable rankings, which is the policy utility of knowing that a country is overall better than another one or vice versa? This kind of criticism is often put to composite indicators, thus it is worthy to tackle this issue.

Indeed we have already seen that rankings are already giving very interesting information for policy purposes. For example, in the KEI framework, we succeeded to find out clear success stories, i.e. top performance countries, and clear policy drivers. However, one should note that for the majority of indicators used in any assessment exercises no clear reference point is available, for instance, when GDP is used nobody knows the ideal value of a Country GDP, thus it is quite common to compare with other Countries GDP, e.g. the USA one. In general to get a set of reference values to be used as benchmarks, two options exist:

- To compare any country performance with a relevant average (in our case EU15 or EU25).
- To construct an “ideal point” defined by choosing the best values reached in any single individual indicator by a country. This is a well established technique in multi-criteria evaluation literature and has the advantage of indicating “real world ideal values”.

In KEI both approaches were followed. The performance of each single country is synthesized by comparing its scores on dimensions and sub-dimensions with the EU25 average. Later on country profiles are shown in details, where both EU25 average and the idea of a best performing country are used for deriving policy priorities.

By looking at the following Table, we have both synthetic and analytic information on single country performance. In fact we know the total numbers of sub-dimensions which are above (+), close (0) or below (-) the EU25 average, thus allowing a quick scoring of countries; but at the same time, it is also possible to derive policy suggestions since all the sub-dimensions are scored. To give some illustrative examples, Finland is clearly a top performing country since it is above or close to the EU25 average for the majority of sub-dimensions. The only plausible policy priorities since the performance is below the average are Entrepreneurship, Organizational indicators, Knowledge production and diffusion and Economic Structure. Entrepreneurship, Organizational indicators and Economic Structure seem problematic for another top performing country, Sweden. For Sweden, Mobility and Knowledge flows also offer space for improvement. On the other side, if one examines the performance of countries such as Italy (above in the average only in Government ICT and Organizational indicators), Portugal (+ only in Financing of innovation and employment and economic welfare) or Greece (+ only in Economic impact of ICT, Income and Employment) it is clear that the space for improvement is enormous, but of course this does not necessarily mean that their governments wish to pursue the objective of being a KBE, it is important to remember that a KBE is one of the possible models that a country may choose and the fact that a poor performance exists might simply mean that this scope is not a policy objective for that country. An interesting result is that EU 15 is NOT always equal or superior to the average of EU25. It is actually below EU25 average in three sub-dimensions: Organizational indicators, Environment and Economic structure; in these areas the enlargement has then lead to an improvement of the average EU performance.

Dimension	Sub-dimension	AT	BE	CY	CZ	DE	DK	EE	ES	EU15	FI	FR	GR	HU	IE	IT	JP	LT	LU	LV	MT	NL	PL	PT	SE	SI	SK	UK	USA
Production and diffusion of ICT	Economic impact of ICT	0	0	-	0	0	+	+	-	0	+	0	+	0	+	0	+	-	0	+	-	+	-	-	+	-	-	+	+
	Internet use by firms	0	0	-	-	+	+	-	-	0	+	+	-	-	+	-	+	-	0	-	+	0	-	-	+	0	-	+	+
	Internet use by individuals	0	0	-	-	+	+	+	-	+	+	+	-	-	-	-	+	-	+	-	-	+	-	-	+	-	-	+	+
	Government ICT	+	0	-	-	0	+	+	0	0	+	+	-	-	0	+	+	-	+	-	0	0	-	-	+	-	-	-	+
Human resources, skills and creativity	General education	-	0	0	-	0	-	-	-	0	+	0	-	-	+	-	-	0	-	-	0	-	-	+	-	-	0	0	
	Human resource in S%T education	0	0	0	-	0	+	+	0	0	+	+	-	-	+	-	+	0	+	0	-	-	-	-	+	-	0	0	
	Skills	0	0	0	-	-	+	-	-	0	+	-	-	-	-	-	+	-	0	0	-	+	-	-	+	+	-	+	+
	Creativity	0	+	-	0	+	+	0	-	0	+	0	-	-	+	0	+	-	+	-	-	+	-	-	+	-	-	+	+
Knowledge production and diffusion	Mobility	+	0	+	-	0	+	+	+	0	+	+	0	-	+	-	+	+	-	+	0	+	-	0	-	+	-	+	+
	R&D	+	0	+	-	+	+	0	-	0	+	+	-	-	-	-	+	0	0	0	0	0	-	-	+	0	-	0	+
	Patents	+	0	0	-	+	+	-	-	0	+	0	-	-	-	-	+	-	+	-	-	+	-	-	+	-	-	0	+
	Bibliometrics	-	0	-	-	0	+	-	-	0	+	0	-	-	-	-	+	-	-	-	0	+	-	-	+	-	-	+	+
Innovation, entrepreneurship and creative diffusion	Knowledge flows	-	-	-	-	-	-	-	-	0	+	-	-	-	-	-	0	-	-	+	-	-	-	0	0	+	-	-	
	Total investment in intangibles	-	-	0	-	-	-	-	-	0	0	0	-	+	+	-	+	-	+	+	0	-	-	-	-	-	-	+	+
	Entrepreneurship	-	0	-	-	+	-	0	0	0	-	0	-	+	-	-	0	0	0	0	-	-	0	-	-	-	0	+	-
	Demand for innovative products	0	-	0	0	0	+	+	0	0	0	0	0	0	+	-	0	0	+	0	-	0	-	-	+	0	+	+	0
Economic outputs	Financing of innovation	0	+	+	-	+	+	+	0	+	+	+	0	-	+	0	+	+	+	+	0	0	-	+	+	0	0	+	+
	Market innovation outputs	0	-	-	0	-	0	0	-	0	0	-	0	-	0	-	+	-	+	-	+	0	-	0	0	+	0	+	0
	Organisational indicators	-	-	0	+	-	-	-	+	-	-	+	0	+	-	+	0	+	-	0	+	+	+	0	-	+	+	+	-
	Income	+	+	+	0	0	0	+	0	0	+	0	+	0	+	-	0	+	+	+	+	-	0	0	-	+	+	0	+
Social performance	Productivity	+	+	-	-	0	0	0	+	0	0	+	0	-	+	0	+	-	+	-	-	0	-	-	0	0	-	0	+
	Employment	0	-	+	0	0	+	-	+	0	+	-	+	-	+	-	+	-	+	0	-	0	-	0	+	0	-	+	+
	Environmental	+	0	-	-	-	0	-	-	-	0	0	-	0	-	0	-	-	-	+	-	0	-	-	+	0	-	-	0
Internationalisation	Employment and economic welfare	+	0	+	0	0	+	-	0	0	0	0	-	+	+	0	+	-	+	0	+	+	-	+	+	+	-	+	+
	Quality of life indicators	+	+	+	-	0	+	-	+	0	0	0	0	-	+	0	0	-	+	-	0	+	-	+	+	-	-	-	+
	Trade	0	+	0	0	0	0	-	0	0	+	0	-	0	+	0	0	-	+	-	0	+	0	-	+	0	0	0	0
Number of sub-dimensions	Knowledge production and diffusion	0	+	0	-	-	-	-	0	+	-	0	-	-	0	-	-	-	+	-	0	0	-	-	0	-	-	+	0
	Economic structure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Human resources	+	+	+	0	+	+	-	0	0	0	+	0	-	+	-	+	-	+	-	0	+	-	0	0	-	-	+	+
	Above the EU25	10	8	8	1	8	17	8	5	3	17	10	3	4	16	2	18	4	17	6	5	12	1	2	19	7	3	17	19
	Close to the EU25	12	14	9	9	13	5	5	10	23	8	14	8	5	3	8	7	5	5	8	9	13	3	5	5	8	6	6	6
	Below the EU25	7	7	12	19	8	7	16	14	3	4	5	18	20	10	19	4	20	7	15	15	4	25	22	5	14	20	6	4

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1. Introduction

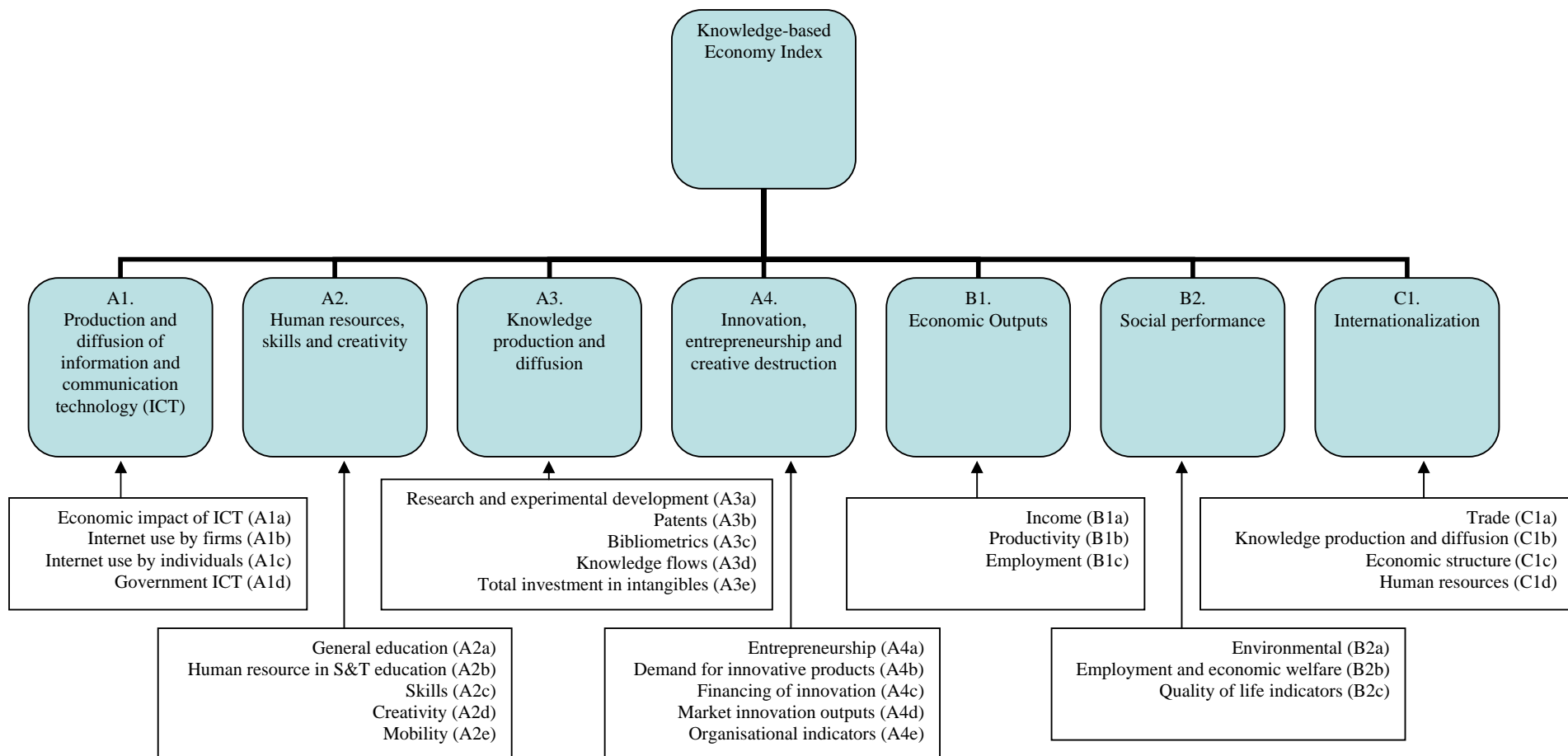
In the KEI conceptual framework of the knowledge economy, a total of 115 individual indicators have been selected to measure the sub-dimensions of the KBE (see Figure 1). The number of indicators per sub-dimensions varies between 1 and 12. For example, the Skills (A2c) sub-dimension includes only one indicator, whilst the Research and experimental development (A3a) sub-dimension includes twelve indicators, all related to different expressions of R&D from either government or business perspective. The high number of individual indicators rises the issue of robustness of the ranking obtained by their aggregation into one composite measure.

To tackle this issue a sensitivity analysis is a fundamental step of the KEI composite indicator. In particular, in building the KEI composite an innovative methodological assumption has been made, i.e. we consider as the final composite index the frequency of all rankings obtained by means of all the simulations carried out. This allows us to deal with the criticism, often made to composite indicators, that rankings are presented as they were under conditions of certainty while it is well known that this is not true in general terms. Most practitioners compute a composite indicator by a simple weighted summation mathematical model. Sometimes it is acknowledged that the ranking obtained is subject to some uncertainty, but this issue is treated as a kind of mathematical appendix for technical readers, and all policy suggestions are derived under the assumption of the linear aggregation model. Here the ranking presented is the one derived by considering the whole spectrum of uncertainty. It is important to note that this is a peculiar characteristic of the KEI composite.

This report answers five main research questions:

6. Is it possible to measure the knowledge economy?
7. What are the drivers of the knowledge economy?
8. How does knowledge economy relate to other complex dimensions?
9. Is it possible to reduce the total number of individual indicators of KEI conceptual framework without losing any relevant information?
10. Are rankings useful at all for deriving policy suggestions?

Figure 1. KEI Conceptual framework of a Knowledge-based Economy



2. Measuring the Knowledge-based Economy: The KEI Composite Indicator and its Main Drivers

The selection of an appropriate methodology is central to any exercise attempting to capture and summarize the interactions among the individual indicators included in a composite indicator. The literature review offered in the JRC/OECD (2005) Handbook on composite indicators discusses the plurality of the approaches that have been used in building a composite indicator and shows that some of the methodologies are suited (more or less) to the purposes for which they are employed. In particular, the authors stress the need for an explicit conceptual framework for the index, and the usefulness of multivariate analysis prior to the aggregation of the individual indicators. They review tools for imputation of missing information, methodologies for weighting and aggregation, and finally methods for assessing the robustness of the index using uncertainty and sensitivity analysis. In Table 1 we present a stylised ‘checklist’ to be followed in the construction of a composite indicator, which we have rearranged from the information contained in the Handbook.

Table 1. Checklist for building a composite indicator

Step	At the end of this Step the constructor should have...
<p>Theoretical framework provides the basis for the selection and combination of variables into a meaningful composite indicator under a fitness-for-purpose principle (involvement of experts and stakeholders is envisaged at this step)</p>	<ul style="list-style-type: none"> • A clear understanding and definition of the multidimensional phenomenon to be measured. • A nested structure of the various sub-groups of the phenomenon (if needed). • A list of selection criteria for the underlying variables, e.g., input, output, process.
<p>Data selection should be based on the analytical soundness, measurability, country coverage, and relevance of the indicators to the phenomenon being measured and relationship to each other. The use of proxy variables should be considered when data are scarce (involvement of experts and stakeholders is envisaged at this step)</p>	<ul style="list-style-type: none"> • Checked the quality of the available indicators. • Discussed the strengths and weaknesses of each selected indicator. • Created a summary table on data characteristics, e.g., availability (across country, time), source, type (hard, soft or input, output, process)
<p>Data treatment consists of - imputing missing data (e.g. single, multiple imputation); - examining whether there are outliers (as they may become unintended benchmarks); - taking logarithms of some indicators values, so that differences at the lower levels matter more; - transforming highly skewed data (e.g. square root, or logarithms).</p>	<ul style="list-style-type: none"> • A complete data set without missing values • A measure of the reliability of each imputed value that allows assessing the impact of imputation on the composite indicator results. • Discussed the presence of outliers in the dataset • Made scale adjustments, if necessary. • Transformed the indicators, if necessary
<p>Multivariate analysis should be used to study the overall structure of the dataset, assess its suitability, and guide subsequent methodological choices (e.g., weighting, aggregation)</p>	<ul style="list-style-type: none"> • Checked the underlying structure of the data along the two main dimensions, namely individual indicators, countries (by means of suitable multivariate methods, e.g., PCA, FA, cluster analysis). • Identified groups of indicators or groups of countries that are statistically “similar” and provided an interpretation of the results. • Compared the statistically-driven structure of the data set to the theoretical framework and discussed eventual differences.
<p>Normalisation should be carried out to render the variables comparable</p>	<ul style="list-style-type: none"> • Selected a suitable normalisation procedure(s) with reference to the theoretical framework and the data properties.
<p>Weighting and aggregation should be done along the lines of the underlying theoretical framework</p>	<ul style="list-style-type: none"> • Selected the appropriate weighting and aggregation procedure(s) with reference to the theoretical framework. • Discussed whether compensability among indicators should be allowed.
<p>Uncertainty and sensitivity analysis should be undertaken to assess the robustness of the composite indicator in</p>	<ul style="list-style-type: none"> • Considered alternative methodological approaches to build the index, and if available, alternative conceptual scenarios.

<p>terms of e.g., the mechanism for including or excluding an indicator, the normalisation scheme, the imputation of missing data, the choice of weights, or the aggregation method.</p>	<ul style="list-style-type: none"> • Identified the sources of uncertainty in the development of the composite indicator and provided the composite scores and ranks with confidence intervals. • Conducted sensitivity analysis of the inference (assumptions), e.g. to show what sources of uncertainty are more influential in determining the scores/ranks.
<p>Links to other indicators should be made to correlate the composite indicator (or its dimensions) with existing (simple or composite) indicators as well as to identify linkages through regressions.</p>	<ul style="list-style-type: none"> • Correlated the composite indicator with relevant measurable phenomena, accounting for the variations of the composite indicator as determined through sensitivity analysis. • Develop data-driven narratives on the results. • Performed causality tests (if time series data are available).
<p>Decomposition into the underlying indicators should be provided to reveal the main drivers for good/bad performance. Transparency is primordial to good analysis and policymaking.</p>	<ul style="list-style-type: none"> • Profiled country performance at the indicator level to reveal what is driving the composite indicator results. • Performed causality tests (if time series data are available). • Performed path analysis to identify if the composite indicator results are overly dominated by a small number of indicators and to explain the relative importance of the sub-components of the composite indicator. • Performed correlation analysis between the composite indicator and (a) the underlying indicators, (b) the dimensions, and among dimensions themselves, so as to show how the different components of the index are associated to each other.
<p>Visualisation of the results should receive proper attention, given that the visualisation can influence (or help to enhance) interpretability.</p>	<ul style="list-style-type: none"> • Identified a coherent set of presentational tools for the targeted audience. • Selected the visualisation technique which communicates the most information. • Visualised the results of the composite indicator in a clear and accurate manner.

Note: rearranged (and extended) from the JRC/OECD (2005) Handbook on composite indicators

The methodological approach to build the KEI composite involved six main steps:

1) Imputation of missing data

Missing data in 2004 were imputed using two different approaches: splines or multiple imputation (the entire dataset 2000-2004 was used for the imputation). Two datasets were thus used in the analysis described next.

2) Directional adjustment of indicators

Data were next adjusted, so that higher values correspond to higher levels of knowledge economy. A (1-value) transformation was applied to 18 indicators (for example, green house gas emissions per capita, amount of waste generated, long term unemployment rate, inequality of income distribution, unadjusted gender pay gap, serious accidents at work, etc.). This step was applied to both datasets.

3) Standardisation of indicators

All indicators were transformed into z-scores by subtracting the sample mean and dividing by the sample standard deviation. This step was applied to both datasets.

4) Factor Analysis within each sub-dimension

The indicators (z-scores) were weighted and aggregated into sub-dimensions using factor analysis. This step was applied to both datasets.

5) Multi-modelling approach

A multi-modelling approach was applied to weight and further aggregate the sub-dimensions scores into dimensions and finally into a composite indicator (see Table 3). The approach consisted of about **2,000 simulations** (saturated sampling) based on combinations of the:

- imputation method (dataset deriving from either splines or multiple imputation),
- number of sub-dimensions (all 29 sub-dimensions included or one-at-time excluded)
- number of dimensions (all seven dimensions included or one-at-time excluded)
- normalisation of the 29 sub-dimensions scores (z-scores or min-max),
- structure relating the sub-dimensions to the dimensions (preserved or not),
- weighting method (factor analysis, equal weighting, data envelopment analysis),
- aggregation rule (additive, multiplicative, non-compensatory multi-criteria analysis).

6) Calculation of dimensions and KEI ranks

The *frequency matrix* of a country's rank in each of the seven dimensions and the overall KEI was calculated across the ~2,000 scenarios. Besides the frequency matrix, the median rank per country was selected for further analysis of the associations between KEI and its main dimensions, or other complex concepts, such as human development.

Table 2: Methodological scenarios for the development of the KEI composite

		Aggregation function		
		Additive (linear)	Multiplicative (geometric averaging)	Non-compensatory multi-criteria analysis
Sub-dimensions included	All (total 29)	•	•	•
	One-at-a-time excluded	•	•	•
Dimensions included	All (total 7)	•	•	•
	One-at-a-time excluded	•	•	•
Pillar Structure	Preserved	•	•	•
	Not preserved	•	•	•
Normalisation	z-scores	•	•	
	Min-max	•	•	
	Raw data			•
Weighting	Factor analysis	•	•	•
	Equal weighting	•	•	•
	Data envelopment analysis	•		

An important point we would like to insist here is that the scenario analysis used for building the KEI frequency matrixes is aimed at dealing with the issue of uncertainty underlying the construction of any composite indicator, in the most comprehensive way as possible (see Table 2). The results obtained by using a composite indicator, depend heavily on the problem's structuring phase. In general main delicate issues are:

1. *Quality of the information available.* In the KEI project particular attention has been devoted to this issue. We then take for granted that the data base provided contains good quality data. However, one should note that even if a data base has been submitted to rigorous quality check, the following problems have still to be tackled to arrive at a composite measure:
 - the consideration of measurement error in the data,
 - the imputation of missing data,
 - the treatment of outliers and extreme values,
 - the transformation of skewed indicators,
 - the standardization/normalization of the data (e.g., re-scaling, standardisation).
2. *Indicators chosen* i.e. which representation of reality we are using. A set of indicators is not the reality, but it is simply a descriptive model of it. It is important then to check the relevance and the explicative capacity of the theoretical framework used. The way we chose to deal with this issue is by looking at the sensitivity of results to the exclusion/inclusion of different individual indicators and dimensions. Although, this analysis may look very technical in nature, in reality a social component is also present. In fact to consider or not a given dimension, normally has behind a long story

of social, political and scientific controversy. To give an example, the environmental dimension nowadays is considered very important in almost any analysis, however this was not true 30 years ago, mainly because the social concerns on the environment in the past were very limited. As a conclusion, we should remember that to include or exclude a given dimension or a set of indicators means to deal or not with peculiar social concerns and social actors.

3. *Direction of each indicator* (i.e. the bigger the better or vice versa, this choice sometimes is not obvious).
4. *The weighting of the indicators* e.g., equal weighting, factor analysis, expert opinion and so on. This again has a technical and a more socio-political component. In the case of the KEI composite, we have considered the following weighting assumptions:
 - equal weights to individual indicators (thus dimensions weight is determined by the total number of individual indicators per dimension),
 - equal weight to the seven dimensions (thus weights to individual indicators vary according to their number per dimension),
 - Factor analysis (thus checking possible double counting),
 - Endogenous weights derived by data envelopment analysis. These weights allow to check how stable is a bottom position of a country – since the best set of weights for that country is used – and then to derive policy priority.
5. *Ranking method used.* When a set of individual indicators is aggregated, a fundamental point to be considered is the one of compensability. *Compensability* refers to the existence of trade-offs, i.e. the possibility of offsetting a disadvantage on some criteria by a sufficiently large advantage on another criterion, whereas smaller advantages would not do the same. Thus a preference relation is non-compensatory if no trade-off occurs and vice versa. The use of weights combined with intensity of preference in the criteria values originates compensatory multi-criteria methods and gives the meaning of trade-offs to the weights. On the contrary, the use of weights combined with ordinal criteria values originates non-compensatory aggregation procedures and gives the weights the meaning of importance coefficients. To give an illustrative example of the compensability issue, we assume that a composite indicator is formed by four indicators: inequality, environmental degradation, GDP per capita and unemployment. Two regions have respective values (21, 1, 1, 1) and (6, 6, 6, 6). These regions would have equal composite indicator scores if the aggregation was additive, i.e. fully compensatory. Yet, these regions represent very different social conditions that would not be reflected in the composite. If the

aggregation rule is only partially compensatory, the use of a geometric aggregation, where $CI_n = \prod_{m=1}^M y_{mn}^{w_m}$ is the right solution. In that case, the first region would have a much lower composite indicator score (=2.14) than the second (=6.00). Although various functional forms for the aggregation of indicators into a composite indicator have been developed in the literature in the standard practice, a composite indicator CI_n for a given country n , can be considered a weighted linear aggregation function applied to a set of m ($m = 1, 2, \dots, M$) normalised variables. As noted in previous KEI WPs by the JRC team, the use of nonlinear aggregation rules to construct composite indicators is **compulsory** for reasons of theoretical consistency when weights have the meaning of *importance coefficients* (i.e. the bigger the weight the more important the individual indicator) or when the assumption of preferential independence among indicators does not hold. Moreover, in case of linear-based composite indicators, compensability among the different individual indicators is always assumed, which implies complete substitutability among the indicators considered. From a normative point of view, such a complete compensability **is often not desirable**. For all these reasons, here we also use a nonlinear/noncompensatory Condorcet consistent aggregation rule for computing the KEI composite indicator (this procedure has also been proposed in previous JRC KEI WPs).

The KEI composite indicator results are the following:

Knowledge Economy Index

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Sweden	54	46																											
Denmark			55	30	14																								
Luxembourg	36	4	14	25	4	7	7	4																					
Finland		18	23	29	9	11	11																						
USA	11	32	2	4	39	9	4																						
Japan			4	7	18	32	36			4																			
UK			2	5	16	38	39																						
Netherlands								86	4		4				7														
Ireland							4		61	14	4	9	9																
Austria									18	50	18	7		7															
Belgium								11	4	11	57	16	2																
France						4			14	18	11	54																	
EU15											4				57	39													
EU25										4	4	14	32	39	7														
Germany													7	79		4	7	4											
Slovenia															7	41	38	14											
Estonia																4	36	25	21	11	4								
Malta															7	13	9	21	23	27									
Cyprus																36	7	4	23	23	7								
Spain																4	4	32	25	29	7								
Czech. Rep.																		4	7	30	39	5	7	7					
Latvia																				20	36	11	21	7		5			
Italy																				29	18	9	29	9	7				
Greece																				4	4	4	29	18	21	7	14		
Lithuania																					4	41	13	32	11				
Hungary																						2	13	13	57	2	14		
Portugal																			4			4		7	11	61	14		
Slovakia																							4	7	18	71			
Poland																													100

Legend:

- Frequency lower 15%
- Frequency between 15 and 30%
- Frequency between 30 and 50%
- Frequency greater than 50%

This is a novel approach to the presentation of results of a composite indicator. Our objective here is to synthesize and make explicit the uncertainty contained in the country ranking. For each country it is indicated the percentage of times it was in a given rank in all the 2,000 simulations, one can see that e.g. Poland was 100% of times in the last position, and Sweden 54% of times in the first position and 46% in the second.

A first consideration is that the overall ranking is very stable; in fact considering the whole 2,000 simulations, all countries are clustered unambiguously. No doubt the top performing countries are Sweden, Denmark Luxembourg, Finland and the USA. Then it follows the group Japan, United Kingdom, Netherlands and Ireland (where Japan and UK are slightly better than the other two). Austria, Belgium, France and Germany form the next group (where Germany is slightly worst than all the other three). All the rest of countries can be considered with a bad performance with respect to a knowledge based economy. However, we could still split this class into two subsets: a first one including Slovenia, Estonia, Malta,

Cyprus, Spain, the Czech Republic, Latvia, Italy, Greece and Lithuania is a bit better than the worst performing group including Hungary, Portugal, Slovakia and Poland. An interesting result is also that overall both USA and Japan have a better performance than EU 15 and EU 25.

To better understand the influence of the conceptual model used to derive these results, we have computed country rankings by using the subset of individual indicators belonging to each one of the seven dimensions, thus other seven rankings have been obtained. The objective of this analysis is to check if in some single dimensions, poor performing countries might present an improvement or vice versa, good performance countries a worsening. Of course rankings are obtained again by considering the whole spectrum of uncertainty related to the computations.

Overall, dimensions A1 (Production and diffusion of ICT), A2 (Human resources, skills and creativity) and A3 (knowledge production and diffusion) supply rankings correlated with the KEI composite indicator highly. In these three dimensions Finland is always the top country, but Sweden is always very close to it. In the bottom of the ranking we can find both Cyprus and Portugal, but Poland is never too far from the last position. On dimension A1 Italy has a net improvement but it is still far from the top performing countries. The grouping of countries is very similar to the one of the KEI composite (with all the seven dimensions). On the contrary, A4, B1, B2 and C1 produce country rankings with bigger differences.

On dimension A4 (Innovation, entrepreneurship and creative destruction), Italy ranks as the bottom country with a very high degree of credibility (frequency= 11% rank 27, 32% rank 28 and 57% rank 29). Also countries like The Netherlands, Belgium, Austria and Germany show a very poor performance. Finland is closer to medium performance countries than to top countries. Spain improves its rank position considerably. Sweden is still a top performing country. Poland improves its performance surely, but it is very volatile (it occupies positions in the range from the 7-th to the 24-th and the frequency it is never higher than 14% in any position).

Taking into account dimension B1 (Economic outputs) only, big surprises exist. Although the bottom countries are very similar to the ones supplied by other dimensions, Greece (5-th position) and Spain (4-th position) are extremely well performing. Cyprus is also improving

considerably. Denmark, Finland and Sweden are instead much worse, since they perform as medium countries.

The same argument applies to dimension C1 (Internationalisation). The bottom countries are quite robust a part from Cyprus which is performing around the 7-th and 8-th positions. Portugal is in a better position than Finland (which is very volatile but never above the 17-th rank). Denmark and Sweden are between positions 11 and 13. Top performing countries are Luxembourg, Belgium, Austria and the USA.

On dimension B2 (Social performance), top countries are Denmark, Sweden, Austria and the Netherlands. Particularly strong is the worsening of Finland which is around the 13-th position. Germany is also performing very badly (frequencies are clustered around positions 22 and 23). Improvements are shown by Hungary, Italy, Portugal and Spain which perform as middle ranked countries.

Production and diffusion of ICT (A1)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Finland	54	46																												
Sweden	46	54																												
Denmark			89			11																								
USA			11	54	36																									
UK				39	43	18																								
Japan				7	21	57	14																							
Luxembourg					14	61	11	4	4			4				4														
Netherlands					14	57	18	11																						
Germany						29	21	39	7	4																				
Estonia						4	11	46	39																					
France							4			68	18		11																	
Austria								7	7	18	29	39																		
EU15										4	46	50																		
Belgium										4	4	7	46	7	32															
Ireland													21	36	11	32														
Malta													18	32	39	11														
EU25													4	25	14	57														
Italy																	93	4	4											
Greece																		57	21	21										
Slovenia																		7	32	36	21		4							
Czech. Rep.																			14	50		7	14							
Spain																			7	7	7	43	21	7	7					
Portugal																					14	50	14	7	14					
Lithuania													14	43	36	7														
Latvia																				14	25	4	14	21	14				7	
Hungary																				4	18		7	18	32	14	7			
Slovakia																											7	14	57	21
Poland																										4	4	14	79	
Cyprus																														100

Legend:
 Frequency lower 15%
 Frequency between 15 and 30%
 Frequency between 30 and 50%
 Frequency greater than 50%

Human resources, skills and creativity (A2)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Finland	100																													
Sweden		50		21	14	7	7																							
Denmark		29	29	18	21	4																								
UK		21	54	18	7																									
Japan				18	36	43	4																							
USA			11	32	21	36																								
Netherlands						11	71	18																						
Ireland							18	82																						
France									86	14																				
Luxembourg									14	50	21		4	4				7												
Belgium										46	54																			
EU15												68	21	11																
Austria									4	11	18	25	18	25																
Germany												14	46	21	18															
EU25												29	7	21	32	11														
Slovenia												7	14	14	14	14	29	7												
Estonia												14				14	14	57												
Cyprus																21	7	14	36	14	7									
Lithuania																		46	43	4	7									
Latvia																			7	43	36		4	11						
Malta																			7	36	21	14	21							
Spain															4					7		21	18	43	7					
Italy																						7	64	25	4					
Czech. Rep.																		4	4		4				64	21				
Slovakia																									7	14	79			
Poland																											100			
Greece																												89	11	
Hungary																													64	36
Portugal																												7	29	64

Legend:
 Frequency lower 15%
 Frequency between 15 and 30%
 Frequency between 30 and 50%
 Frequency greater than 50%

Knowledge production and diffusion (A3)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Finland	##																												
Sweden		64	36																										
Japan		36	64																										
USA				##																									
Netherlands					82	18																							
Denmark					14	64	18	4																					
Germany						43	7	4			11	29	7																
Luxembourg						32	46	14	7																				
EU15							36	46	18																				
France					11		4		18	29	4	36																	
UK							21	18	32	14		7	7																
Austria									25	25	21	29																	
EU25				4			4	4	32		21	29	7																
Malta						7	7		11	7	4	7	7	36	14														
Belgium													21	79															
Ireland															86	14													
Slovenia															71	21	4	4											
Cyprus															14	14	57	7	7										
Estonia																	18	75	7										
Hungary												7	21	36	11	11	14												
Czech. Rep.																						11	14	29	18	29			
Lithuania																		4				25	14	4	11	29	7	7	
Latvia																						7	7	11	18	11	4	36	7
Italy																						18	11	14	4	7	14	29	4
Portugal																							11	32	18	4	36		
Spain																						14	14	14		18	21	18	
Slovakia																									36	14	43	7	
Greece																											7	46	46
Poland																											4	43	54

Legend:
 Frequency lower 15%
 Frequency between 15 and 30%
 Frequency between 30 and 50%
 Frequency greater than 50%

Innovation, entrepreneurship and creative destruction (A4)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
UK	79	21																												
Japan		43	18	29	7	4																								
Slovakia		7	14	61	18																									
Sweden		14	21	7	21	36																								
Luxembourg			11	32	39	18																								
Denmark					4	50	11	18	11		4	4																		
Estonia						7	46	32					7					7												
France				14	18	18	18	29	4																					
Finland									32	21		14	11	7	7	4						4								
Lithuania							7	4	14	29	18	14	7							4			4							
Spain									4	18	32	18	21				7													
Hungary			4			4	11	25		4		4			11	4	4	11	4	11	7									
Malta									4	32	7	7		11	11	4	14	4			4						4			
EU25									4	4	4	11	29	11	7	18	7					7								
EU15										32	11	4	14	7	11	14	4	4												
Ireland									4	11		7	18	11	14	7	7	7	7	4	4		4	4		4	4			
USA												14	4	25	14	4	18	7												
Czech. Rep.								7		4					4	7	29	11	18	14	4	4								
Poland							7	4				4		11	4		7	14				11	11	7	14	7				
Netherlands													4	4	7		4	4	36	25	11	7								
Slovenia													4			21	11		7	11	21	14	7	4						
Belgium														7		4	4				4	18	43	7		4	11			
Latvia													4	4						7	7		7	29	21	14	7			
Greece																			4	7			4	32	43	11				
Austria											4		4			7										14	39	32		
Germany																									4	39	32	11	4	11
Cyprus																						4	11	7		14	14	14	29	
Portugal																							4	4		7	32	50	4	
Italy																											11	32	57	

Legend:
 Frequency lower 15%
 Frequency between 15 and 30%
 Frequency between 30 and 50%
 Frequency greater than 50%

Economic outputs (B1)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Luxembourg	71	29																											
Ireland	29	71																											
USA			##																										
Spain				##																									
Greece					89	7	4																						
UK					4	64	29		4																				
Japan							61	4	25	11																			
Belgium								25	36	25		14																	
Austria								14	21	14	36		4	7	4														
Denmark								36	7	14	7	7	29																
Cyprus					7	25	7			7	7			39	7														
Finland								14	14	7	14	4	43	4															
Netherlands										36	50	14																	
Sweden								7	7			36	50																
Estonia														7	79	4	4	4	4										
EU15														4	7	39	14	21	14										
France																21	50	14		7	4	4							
Latvia					4											14	39	29	7	7									
Slovenia																7	7	14	71										
EU25																	4	14	82										
Germany																				4	82	14							
Czech. Rep.																						57	7	29	7				
Italy																						4	71	25					
Lithuania																						29	14	54	4				
Portugal																			4			7			43	43		4	
Slovakia																									46	54			
Hungary																										4	93	4	
Poland																											7	93	
Malta																													100

Legend:

Frequency lower 15%

Frequency between 15 and 30%

Frequency between 30 and 50%

Frequency greater than 50%

Social performance (B2)

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Denmark	##																													
Sweden		71	29																											
Austria		25	61		14																									
Netherlands			14	71	4		7	4																						
USA				11	79	7			4																					
Japan						71	14	4	4			4										4								
Belgium						7	75	4		11	4																			
Luxembourg						4	46	18	18	7	7																			
Cyprus				4	4	7		14	18	18	11	11		4	4		4	4												
Ireland				4	7		4	7	25	18	4	4	11	4						7			4							
EU25								7	32	7	25	14	7	7																
Slovenia				4			4	7		25	39	21																		
Finland										11	11	11		54	4	4		7												
UK												7	4	57	14	11	4	4												
France												14		18	36	11	21													
Hungary											4	7	4	36	4	39	7													
Italy											18			4	43		21	7		7										
Portugal												4		4	21	11	29	18	7	7										
Spain																7	21	18	21	18	11			4						
Malta															4		4	14	32	32	14									
Greece																7	4	4	14	18	25			29						
Germany																					4		50	46						
EU15																4	4	7	7	7		29	32	4	7					
Latvia																		4	7	14	4	4	29	32	7					
Czech. Rep.																						4	11	4	82					
Lithuania																										7	86	7		
Estonia																											50	7	43	
Poland																											39	61		
Slovakia																												11	32	57

Legend:

Frequency lower 15%

Frequency between 15 and 30%

Frequency between 30 and 50%

Frequency greater than 50%

Internationalisation (C1)																													
	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Luxembourg	86	14																											
Belgium	14	64	4	18																									
Austria			32	36	11	14		4	4																				
EU15			25	39		14	18	4																					
USA		7	4	4	43	21	7		14																				
Cyprus					14	14	32	25	4	4	7																		
UK			18	11	11	7	39	11	4																				
EU25		14		7		18	7	32		14			7																
Ireland			4		14	11	4	4	21		14	14	11		4														
France					4	25	29	25	11	7																			
Netherlands							18	21	36	21		4																	
Denmark								7	29	54	7	4																	
Sweden										14	50					7	21		7										
Czech. Rep.								7	11	4				25	7	25	14				4	4							
Malta												11	14	39	36														
Spain													21	25	18	25	11												
Germany												4	18	4	7	36	14	7	4	4	4		4						
Portugal												4	11	4	4	4	36	11	18	4	7								
Japan													4	7		18	46	25											
Slovenia												4	4	4		11	21	29	29										
Finland																4	7	7	14	14	11	11	4				18	7	4
Hungary																					29	18	25	25	4				
Poland																					46	39	7	7					
Italy																						18	14	43	25				
Slovakia												7							4	4	21			18	39	4		4	
Estonia																				4	11	46	32	7					
Lithuania																							21	50	29				
Latvia																											18	68	14
Greece																											4	14	82

Legend:
Frequency lower 15%
Frequency between 15 and 30%
Frequency between 30 and 50%
Frequency greater than 50%

The overall variation of country positions is synthesised in figure 2, where black marks correspond to the median KEI composite indicator rank and whiskers show best and worst rank occupied by a country considering the whole 2,000 simulations. The internal consistency of KEI conceptual framework is synthesised in Tables 3 and 4, where the relationship between KEI overall ranking and the dimensions and sub-dimensions considered is analyzed by using the Spearman rank correlation coefficients. As a rough first conclusion we could state that overall all dimensions play a role but surely the less influential seems to be the innovation, entrepreneurship and creative destruction dimension. This conclusion is corroborated by a more sophisticated tool i.e. Path Analysis. By using path analysis, the influence of each single dimension on the total ranking can be computed (this influence is divided into a direct effect and an indirect one). Results of the path analysis are presented in table 5. A first conclusion is that all dimensions seem to have a more or less equal impact (the range is between 12 and 18) on the KEI ranking (please note that here only the linear aggregation is used, since path analysis cannot be carried out for the non-compensatory aggregation rule) except dimension A4 (Innovation, entrepreneurship and creative

destruction, whose score is 8). The variability is much higher if one looks at the sub-dimension levels (e.g. very low scores can be found for knowledge flows (7) or organizational indicators (2)). We can expect an even higher variability at the individual indicator level; this is potentially very relevant if one desires reducing the set of indicators of the KEI conceptual framework. This research issue will be dealt with later on in this report.

Figure 2. Median and associated 5th and 95th percentiles for the rank distribution

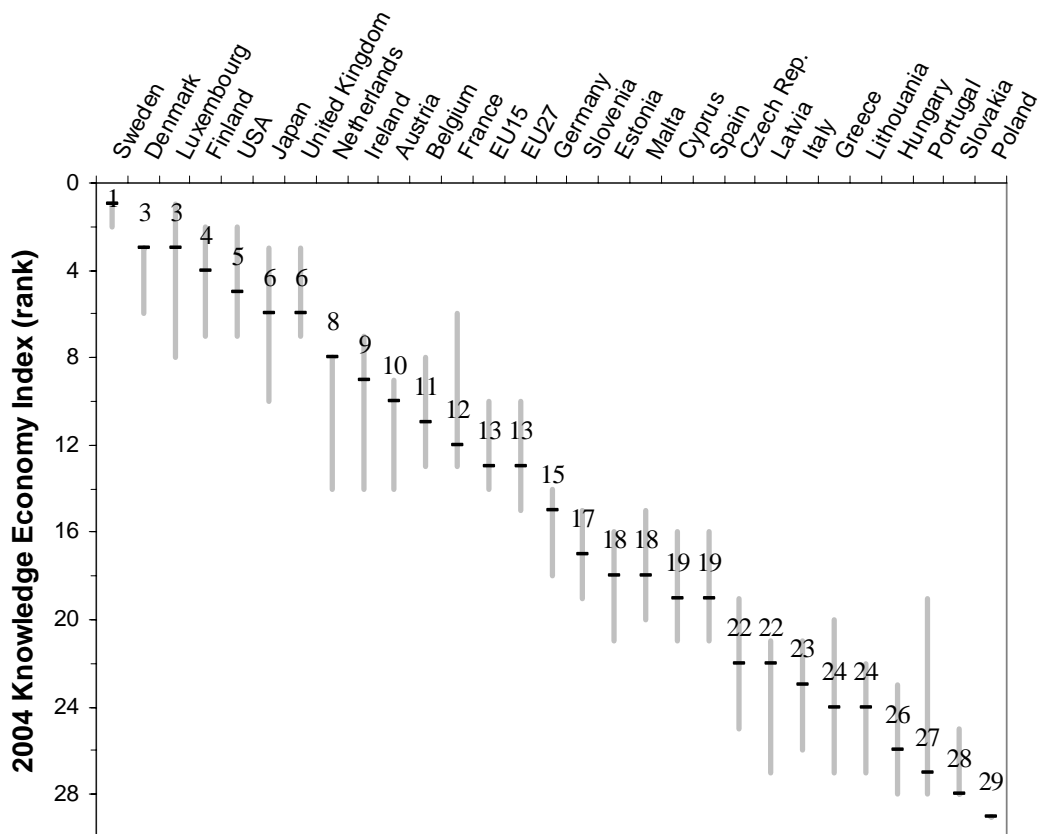


Table 3: Spearman rank correlation coefficients between KEI and its seven dimensions (median ranks across ~2,000 simulations)

	Production and diffusion of ICT	Human resources, skills and creativity	Knowledge production and diffusion	Innovation, entrepreneurship and creative destruction	Economic outputs	Social performance	Internationalisation
<i>KEI</i>	0.90	0.95	0.91	0.40	0.68	0.78	0.63
Production and diffusion of ICT		0.87	0.88	0.42	0.54	0.58	0.41
Human resources, skills and creativity			0.90	0.44	0.60	0.68	0.53
Knowledge production and diffusion				0.37	0.42	0.69	0.55
Innovation, entrepreneurship and creative destruction					0.17	0.06	0.04
Economic outputs						0.59	0.48
Social performance							0.61
Internationalisation							1.00

All coefficients are significant ($p < 0.05, n = 29$).

Table 4: Spearman rank correlation coefficients between the dimensions and sub-dimensions in KEI (median ranks)

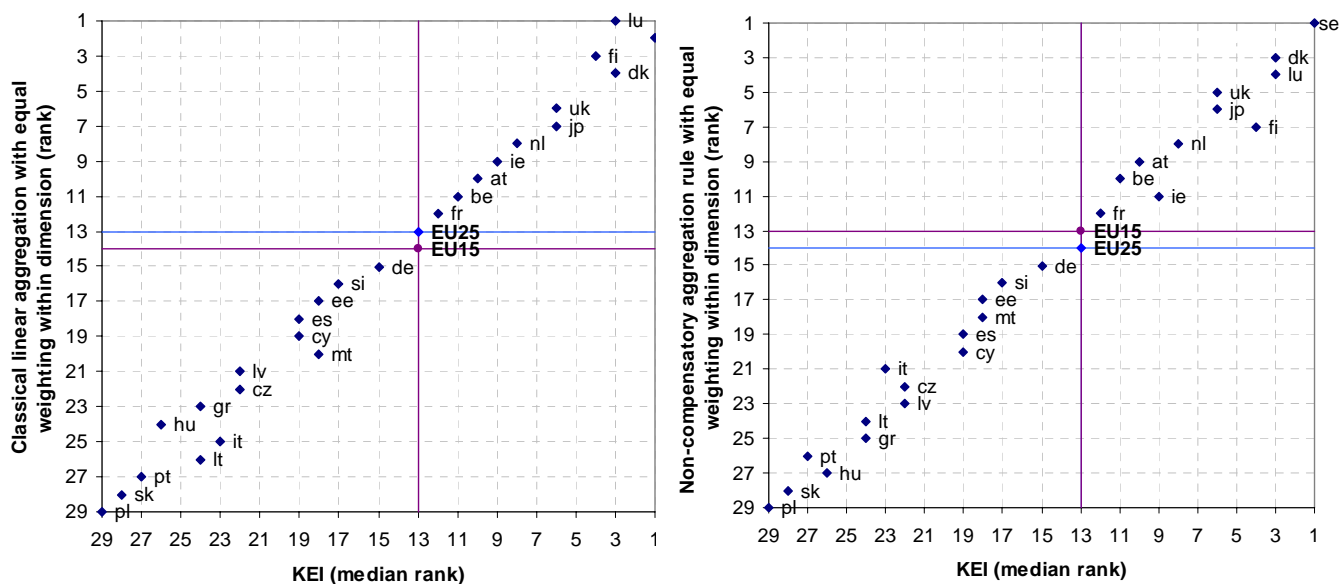
<i>A1. Production and diffusion of ICT</i>		<i>A2. Human resources, skills and creativity</i>	
Economic impact of ICT sector	0.69	General education	0.80
Internet use by firms	0.84	Human resource in S&T education	0.84
Internet use by individuals	0.91	Skills	0.87
Government ICT	0.84	Creativity	0.82
		Mobility	0.54
<i>A3. Knowledge production and diffusion</i>		<i>A4. Innovation, entrepreneurship and creative destruction</i>	
Research and experimental development	0.88	Entrepreneurship	0.37
Patents	0.95	Demand for innovative products	0.63
Bibliometrics	0.87	Financing of innovation	0.41
Knowledge flows	0.26*	Market innovation outputs	0.53
Total investment in intangibles	0.65	Organisational indicators	0.03*
<i>B1. Economic outputs</i>		<i>B2. Social performance</i>	
Income	0.66	Environmental	0.51
Productivity	0.75	Employment and economic welfare	0.83
Employment	0.82	Quality of life indicators	0.72
<i>C1. Internationalisation</i>			
Trade	0.59		
Knowledge production and diffusion	0.87		
Economic structure	0.46		
Human resources	0.82		

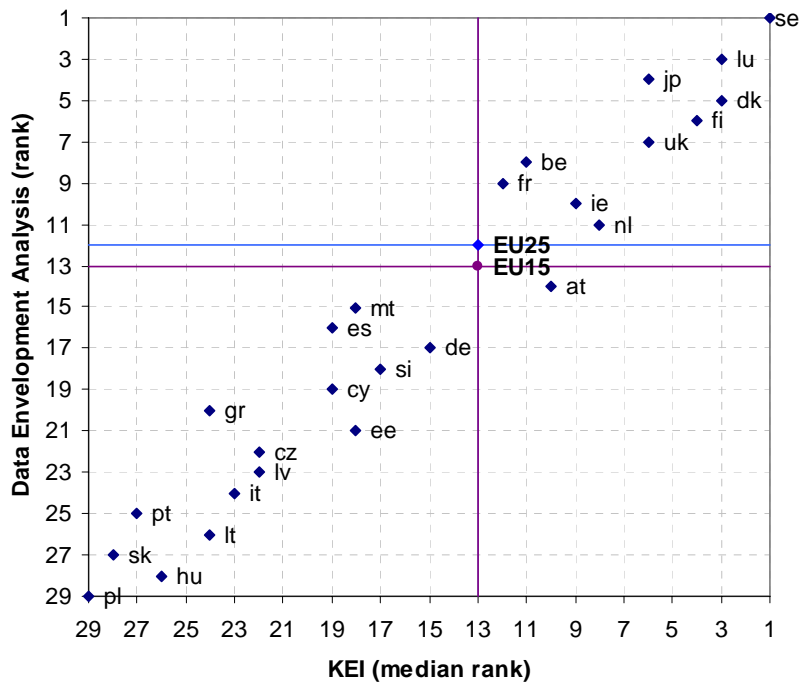
All coefficients are significant ($p < 0.05, n = 29$); coefficient non significant ($p >> 0.05$).

Table 5: Path Analysis results: effect of the sub-dimensions and dimensions to KEI (median ranks)

Dimensions and sub-dimensions	Direct and indirect effect (%)	
<i>A1. Production and diffusion of ICT</i>		17
Economic impact of ICT sector	21	
Internet use by firms	26	
Internet use by individuals	28	
Government ICT	26	
<i>A2. Human resources, skills and creativity</i>		18
General education	20	
Human resource in S&T education	22	
Skills	22	
Creativity	21	
Mobility	14	
<i>A3. Knowledge production and diffusion</i>		17
Research and experimental development	24	
Patents	26	
Bibliometrics	24	
Knowledge flows	7	
Total investment in intangibles	18	
<i>A4. Innovation, entrepreneurship and creative destruction</i>		8
Entrepreneurship	18	
Demand for innovative products	32	
Financing of innovation	20	
Market innovation outputs	28	
Organisational indicators	2	
<i>B1. Economic outputs</i>		13
Income	30	
Productivity	33	
Employment	37	
<i>B2. Social performance</i>		15
Environmental	26	
Employment and economic welfare	40	
Quality of life indicators	34	
<i>C1. Internationalisation</i>		12
Trade	22	
Knowledge production and diffusion	32	
Economic structure	17	
Human resources	30	

Let us now look at the comparison between the KEI median ranking and those produced by a particular scenario (selected interesting examples). The rankings derived by a linear aggregation rule and a non-compensatory one (under the equal weighting within dimension assumption) are highly correlated, although the non-compensatory one appears more stable. Compensability might be an issue for Finland whose position in the non-compensatory ranking is definitely worse than the ones of Sweden, Denmark, Luxembourg, United Kingdom and Japan. The bottom countries are very stable in both rankings. Useful information is also coming from the comparison between the KEI median ranking and the ranking derived by using data envelopment analysis weights. Since these weights are beneficial for the bottom countries, we can state quite safely that even with endogenous weights the bottom countries are no doubt very stable, thus they are very far from being knowledge based economy countries. Regarding the top countries, it is noteworthy the strong top position of Sweden and the fact that Finland, even with its best set of weights, is still worse than Luxembourg, Japan and Denmark. A final observation is about Ireland. This country belongs to the set of more or less good performance countries, but it is never a real top countries, even with its best set of weights, we could thus conclude that according to the KEI conceptual framework and its statistical elaboration, the common perception that Finland and Ireland are the most relevant success stories of knowledge based economies is somewhat misleading.

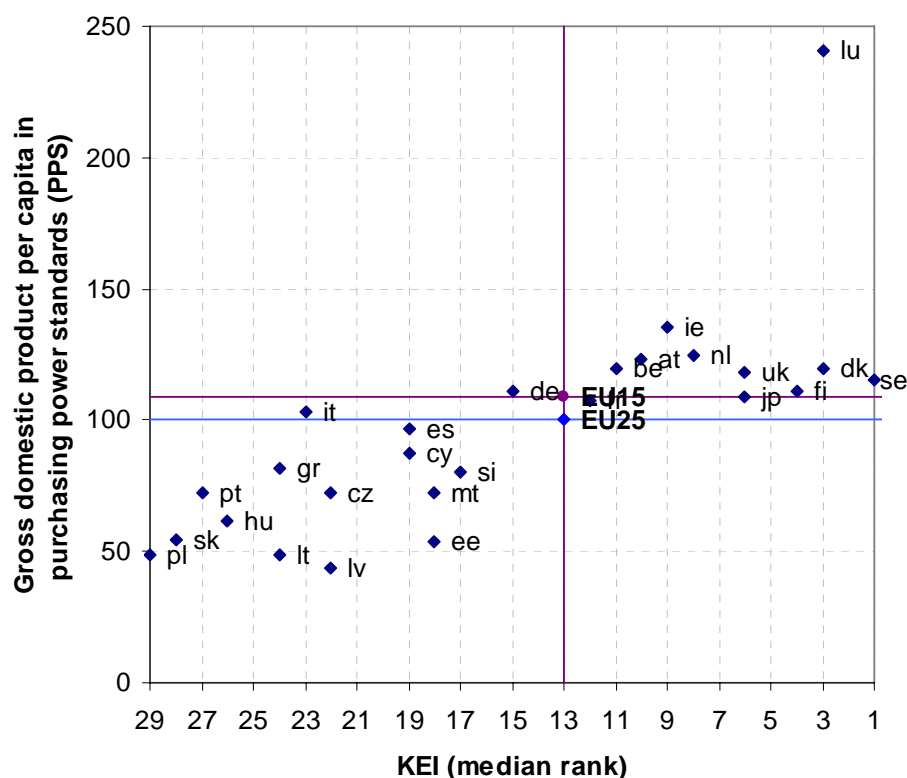




3. Relationship between the knowledge economy Index and other complex dimensions

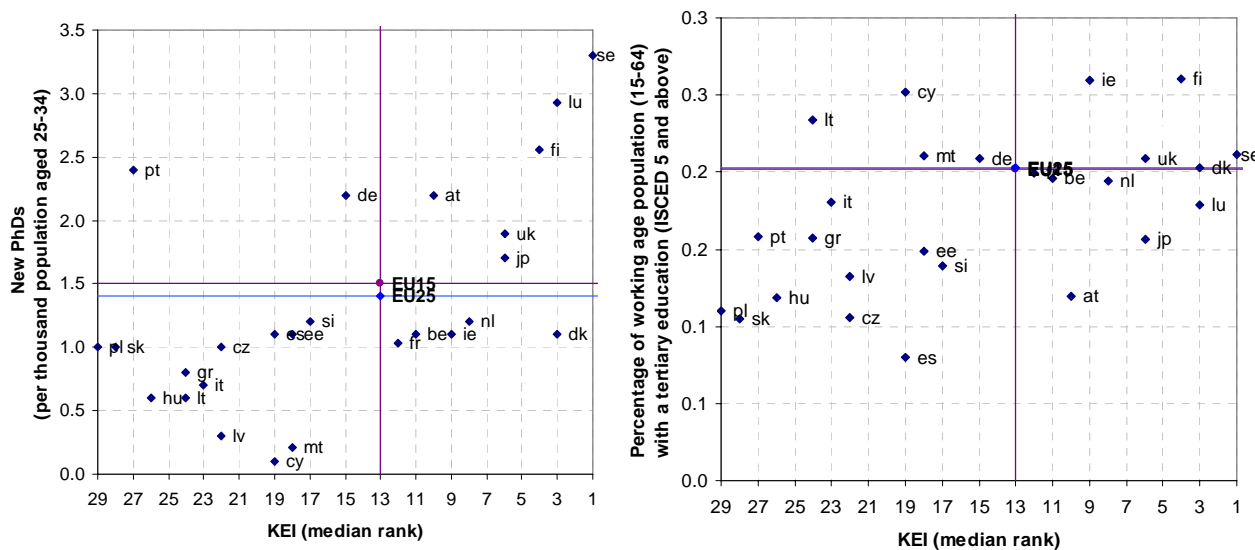
In this Section, we will try to benchmark the KEI composite with some standard economic theory results; this is done by first looking again to KEI conceptual framework and then by comparing KEI median ranking with some other relevant composite indicators. Economic theory tries to take technological change into account by two main theories: *Human capital theory* (whose main foundational principal is the recognition of the role of education and importance of skills people has) and *endogenous growth* (whose main idea is the Schumpeterian concept of accumulation of knowledge due to research and innovation in leading private firms).

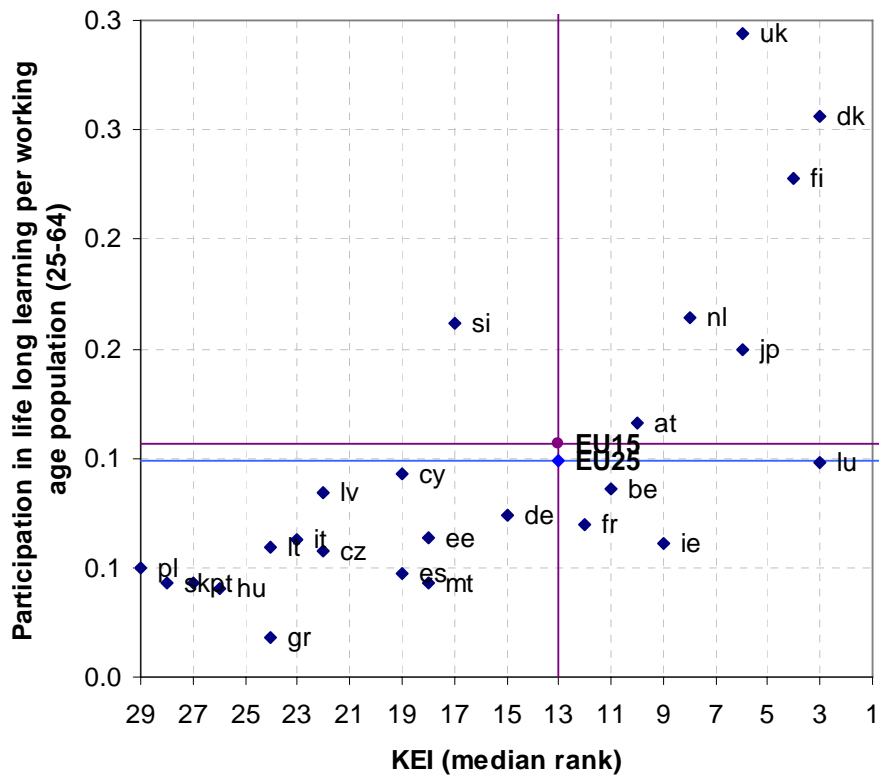
First of all, let us try to understand if to be a knowledge based economy is relevant at all for a good overall economic performance. By looking at the relationship between GDP and the KEI median ranking the answer is YES. Except Germany, Italy and Spain which have a high level of GDP per capita without any particular good performance on a KBE, all the other high level GDP countries seem to perform well in the KEI composite (where Luxembourg can be considered an extreme case -probably an outlier-).



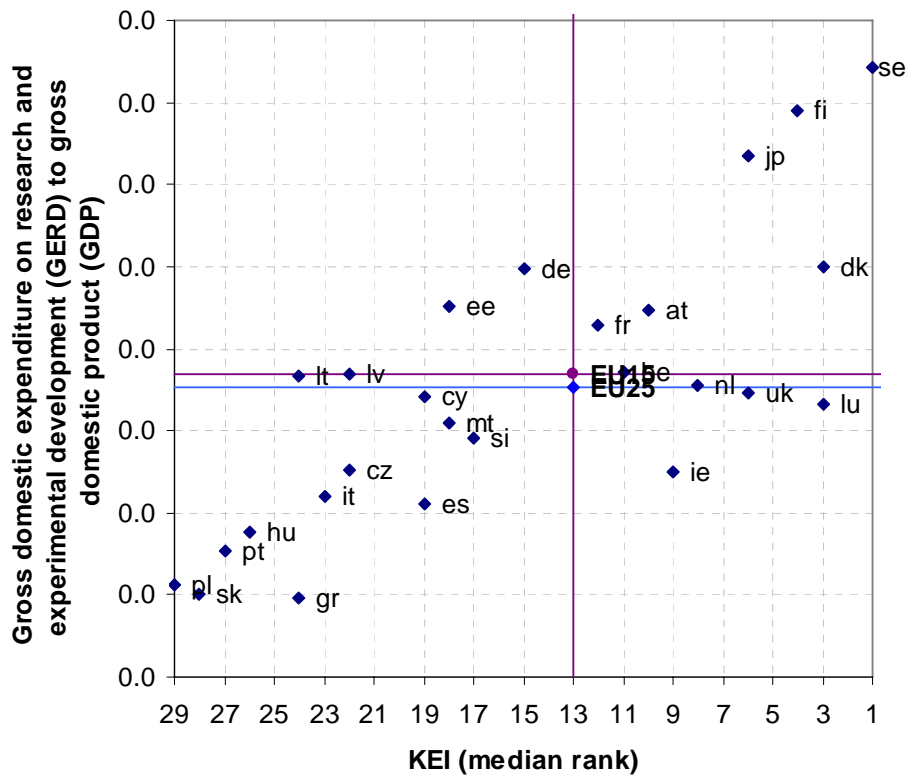
As we already know at the level of dimensions considered in the KEI framework, they all seem to have an influence on the knowledge based economies, thus both economic theories seem to have an influence (since roughly both theoretical models are conceptualised). However, a first result was that the Innovation, entrepreneurship and creative destruction dimension appears not to be very relevant; thus starting challenging the Schumpeterian model. Let us then start by checking if the human capital theory is more relevant in the case of the KEI composite, for doing so we go deeper than the dimensional hierarchical level.

The following conclusions can be drawn from our analysis. While the number of Ph.Ds seems to play a role in explaining the success of a knowledge based economy (all countries with an high number of Ph.Ds, except Portugal, are top countries in the KEI median ranking), the same result does not apply to percentage of working population with a tertiary education (very clear the case of Italy where the number of working population with a tertiary education is extremely high, but the number of Ph.Ds is small). Participation to life long learning seems also to be a success factor, although not for all top countries. In sum, we could state that the human capital theory seems to be corroborated by the KEI results roughly.





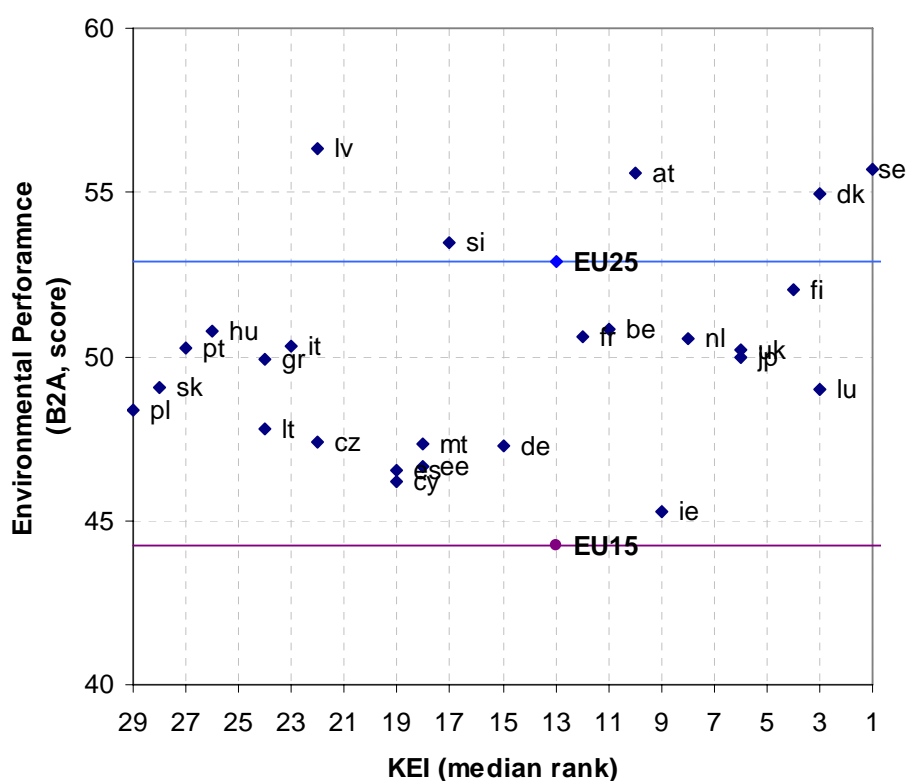
However, if one considers, what probably is the most important Schumpeterian indicator, i.e. Gross domestic expenditure on research and experimental development, the relationship with the KEI median is a clear cut one: countries which invest in research are top countries in a KBE. Research is a key driver for a KBE surely, thus the endogenous growth idea seems also corroborated.



Let us now look at other concepts embedded in the idea of a knowledge economy. A popular one is *eco-efficiency*. i.e. the idea that advanced economies, such as knowledge based economies, are more environmental friendly since they use less material goods and are more energy efficient in productive activities. Unfortunately, the *Jevons' paradox*¹ teaches us that an increase in efficiency in using a resource leads, in the medium to long term, to an increased consumption of that resource (rather than a decrease). This is a classic example of the co-existence of opposite causal links emerging when considering the same process at different (spatial, temporal) scales. Trade-offs also emerge when considering different attributes of performance or when adopting different disciplinary analyses. Sustainability literature clearly emphasizes that environmental preservation has an economic cost and

¹ In 1865, William Stanley Jevons wrote an influential book, entitled *The Coal Question; An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal Mines* (London: Macmillan & Co). In Chapter seven, entitled 'Of the economy of fuel', Jevons observed that the consumption of coal rose rapidly after James Watt had introduced his coal-fired steam engine, which much improved the efficiency of Thomas Newcomen's earlier designs. Watt's innovations made coal a more efficient source of power, leading to an increased use of the steam engine in a wider range of industries. This in turn increased total coal consumption, even though the amount of coal required for any particular application dropped through efficiency gains. Thus in general, technological efficiency will not result in the liberation from environmental damage as it has been promised. For a recent discussion on the Jevons' paradox sees John M. Polimenia and Raluca Iorgulescu Polimeni – Jevons's paradox and the myth of technological liberation, [Ecological Complexity Volume 3, Issue 4](#), December 2006, Pages 344-353.

economic growth has an environmental cost, no escapes from this conflict exists². These arguments seem corroborated by the KEI measure. In fact, as one can see, no clear relationship between environmental performance and a KBE exists.

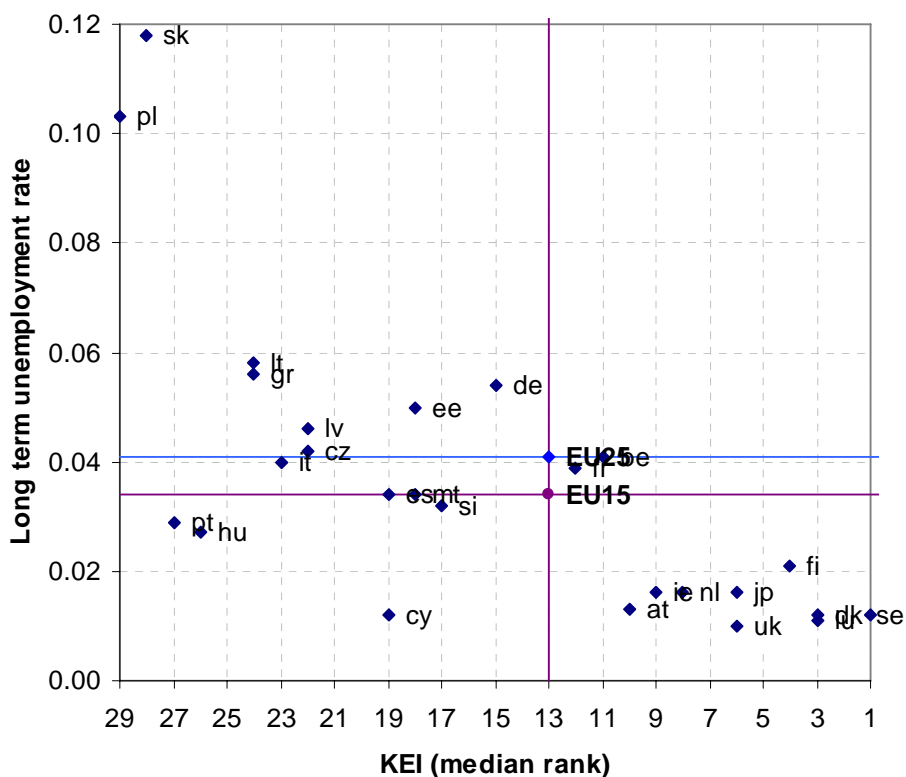


Another interesting aspect of a KBE is unemployment. Job creation can be successfully increased in the short term, by a slowdown of the rate of technological progress. As noted by the Kok report³, this is exactly what has recently happened inside the European Union. But in a longer time horizon, this strategy may easily cause the collapse of the economy given that non-specialized low productivity jobs can easily be substituted by lower wage labour in other parts of the world. Thus, in the short term technological progress and job creation are conflicting objectives but they might be compatible in the long period if a right balance (i.e. compromise) between flexibility and employment security is found. If the relationship between long term unemployment rate and the KEI median ranking is displayed, this

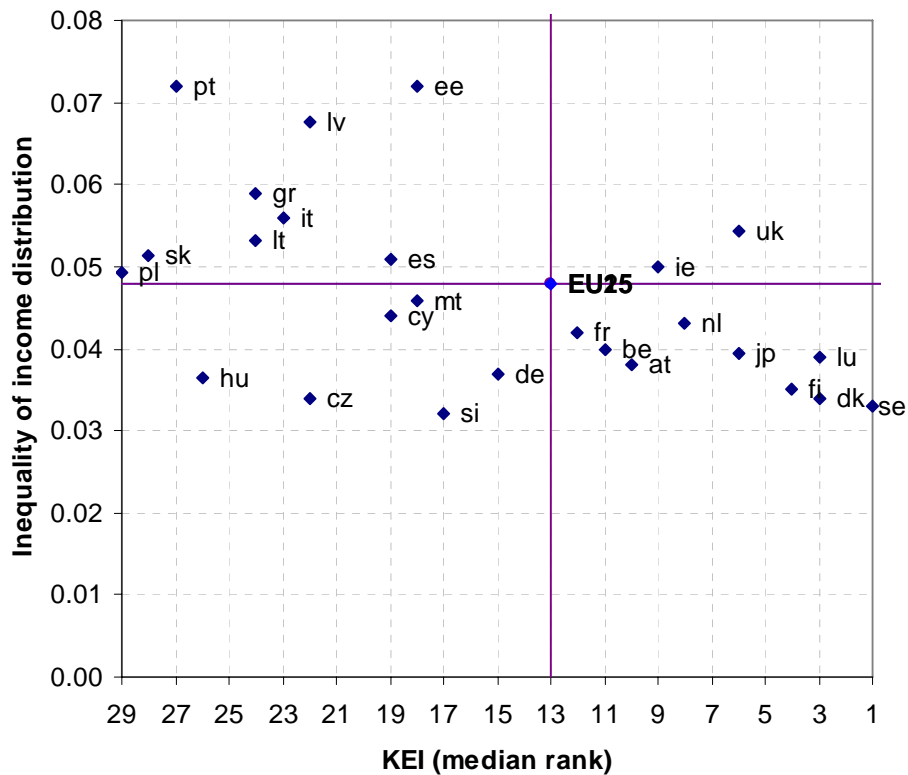
² The so-called “environmental Kuznets curve” assumption states that when GDP grows, initially the environmental impact is also bigger, but when prosperity is sufficiently high, the environmental impact decreases very much. According to this theoretical framework economic growth and environmental preservation are not necessarily in conflict. However, the truth of this assumption depends on the type of environmental impact considered. For example, for SO₂ or for urban smoke concentration it always applies, but if one considers carbon dioxide emissions, total energy consumption or urban waste the empirical relation with GDP goes always in the same direction, thus GDP growth in this cases, implies much more environmental impact.

³Kok W. (2004.) - The High Level Group on Lisbon Strategy (chaired by Wim Kok) (2004) – Facing the Challenge, European Communities, Luxembourg.

compatibility between technological progress and job creation seems to be true. All top countries in the KEI measure are presenting an extremely low long term unemployment rate. This aspect of a KBE seems extremely interesting and encouraging.

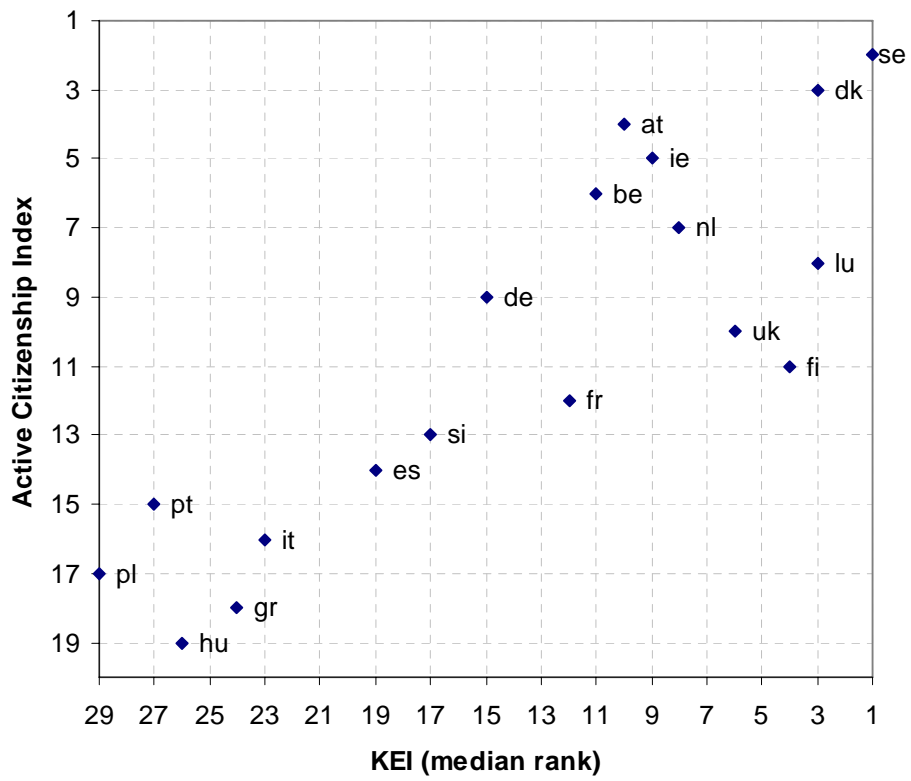
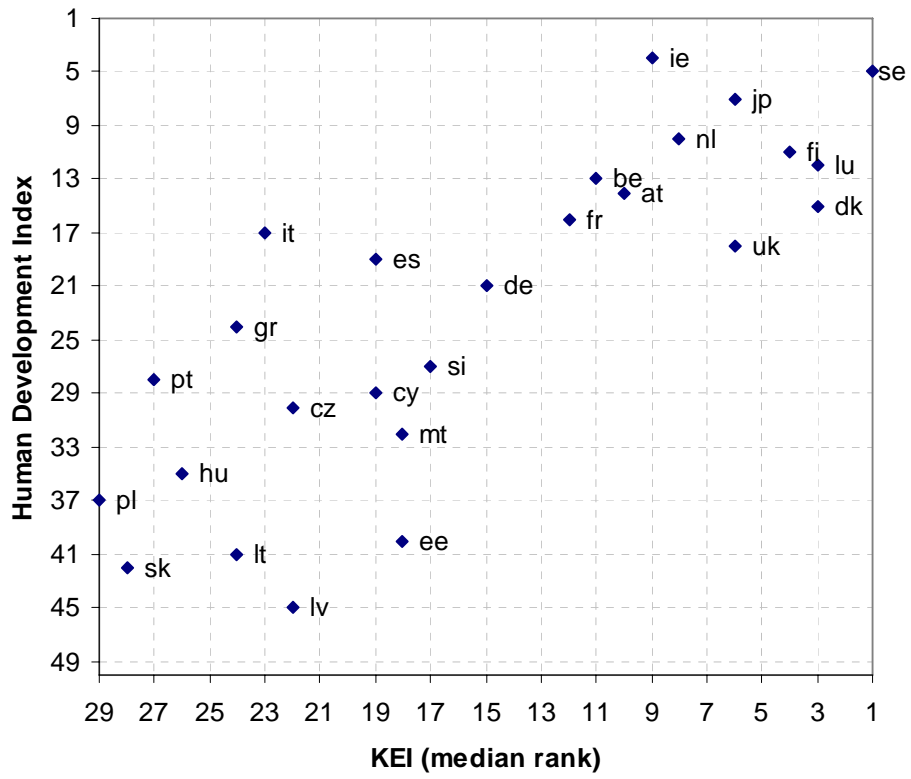


Another common statement about a KBE is that income distribution inequalities are reduced. This statement appears difficult to corroborate by examining the relationship between the KEI measure and the income distribution inequality. No precise relationship exists and when it seems to exist, in reality might simply be a corroboration of the classical Kuznets curve model, where income distribution inequality is supposed to decrease when GDP increases (one should not forget that KEI and GDP are correlated).



As an external benchmark, we look at the relationship between the KEI composite and the Human Development Index. The relationship found seems again a corroboration of the human capital theories, in fact the correlation between KEI and the HDI is extremely high. A peculiar behaviour is the one of Italy and Spain whose HDI is high but the KEI performance is poor.

In this context a relevant index to use as a final external benchmark might be the Active Citizenship Index. This index produced at JRC by CRELL (Centre for Research on Lifelong Learning) is an attempt to measure a component of the social capital, and thus can be considered as complementary to the human capital measurements, which look more at individual skills. It is interesting to note that this index correlates very much with the KEI median ranking, thus it might open interesting research questions on the importance of the social component in a knowledge based economy.



4. Is it possible to reduce the total number of individual indicators of KEI conceptual framework without losing any relevant information?

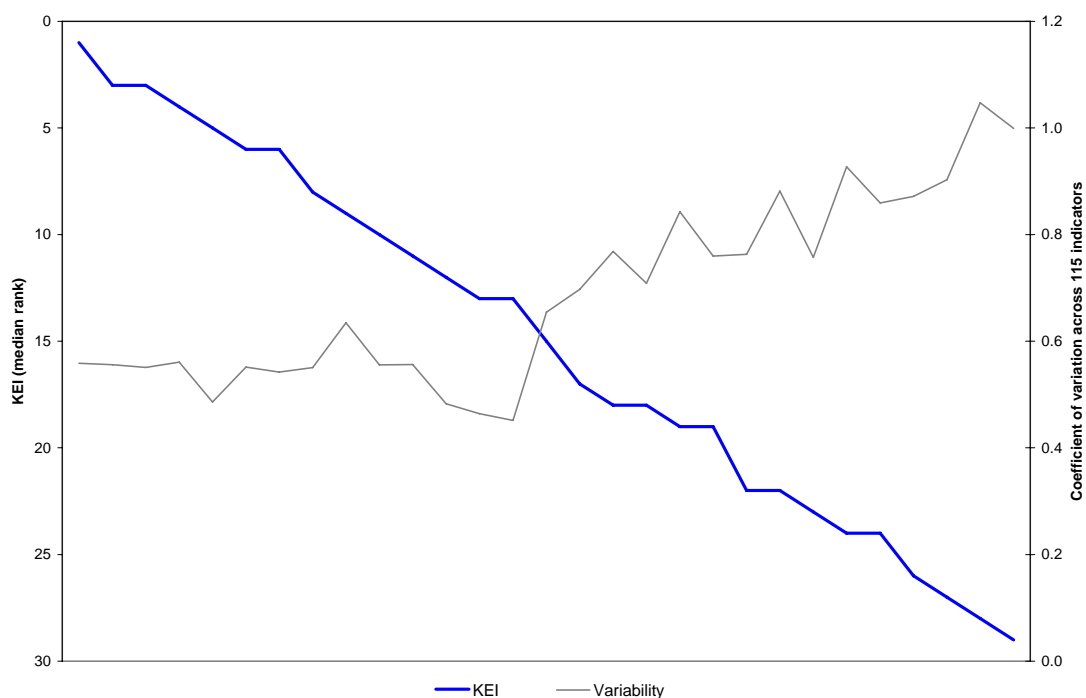
Let us discuss the relationship between the KEI median rank and the variability in the set of 115 underlying indicators composing the Knowledge Economy Index. The variability is expressed here by means of the coefficient of variation that is calculated as the ratio of the standard deviation to the mean of the 115 indicators' values per country. The indicators are scaled using the Min-max approach for the purposes of this analysis only and with a view to avoid an eventual underestimation of the variability, for example, if the standardisation method had been used. Note that in a more general case one would study the composite indicator scores versus the variability in the underlying indicators. In our case, the KEI results focus on the country ranks, so as to accommodate for the non-linear/non-compensatory multi-criteria analysis.

Figure 3 shows that the variability increases as we move towards the bottom-ranked countries. In fact, countries ranked between 1st and 15th position in the overall KEI tend to score uniformly high in the majority of the underlying indicators, as shown by the relatively low coefficient of variation (lower than 0.6) across the indicators values. On the other hand, countries ranked after the 16th position have a variability value greater than 0.6 up to 1.0 or slightly higher. A scissors pattern is evident. The correlation coefficient between the KEI median rank (opposite sign) and the coefficient of variation series is equal to $r = -0.878$, indicating *a strong degree of reverse association between the KEI ranks and the variability in the underlying indicators*. For comparison purposes, in the case of the Trade and Development Index (UNCTD, 2005) that was based on eleven components and developed for 110 countries, the correlation coefficient between the index scores and the coefficients of variation series was also high ($r = -0.93$).

An implication of this finding is that while changes in the KEI ranks over time could be regarded as a quantitative indication of trends in knowledge economy in Europe and in the USA and Japan, those in respect of the variability could be seen as qualitative changes. Reducing even further the variability in the indicators should be among the objectives of policies and strategies for a knowledge economy. To be successful, a country must put simultaneous thrust on multiple goals within a coherent knowledge economy strategy, while emphasizing reduction of the existing gaps in areas where performance is lagging. As the

exceptional behaviour of a few countries that have very low overall KEI performance but very high performance in just few of the sub-dimensions, a disproportionate emphasis on a limited number of objectives without concomitant focus on many of the determinants of knowledge economy can yield only marginal results.

Figure 3. The scissor diagram of KEI and variability



At a next step, we aim to reduce the attention from the suite of the 115 underlying indicators to a more parsimonious list, so as to present the country profiles and give some indication of the key indicators for the knowledge economy. We are not arguing in favour of using this reduced list of indicators to develop another version of the KEI. The approach undertaken here is guided by the need to present the country profiles.

To this end, we first undertook both forward and backward stepwise regression, so as to identify those indicators within a KEI dimension that represent (in a linear fashion) the dimension. We also applied forward/stepwise regression to choose those indicators that represent best the overall KEI rank. We finally crosschecked, using canonical analysis, whether the subset of indicators describes reliably the set of the seven KEI dimensions and the overall KEI. Results are shown in Table 6, where the 23 indicators (from a total of 115) are proven sufficient to describe 97.4% of the variation in the overall set (KEI and its seven dimensions).

Table 6. Reduced set of indicators on the knowledge economy to serve for the country profiling needs

Production and diffusion of ICT (A1)

ICT value-added (% of total business sector value added)

SMEs ordering over the Internet (% of total SMEs)

Individuals using the internet for banking (% total)

Human resources, skills and creativity (A2)

Pisa reading literacy of 15y (average score)

Total researchers (per 1000 labour force in FTE)

Participation in lifelong learning (% of working 25-64y)

Employed in creative occupations (% total)

Knowledge production and diffusion (A3)

BERD performed in service industries (%)

EPO high tech patent applications (per million pop.)

Triadic patent families (per million pop.)

Innovation, entrepreneurship and creative production (A4)

Firm entries (birth rate)

GDP (per capita)

Early-stage venture capital (% GDP)

SMEs reporting non technological change (%)

Economic outputs (B1)

GDP per capita (in PPS)

Real GDP growth rate

Total employment growth

Social performance (B2)

Long term unemployment rate

Hampered in daily activities because of chronic conditions

Rooms per person by tenure status and type of housing

Internationalisation (C1)

Technology balance of payments (% GERD)

Co authorship share on international S&E articles

Foreign PhD students (% total PhD enrolment)

5. Are rankings useful at all for deriving policy suggestions?

A nasty question at this point might be: *is all this effort we have done of any use?* Even if we have very reliable rankings, which is the policy utility of knowing that a country is overall better than another one or vice versa? This kind of criticism is often put to composite indicators, thus it is worthy to tackle this issue.

Indeed we have already seen that rankings are already giving very interesting information for policy purposes. For example, in the KEI framework, we succeeded to find out clear success stories, i.e. top performance countries, and clear policy drivers. However, one should note that for the majority of indicators used in any assessment exercises no clear reference point is available, for instance, when GDP is used nobody knows the ideal value of a Country GDP, thus it is quite common to compare with other Countries GDP, e.g. the USA one. In general to get a set of reference values to be used as benchmarks, two options exist:

- To compare any country performance with a relevant average (in our case EU15 or EU25).
- To construct an “ideal point” defined by choosing the best values reached in any single individual indicator by a country. This is a well established technique in multi-criteria evaluation literature and has the advantage of indicating “real world ideal values”.

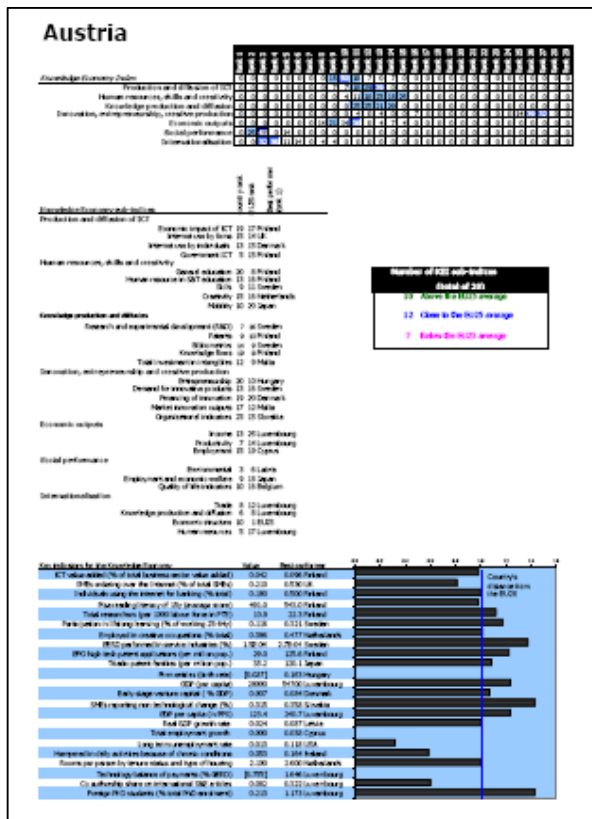
Here we follow both approaches. We will first synthesise the performance of each single country by comparing its scores on dimensions and sub-dimensions with the EU25 average. Later on country profiles are shown in details, where both EU25 average and the idea of a best performing country are used for deriving policy priorities.

By looking at the following Table, we have both synthetic and analytic information on single country performance. In fact we know the total numbers of sub-dimensions which are above (+), close (0) or below (-) the EU25 average, thus allowing a quick scoring of countries; but at the same time, it is also possible to derive policy suggestions since all the sub-dimensions are scored. To give some illustrative examples, Finland is clearly a top performing country since it is above or close to the EU25 average for the majority of sub-dimensions. The only plausible policy priorities since the performance is below the average are Entrepreneurship, Organizational indicators, Knowledge production and diffusion and Economic Structure.

Entrepreneurship, Organizational indicators and Economic Structure seem problematic for another top performing country, Sweden. For Sweden, Mobility and Knowledge flows also offer space for improvement. On the other side, if one examines the performance of countries such as Italy (above in the average only in Government ICT and Organizational indicators), Portugal (+ only in Financing of innovation and employment and economic welfare) or Greece (+ only in Economic impact of ICT, Income and Employment) it is clear that the space for improvement is enormous, but of course this does not necessarily mean that their governments wish to pursue the objective of being a KBE, it is important to remember that a KBE is one of the possible models that a country may choose and the fact that a poor performance exists might simply mean that this scope is not a policy objective for that country. An interesting result is that EU 15 is NOT always equal or superior to the average of EU25. It is actually below EU25 average in three sub-dimensions: Organizational indicators, Environment and Economic structure; in these areas the enlargement has then lead to an improvement of the average EU performance.

Dimension	Sub-dimension	AT	BE	CY	CZ	DE	DK	EE	ES	EU15	FI	FR	GR	HU	IE	IT	JP	LT	LU	LV	MT	NL	PL	PT	SE	SI	SK	UK	USA
Production and diffusion of ICT	Economic impact of ICT	0	0	-	0	0	+	+	-	0	+	0	+	0	+	0	+	-	0	+	-	+	-	-	+	-	-	+	+
	Internet use by firms	0	0	-	-	+	+	-	-	0	+	+	-	-	+	-	+	-	0	-	+	0	-	-	+	0	-	+	+
	Internet use by individuals	0	0	-	-	+	+	+	-	+	+	+	-	-	-	-	+	-	+	-	-	+	-	-	+	-	-	+	+
	Government ICT	+	0	-	-	0	+	+	0	0	+	+	-	-	0	+	+	-	+	-	0	0	-	-	+	-	-	-	+
Human resources, skills and creativity	General education	-	0	0	-	0	-	-	-	0	+	0	-	-	+	-	-	0	-	-	0	-	-	+	-	-	0	0	
	Human resource in S%T education	0	0	0	-	0	+	+	0	0	+	+	-	-	+	-	+	0	+	0	-	-	-	-	+	-	0	0	
	Skills	0	0	0	-	-	+	-	-	0	+	-	-	-	-	-	+	-	0	0	-	+	-	-	+	+	-	+	+
	Creativity	0	+	-	0	+	+	0	-	0	+	0	-	-	+	0	+	-	+	-	+	-	+	-	-	+	-	+	+
Knowledge production and diffusion	Mobility	+	0	+	-	0	+	+	+	0	+	+	0	-	+	-	+	+	-	+	0	+	-	0	-	+	-	+	+
	R&D	+	0	+	-	+	+	0	-	0	+	+	-	-	-	-	+	0	0	0	0	0	-	-	+	0	-	0	+
	Patents	+	0	0	-	+	+	-	-	0	+	0	-	-	-	-	+	-	+	-	-	+	-	-	+	-	-	0	+
	Bibliometrics	-	0	-	-	0	+	-	-	0	+	0	-	-	-	-	+	-	-	-	0	+	-	-	+	-	-	+	+
Innovation, entrepreneurship and creative diffusion	Knowledge flows	-	-	-	-	-	-	-	-	0	+	-	-	-	-	-	0	-	-	+	-	-	-	0	0	+	-	-	
	Total investment in intangibles	-	-	0	-	-	-	-	-	0	0	0	-	+	+	-	+	-	+	+	0	-	-	-	-	-	-	+	+
	Entrepreneurship	-	0	-	-	+	-	0	0	0	-	0	-	+	-	-	0	0	0	0	-	-	0	-	-	-	0	+	-
	Demand for innovative products	0	-	0	0	0	+	+	0	0	0	0	0	0	+	-	0	0	+	0	-	0	-	-	+	0	+	+	0
Economic outputs	Financing of innovation	0	+	+	-	+	+	+	0	+	+	+	0	-	+	0	+	+	+	+	0	0	-	+	+	0	0	+	+
	Market innovation outputs	0	-	-	0	-	0	0	-	0	0	-	0	-	0	-	+	-	+	-	+	0	-	0	0	+	0	+	0
	Organisational indicators	-	-	0	+	-	-	-	+	-	-	+	0	+	-	+	0	+	-	0	+	+	+	0	-	+	+	+	-
	Income	+	+	+	0	0	0	+	0	0	+	0	+	0	+	-	0	+	+	+	+	-	0	0	-	+	+	0	+
Social performance	Productivity	+	+	-	-	0	0	0	+	0	0	+	0	-	+	0	+	-	+	-	-	0	-	-	0	0	-	0	+
	Employment	0	-	+	0	0	+	-	+	0	+	-	+	-	+	-	+	-	+	0	-	0	-	0	+	0	-	+	+
	Environmental	+	0	-	-	-	0	-	-	-	0	0	-	0	-	0	-	-	-	+	-	0	-	-	+	0	-	-	0
	Employment and economic welfare	+	0	+	0	0	+	-	0	0	0	0	-	+	+	0	+	-	+	0	+	+	-	+	+	+	-	+	+
Internationalisation	Quality of life indicators	+	+	+	-	0	+	-	+	0	0	0	0	-	+	0	0	-	+	-	0	+	-	+	+	-	-	-	+
	Trade	0	+	0	0	0	0	-	0	0	+	0	-	0	+	0	0	-	+	-	0	+	0	-	+	0	0	0	0
	Knowledge production and diffusion	0	+	0	-	-	-	-	0	+	-	0	-	-	0	-	-	-	+	-	0	0	-	-	0	-	-	+	0
	Economic structure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of sub-dimensions	Human resources	+	+	+	0	+	+	-	0	0	0	+	0	-	+	-	+	-	+	-	0	+	-	0	0	-	-	+	+
	Above the EU25	10	8	8	1	8	17	8	5	3	17	10	3	4	16	2	18	4	17	6	5	12	1	2	19	7	3	17	19
	Close to the EU25	12	14	9	9	13	5	5	10	23	8	14	8	5	3	8	7	5	5	8	9	13	3	5	5	8	6	6	6
	Below the EU25	7	7	12	19	8	7	16	14	3	4	5	18	20	10	19	4	20	7	15	15	4	25	22	5	14	20	6	4

To understand the country profiles presented, the following explanations are useful.



The Country Profiles present a compilation of selected data and statistics for each individual country included in the Knowledge Economy Index. The European Union countries included are: Austria, Belgium, Cyprus, Czech. Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and United Kingdom. The EU15 and EU25 are also included. Finally, two non-European countries are used for benchmarking purposes: Japan and the United States of America.

❶ Knowledge Economy Index (KEI) and its seven main dimensions

The first section presents the frequency distribution (%) of a country’s rank in KEI and in each of the seven dimensions (Production and diffusion of ICT; Human

resources, skills and creativity, etc.). These frequencies are estimated over ~2000 scenarios in the development of the KEI depending on:

- a. imputation method (dataset deriving from either splines or multiple imputation),
- b. number of sub-dimensions (all 29 sub-dimensions included or one-at-time excluded)
- c. number of dimensions (all seven dimensions included or one-at-time excluded)
- d. normalisation of the 29 sub-dimensions scores (z-scores or min-max),
- e. structure relating the sub-dimensions to the dimensions (preserved or not),
- f. weighting method (factor analysis, equal weighting, data envelopment analysis),
- g. aggregation rule (additive, multiplicative, non-compensatory multi-criteria analysis).

For example, Austria has a frequency value 50 under rank 10, which implies that Austria was ranked 10th (total of 29 positions) in the KEI in 50% of the scenarios. A colour code summarizes the frequencies as follows:

Frequency lower 15%
Frequency between 15 and 30%
Frequency between 30 and 50%
Frequency greater than 50%

❷ Knowledge Economy Index sub-indices

The second section presents the country rank in each of the 29 sub-indices (grouped under the seven main dimensions). For comparative purposes, the EU25 rank and the best performing country in each sub-dimension are also shown. A summary table provides the number of sub-dimensions that are above, close to, or below the EU25 score. A country’s

performance was deemed to be close to the EU25 performance if the country score is in the range $[90\% \cdot EU25_{score}, 110\% \cdot EU25_{score}]$.

③ Key indicators for the Knowledge Economy

The third section offers the raw data values for a country across 23 indicators, which were selected from the dataset of 115 indicators underlying the Knowledge Economy Index. The 23 indicators were originally grouped (together with the rest 92 indicators) under the seven main dimensions as follows:

Production and diffusion of ICT:

ICT value-added (% of total business sector value added); SMEs ordering over the Internet (% of total SMEs); Individuals using the internet for banking (% total)

Human Resources, skills and creativity:

Pisa reading literacy of 15y (average score); Total researchers (per 1000 labour force in FTE); Participation in lifelong learning (% of working 25-64y); Employed in creative occupations (% total)

Knowledge production and diffusion:

BERD performed in service industries (%); EPO high tech patent applications (per million pop.); Triadic patent families (per million pop.)

Innovation, entrepreneurship, creative production:

Firm entries (birth rate); GDP (per capita); Early-stage venture capital (% GDP); SMEs reporting non technological change (%)

Economic outputs:

GDP per capita (in PPS); Real GDP growth rate; Total employment growth

Social performance:

Long term unemployment rate; Hampered in daily activities because of chronic conditions; Rooms per person by tenure status and type of housing

Internationalisation:

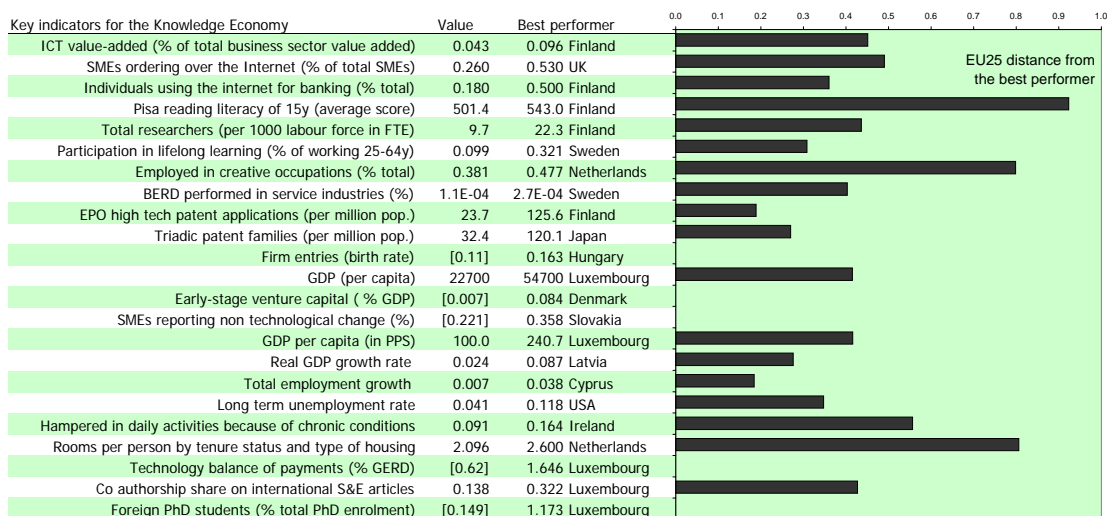
Technology balance of payments (% GERD); Co authorship share on international S&E articles; Foreign PhD students (% total PhD enrolment)

In case a country missed data for a given indicator, the missing datum was estimated by multiple imputation. Estimates are included in brackets and report the mean value based on the multiple imputation. For comparative purposes, the best performing country and score are shown. A graph complements the information provided in this section by displaying the relative distance of the country score from the respective EU25 value. Estimated values are not displayed in the graph. For the EU25 profile, this last graph shows the distance of the EU25 from the best performing country in the KEI dataset.

EU25

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	4	14	32	39	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	25	14	57	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	29	7	21	32	11	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	4	0	0	4	32	0	21	29	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	4	4	11	29	11	7	18	7	0	0	7	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	14	82	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	7	32	7	25	14	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	14	0	7	0	18	7	32	0	14	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT		
Economic impact of ICT	17	Finland
Internet use by firms	14	UK
Internet use by individuals	15	Denmark
Government ICT	15	Finland
Human resources, skills and creativity		
General education	8	Finland
Human resource in S&T education	16	Finland
Skills	11	Sweden
Creativity	16	Netherlands
Mobility	20	Japan
Knowledge production and diffusion		
Research and experimental development (R&D)	16	Sweden
Patents	13	Finland
Bibliometrics	9	Sweden
Knowledge flows	8	Finland
Total investment in intangibles	9	Malta
Innovation, entrepreneurship and creative production		
Entrepreneurship	10	Hungary
Demand for innovative products	16	Sweden
Financing of innovation	20	Denmark
Market innovation outputs	12	Malta
Organisational indicators	15	Slovakia
Economic outputs		
Income	25	Luxembourg
Productivity	14	Luxembourg
Employment	19	Cyprus
Social performance		
Environmental	6	Latvia
Employment and economic welfare	18	Japan
Quality of life indicators	16	Belgium
Internationalisation		
Trade	12	Luxembourg
Knowledge production and diffusion	8	Luxembourg
Economic structure	1	EU25
Human resources	17	Luxembourg

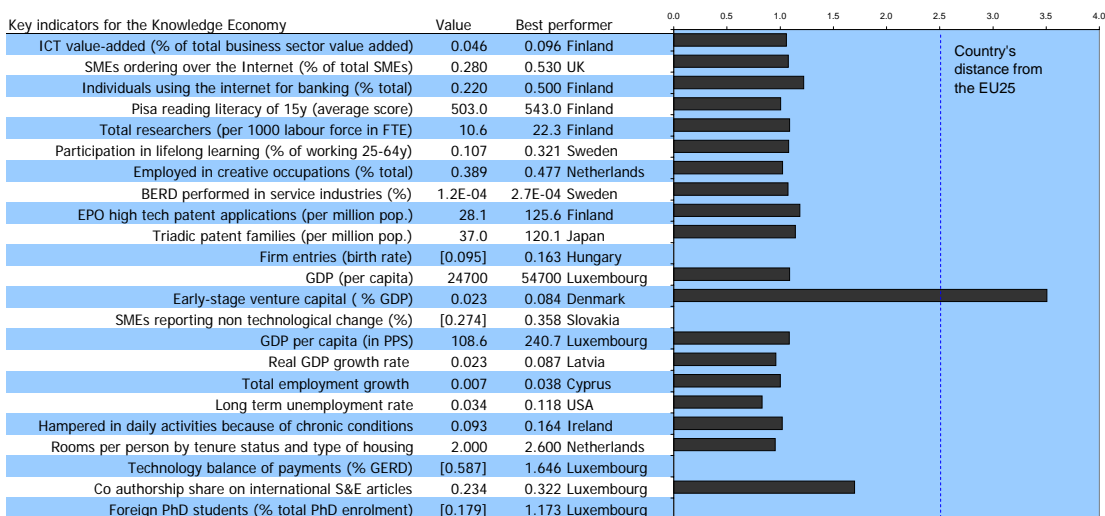


EU15

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	4	0	57	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	4	46	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	68	21	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	36	46	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	32	11	4	14	7	11	14	4	4	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	39	14	21	14	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	7	7	0	29	32	4	7	0	0	0	
Internationalisation	0	0	25	39	0	14	18	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	15	17	Finland
Internet use by firms	12	14	UK
Internet use by individuals	11	15	Denmark
Government ICT	12	15	Finland
Human resources, skills and creativity			
General education	9	8	Finland
Human resource in S&T education	12	16	Finland
Skills	10	11	Sweden
Creativity	12	16	Netherlands
Mobility	20	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	14	16	Sweden
Patents	11	13	Finland
Bibliometrics	8	9	Sweden
Knowledge flows	9	8	Finland
Total investment in intangibles	10	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	14	10	Hungary
Demand for innovative products	14	16	Sweden
Financing of innovation	10	20	Denmark
Market innovation outputs	10	12	Malta
Organisational indicators	23	15	Slovakia
Economic outputs			
Income	23	25	Luxembourg
Productivity	12	14	Luxembourg
Employment	14	19	Cyprus
Social performance			
Environmental	29	6	Latvia
Employment and economic welfare	16	18	Japan
Quality of life indicators	11	16	Belgium
Internationalisation			
Trade	11	12	Luxembourg
Knowledge production and diffusion	2	8	Luxembourg
Economic structure	2	1	EU25
Human resources	14	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
3	Above the EU25 average
23	Close to the EU25 average
3	Below the EU25 average

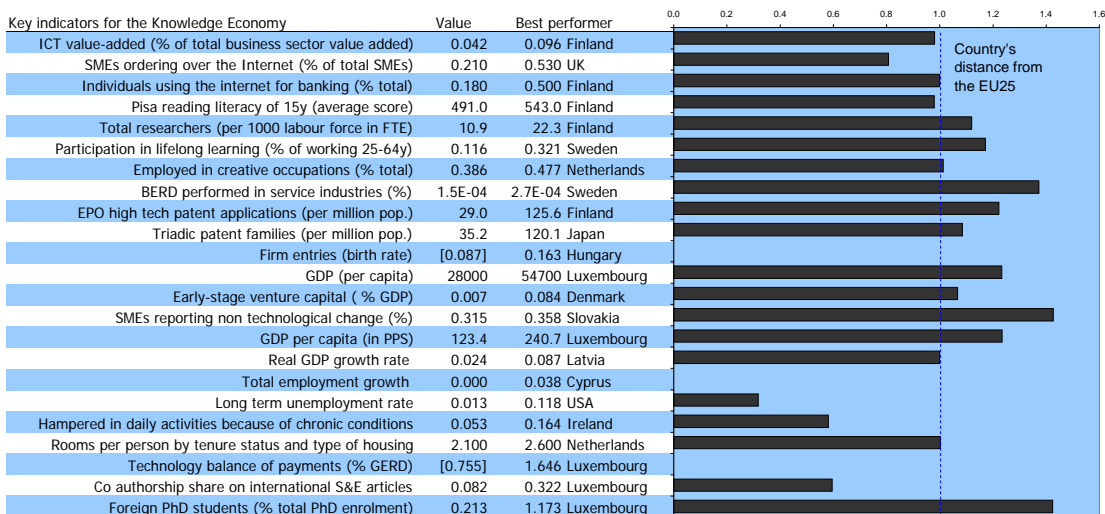


Austria

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29		
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	18	50	18	7	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	7	7	18	29	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	4	11	18	25	18	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	25	25	21	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	4	0	4	0	0	7	0	0	0	0	0	0	0	0	0	0	14	39	32	0	0	
Economic outputs	0	0	0	0	0	0	14	21	14	36	0	4	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Social performance	0	25	61	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	32	36	11	14	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	19	17	Finland
Internet use by firms	15	14	UK
Internet use by individuals	13	15	Denmark
Government ICT	5	15	Finland
Human resources, skills and creativity			
General education	20	8	Finland
Human resource in S&T education	13	16	Finland
Skills	9	11	Sweden
Creativity	15	16	Netherlands
Mobility	10	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	7	16	Sweden
Patents	9	13	Finland
Bibliometrics	14	9	Sweden
Knowledge flows	19	8	Finland
Total investment in intangibles	12	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	20	10	Hungary
Demand for innovative products	13	16	Sweden
Financing of innovation	19	20	Denmark
Market innovation outputs	17	12	Malta
Organisational indicators	25	15	Slovakia
Economic outputs			
Income	13	25	Luxembourg
Productivity	7	14	Luxembourg
Employment	15	19	Cyprus
Social performance			
Environmental	3	6	Latvia
Employment and economic welfare	9	18	Japan
Quality of life indicators	10	16	Belgium
Internationalisation			
Trade	8	12	Luxembourg
Knowledge production and diffusion	6	8	Luxembourg
Economic structure	10	1	EU25
Human resources	5	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
10	Above the EU25 average
12	Close to the EU25 average
7	Below the EU25 average

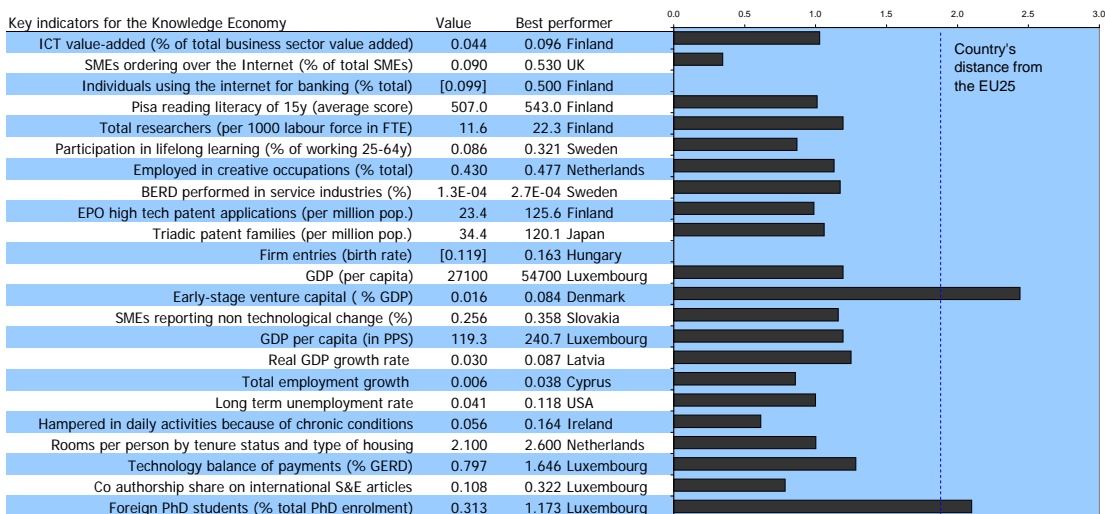


Belgium

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	11	4	11	57	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	4	7	46	7	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	46	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	79	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	7	0	4	4	0	0	4	18	43	7	0	4	11	0	0	0	0
Economic outputs	0	0	0	0	0	0	25	36	25	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	7	75	4	0	11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	14	64	4	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	18	17	Finland
Internet use by firms	16	14	UK
Internet use by individuals	14	15	Denmark
Government ICT	11	15	Finland
Human resources, skills and creativity			
General education	10	8	Finland
Human resource in S&T education	11	16	Finland
Skills	14	11	Sweden
Creativity	6	16	Netherlands
Mobility	17	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	15	16	Sweden
Patents	12	13	Finland
Bibliometrics	11	9	Sweden
Knowledge flows	13	8	Finland
Total investment in intangibles	17	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	4	10	Hungary
Demand for innovative products	25	16	Sweden
Financing of innovation	13	20	Denmark
Market innovation outputs	19	12	Malta
Organisational indicators	20	15	Slovakia
Economic outputs			
Income	10	25	Luxembourg
Productivity	3	14	Luxembourg
Employment	23	19	Cyprus
Social performance			
Environmental	8	6	Latvia
Employment and economic welfare	20	18	Japan
Quality of life indicators	1	16	Belgium
Internationalisation			
Trade	5	12	Luxembourg
Knowledge production and diffusion	4	8	Luxembourg
Economic structure	5	1	EU25
Human resources	6	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
8	Above the EU25 average
14	Close to the EU25 average
7	Below the EU25 average

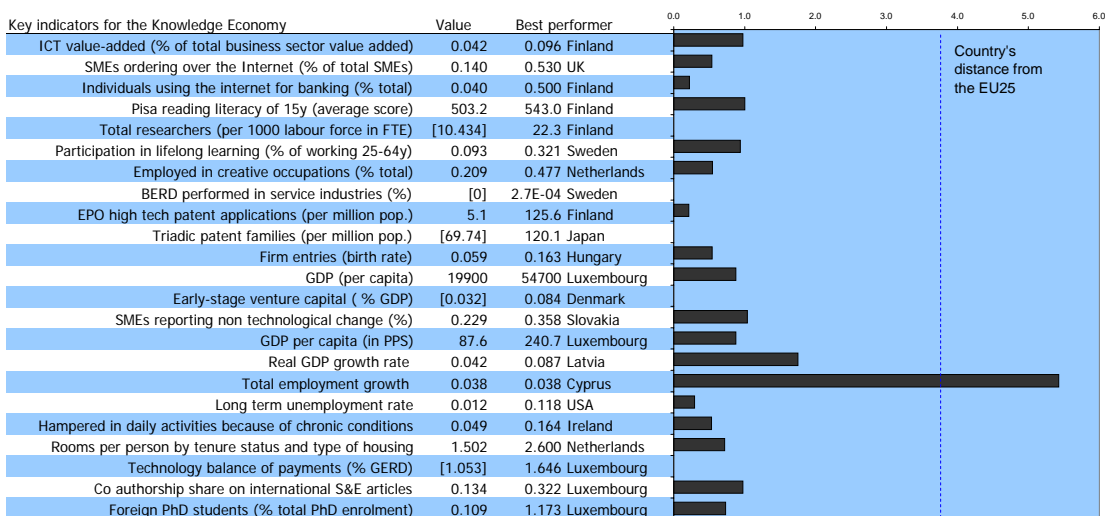


Cyprus

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	7	4	23	23	7	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	7	14	36	14	7	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	57	7	7	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	11	7	0	14	7	0	14	14	29
Economic outputs	0	0	0	0	7	25	7	0	0	7	0	7	0	39	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	4	4	7	0	14	18	18	11	11	0	4	4	0	4	4	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	14	14	32	25	4	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	28	17	Finland
Internet use by firms	20	14	UK
Internet use by individuals	26	15	Denmark
Government ICT	27	15	Finland
Human resources, skills and creativity			
General education	5	8	Finland
Human resource in S&T education	17	16	Finland
Skills	13	11	Sweden
Creativity	29	16	Netherlands
Mobility	8	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	9	16	Sweden
Patents	15	13	Finland
Bibliometrics	29	9	Sweden
Knowledge flows	27	8	Finland
Total investment in intangibles	11	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	29	10	Hungary
Demand for innovative products	11	16	Sweden
Financing of innovation	7	20	Denmark
Market innovation outputs	29	12	Malta
Organisational indicators	16	15	Slovakia
Economic outputs			
Income	12	25	Luxembourg
Productivity	27	14	Luxembourg
Employment	1	19	Cyprus
Social performance			
Environmental	27	6	Latvia
Employment and economic welfare	5	18	Japan
Quality of life indicators	5	16	Belgium
Internationalisation			
Trade	15	12	Luxembourg
Knowledge production and diffusion	5	8	Luxembourg
Economic structure	14	1	EU25
Human resources	4	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
8	Above the EU25 average
9	Close to the EU25 average
12	Below the EU25 average

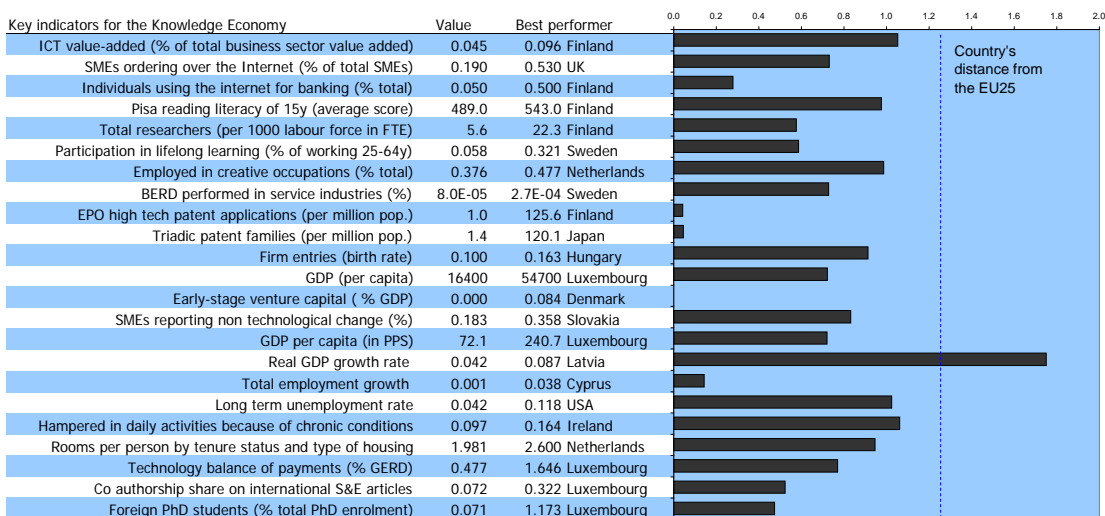


Czech. Rep.

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	30	39	5	7	7	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	50	0	7	14	0	14	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	4	0	4	0	64	21	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	14	29	18	29	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	7	0	4	0	0	0	0	0	4	7	29	11	18	14	4	4	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	7	29	7	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	11	4	4	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	7	11	4	0	0	25	7	25	14	0	0	4	4	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	21	17	Finland
Internet use by firms	19	14	UK
Internet use by individuals	27	15	Denmark
Government ICT	23	15	Finland
Human resources, skills and creativity			
General education	23	8	Finland
Human resource in S&T education	27	16	Finland
Skills	22	11	Sweden
Creativity	18	16	Netherlands
Mobility	22	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	22	16	Sweden
Patents	25	13	Finland
Bibliometrics	23	9	Sweden
Knowledge flows	18	8	Finland
Total investment in intangibles	13	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	18	10	Hungary
Demand for innovative products	10	16	Sweden
Financing of innovation	23	20	Denmark
Market innovation outputs	13	12	Malta
Organisational indicators	10	15	Slovakia
Economic outputs			
Income	22	25	Luxembourg
Productivity	21	14	Luxembourg
Employment	20	19	Cyprus
Social performance			
Environmental	22	6	Latvia
Employment and economic welfare	17	18	Japan
Quality of life indicators	23	16	Belgium
Internationalisation			
Trade	14	12	Luxembourg
Knowledge production and diffusion	20	8	Luxembourg
Economic structure	3	1	EU25
Human resources	20	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
1	Above the EU25 average
9	Close to the EU25 average
19	Below the EU25 average

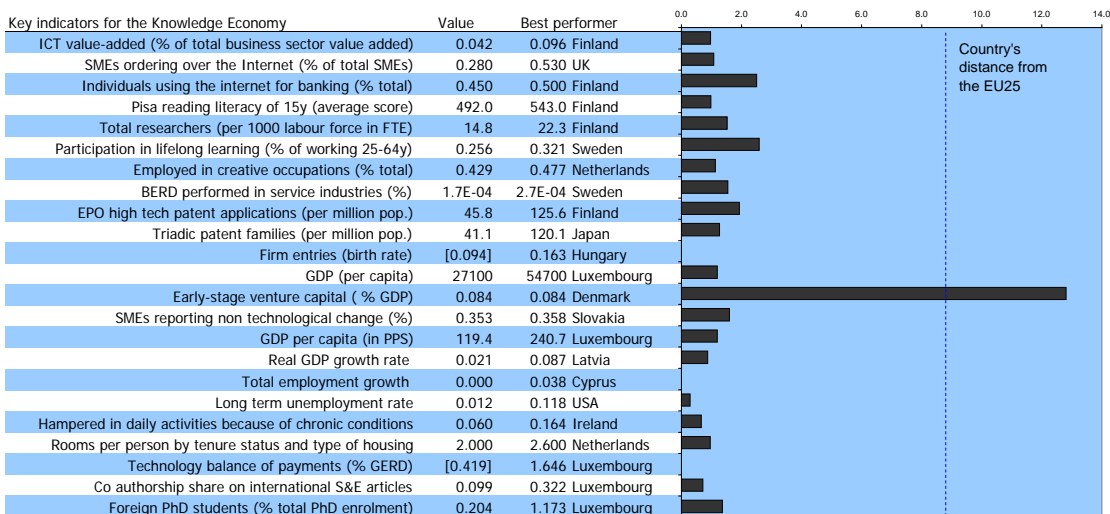


Denmark

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	55	30	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Production and diffusion of ICT	0	0	89	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	29	29	18	21	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Knowledge production and diffusion	0	0	0	0	14	64	18	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	4	50	11	18	11	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Economic outputs	0	0	0	0	0	0	0	36	7	14	7	7	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Social performance	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	7	29	54	7	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	11	17	Finland
Internet use by firms	2	14	UK
Internet use by individuals	1	15	Denmark
Government ICT	3	15	Finland
Human resources, skills and creativity			
General education	16	8	Finland
Human resource in S&T education	3	16	Finland
Skills	3	11	Sweden
Creativity	7	16	Netherlands
Mobility	3	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	5	16	Sweden
Patents	6	13	Finland
Bibliometrics	3	9	Sweden
Knowledge flows	15	8	Finland
Total investment in intangibles	14	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	16	10	Hungary
Demand for innovative products	5	16	Sweden
Financing of innovation	1	20	Denmark
Market innovation outputs	15	12	Malta
Organisational indicators	28	15	Slovakia
Economic outputs			
Income	18	25	Luxembourg
Productivity	13	14	Luxembourg
Employment	6	19	Cyprus
Social performance			
Environmental	4	6	Latvia
Employment and economic welfare	2	18	Japan
Quality of life indicators	3	16	Belgium
Internationalisation			
Trade	7	12	Luxembourg
Knowledge production and diffusion	18	8	Luxembourg
Economic structure	13	1	EU25
Human resources	7	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
17	Above the EU25 average
5	Close to the EU25 average
7	Below the EU25 average

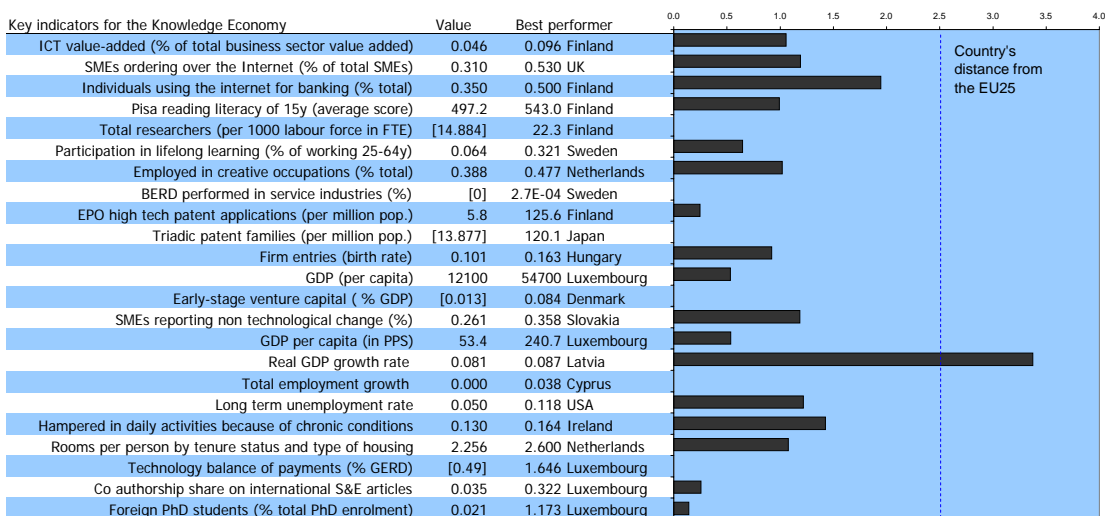


Estonia

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29			
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	36	25	21	11	4	0	0	0	0	0	0	0	0		
Production and diffusion of ICT	0	0	0	0	0	0	0	4	11	46	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	14	0	0	14	14	57	0	0	0	0	0	0	0	0	0	0	0	0	0		
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Innovation, entrepreneurship, creative production	0	0	0	0	0	7	46	32	0	0	0	0	0	0	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0		
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	7	79	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0		
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	11	46	32	7	43

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	9	17	Finland
Internet use by firms	18	14	UK
Internet use by individuals	10	15	Denmark
Government ICT	6	15	Finland
Human resources, skills and creativity			
General education	19	8	Finland
Human resource in S&T education	8	16	Finland
Skills	18	11	Sweden
Creativity	14	16	Netherlands
Mobility	13	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	12	16	Sweden
Patents	20	13	Finland
Bibliometrics	22	9	Sweden
Knowledge flows	23	8	Finland
Total investment in intangibles	15	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	15	10	Hungary
Demand for innovative products	2	16	Sweden
Financing of innovation	15	20	Denmark
Market innovation outputs	8	12	Malta
Organisational indicators	22	15	Slovakia
Economic outputs			
Income	5	25	Luxembourg
Productivity	17	14	Luxembourg
Employment	22	19	Cyprus
Social performance			
Environmental	25	6	Latvia
Employment and economic welfare	24	18	Japan
Quality of life indicators	29	16	Belgium
Internationalisation			
Trade	24	12	Luxembourg
Knowledge production and diffusion	27	8	Luxembourg
Economic structure	18	1	EU25
Human resources	22	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
8	Above the EU25 average
5	Close to the EU25 average
16	Below the EU25 average



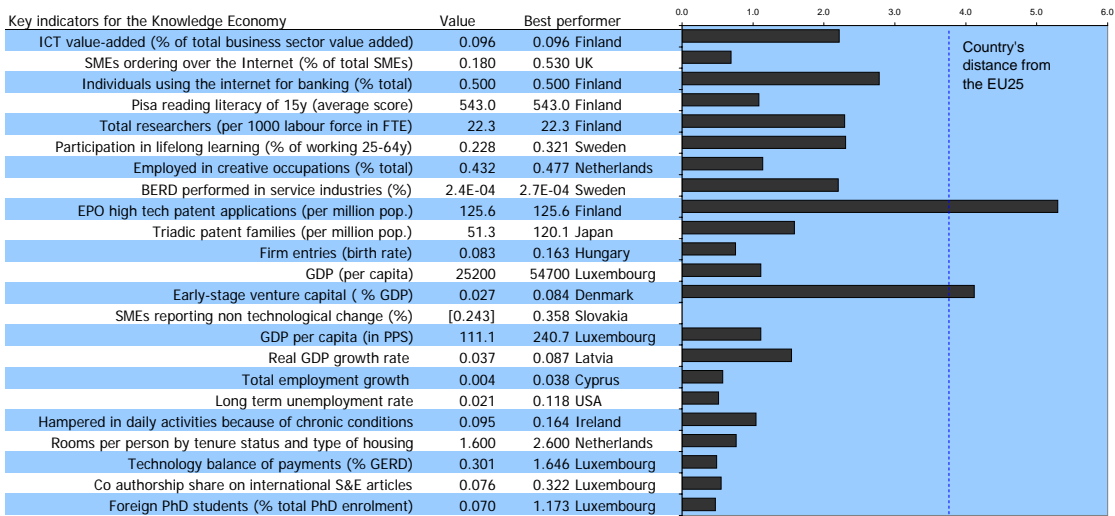
Finland

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	18	23	29	9	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	54	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	32	21	0	14	11	7	7	4	0	0	0	0	0	4	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	14	14	7	14	4	43	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	11	11	11	54	4	4	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	7	14	14	11	11	4	0	0	18	7	4	

Knowledge Economy sub-indices

	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	1	17	Finland
Internet use by firms	9	14	UK
Internet use by individuals	3	15	Denmark
Government ICT	1	15	Finland
Human resources, skills and creativity			
General education	1	8	Finland
Human resource in S&T education	1	16	Finland
Skills	4	11	Sweden
Creativity	5	16	Netherlands
Mobility	4	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	2	16	Sweden
Patents	1	13	Finland
Bibliometrics	4	9	Sweden
Knowledge flows	1	8	Finland
Total investment in intangibles	9	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	19	10	Hungary
Demand for innovative products	12	16	Sweden
Financing of innovation	8	20	Denmark
Market innovation outputs	11	12	Malta
Organisational indicators	18	15	Slovakia
Economic outputs			
Income	8	25	Luxembourg
Productivity	16	14	Luxembourg
Employment	11	19	Cyprus
Social performance			
Environmental	7	6	Latvia
Employment and economic welfare	15	18	Japan
Quality of life indicators	19	16	Belgium
Internationalisation			
Trade	4	12	Luxembourg
Knowledge production and diffusion	28	8	Luxembourg
Economic structure	28	1	EU25
Human resources	13	17	Luxembourg

Number of KEI sub-indices (total of 29)	
17	Above the EU25 average
8	Close to the EU25 average
4	Below the EU25 average

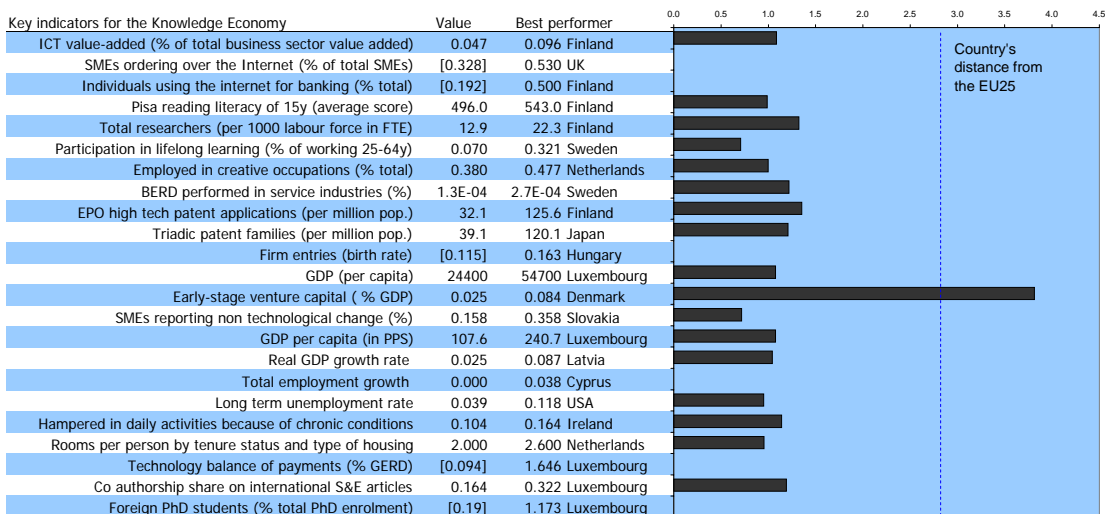


France

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	4	0	0	14	18	11	5.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	4	0	68	18	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	86	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	11	0	4	0	18	29	4	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	14	18	18	18	29	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	50	14	0	7	4	4	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	14	0	18	36	11	21	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	4	25	29	25	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	13	17	Finland
Internet use by firms	10	14	UK
Internet use by individuals	12	15	Denmark
Government ICT	10	15	Finland
Human resources, skills and creativity			
General education	13	8	Finland
Human resource in S&T education	5	16	Finland
Skills	17	11	Sweden
Creativity	17	16	Netherlands
Mobility	5	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	8	16	Sweden
Patents	10	13	Finland
Bibliometrics	13	9	Sweden
Knowledge flows	21	8	Finland
Total investment in intangibles	7	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	8	10	Hungary
Demand for innovative products	19	16	Sweden
Financing of innovation	9	20	Denmark
Market innovation outputs	20	12	Malta
Organisational indicators	7	15	Slovakia
Economic outputs			
Income	20	25	Luxembourg
Productivity	6	14	Luxembourg
Employment	21	19	Cyprus
Social performance			
Environmental	11	6	Latvia
Employment and economic welfare	21	18	Japan
Quality of life indicators	17	16	Belgium
Internationalisation			
Trade	14	12	Luxembourg
Knowledge production and diffusion	13	8	Luxembourg
Economic structure	7	1	EU25
Human resources	11	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
10	Above the EU25 average
14	Close to the EU25 average
5	Below the EU25 average



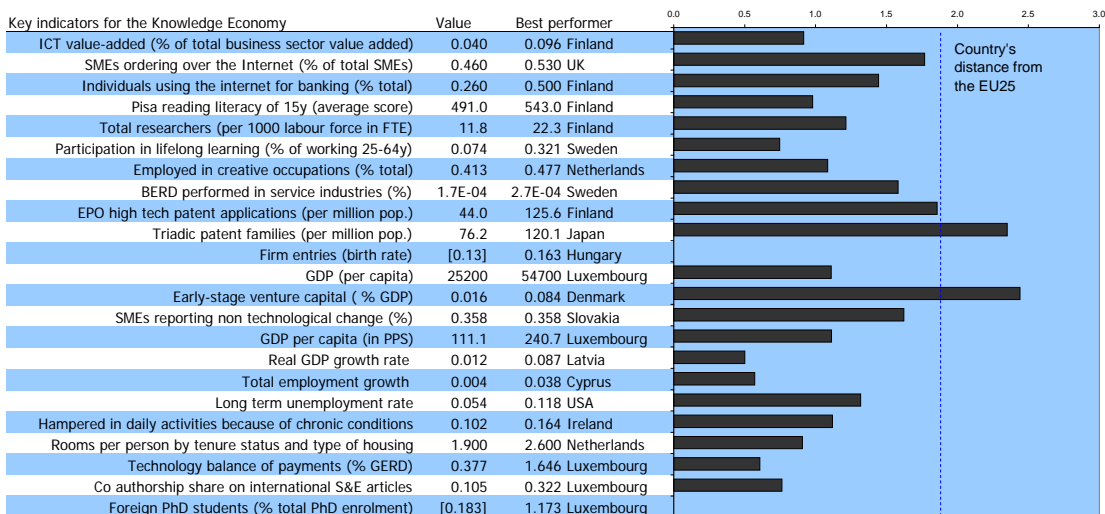
Germany

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	79	4	7	4	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	29	21	39	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	14	46	21	18	0	0	0	0	0	0	0	0	0	0	0	0	0	
Knowledge production and diffusion	0	0	0	0	0	0	43	7	4	0	11	29	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	39	32	11	4	11	
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	82	14	0	0	0	0	0	0	0	0	
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	50	46	0	0	0	0	0	
Internationalisation	0	0	0	0	0	0	0	0	0	0	4	0	18	4	7	36	14	7	4	4	4	0	4	0	0	0	0	0	0	

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			

Economic impact of ICT	16	17	Finland
Internet use by firms	3	14	UK
Internet use by individuals	8	15	Denmark
Government ICT	17	15	Finland
Human resources, skills and creativity			
General education	11	8	Finland
Human resource in S&T education	14	16	Finland
Skills	16	11	Sweden
Creativity	8	16	Netherlands
Mobility	19	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	6	16	Sweden
Patents	4	13	Finland
Bibliometrics	10	9	Sweden
Knowledge flows	28	8	Finland
Total investment in intangibles	12	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	3	10	Hungary
Demand for innovative products	23	16	Sweden
Financing of innovation	13	20	Denmark
Market innovation outputs	25	12	Malta
Organisational indicators	29	15	Slovakia
Economic outputs			
Income	26	25	Luxembourg
Productivity	15	14	Luxembourg
Employment	18	19	Cyprus
Social performance			
Environmental	24	6	Latvia
Employment and economic welfare	19	18	Japan
Quality of life indicators	13	16	Belgium
Internationalisation			
Trade	9	12	Luxembourg
Knowledge production and diffusion	16	8	Luxembourg
Economic structure	26	1	EU25
Human resources	10	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
8	Above the EU25 average
13	Close to the EU25 average
8	Below the EU25 average

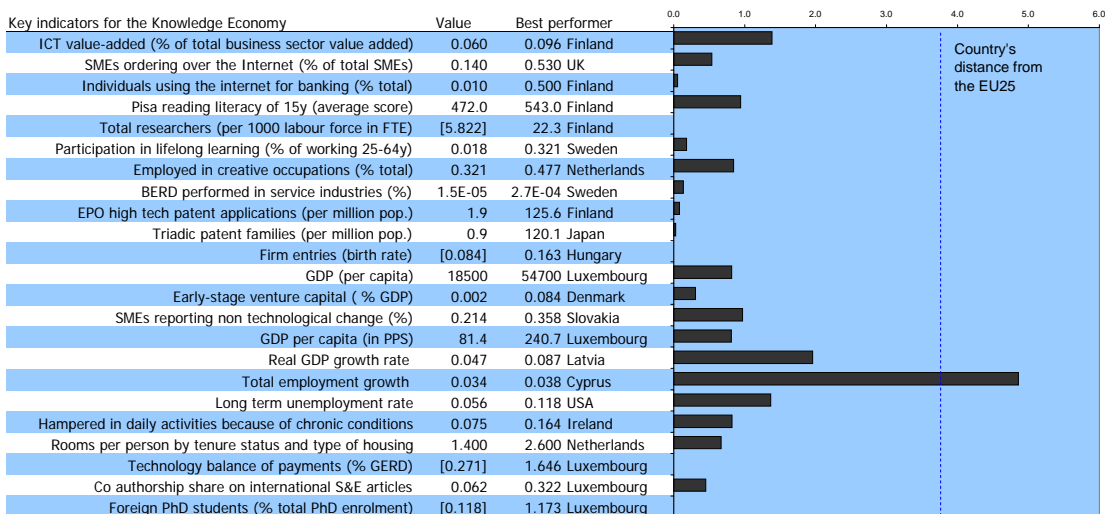


Greece

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29		
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	29	18	21	7	14	0	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	21	21	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	11	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	46	46	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	0	4	0	32	43	11	0	0	0	
Economic outputs	0	0	0	0	89	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	4	14	18	25	0	0	0	29	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	14	82	0	

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	3	17	Finland
Internet use by firms	21	14	UK
Internet use by individuals	28	15	Denmark
Government ICT	20	15	Finland
Human resources, skills and creativity			
General education	27	8	Finland
Human resource in S&T education	23	16	Finland
Skills	27	11	Sweden
Creativity	25	16	Netherlands
Mobility	20	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	28	16	Sweden
Patents	26	13	Finland
Bibliometrics	21	9	Sweden
Knowledge flows	26	8	Finland
Total investment in intangibles	17	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	22	10	Hungary
Demand for innovative products	24	16	Sweden
Financing of innovation	22	20	Denmark
Market innovation outputs	6	12	Malta
Organisational indicators	14	15	Slovakia
Economic outputs			
Income	11	25	Luxembourg
Productivity	10	14	Luxembourg
Employment	7	19	Cyprus
Social performance			
Environmental	17	6	Latvia
Employment and economic welfare	26	18	Japan
Quality of life indicators	14	16	Belgium
Internationalisation			
Trade	26	12	Luxembourg
Knowledge production and diffusion	25	8	Luxembourg
Economic structure	27	1	EU25
Human resources	19	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
3	Above the EU25 average
8	Close to the EU25 average
18	Below the EU25 average

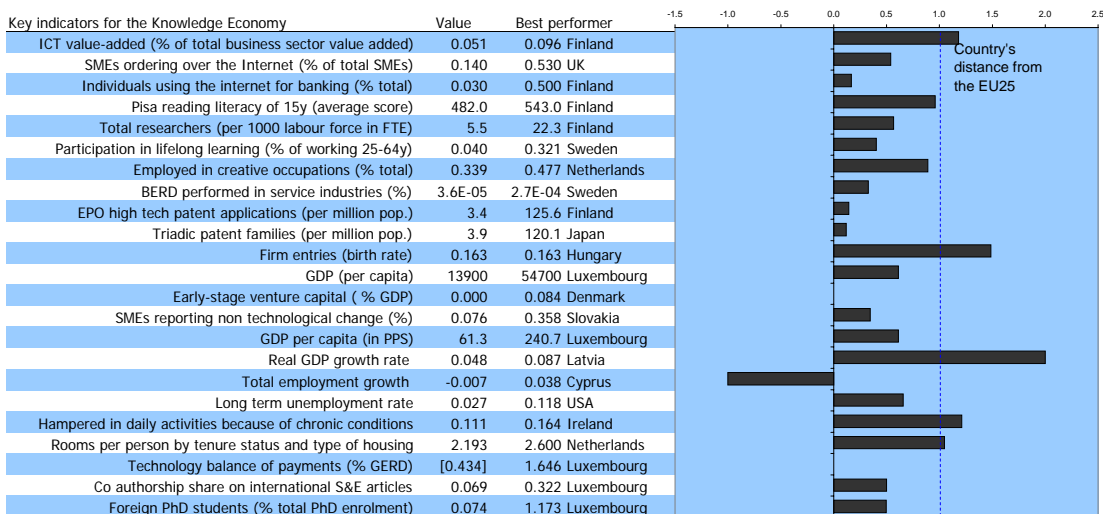


Hungary

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29					
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	13	13	57	2	14	0					
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	18	0	7	18	32	14	7	0		
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	36	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21	36	11	11	14	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	4	0	0	4	11	25	0	4	0	4	0	0	11	4	4	11	4	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	93	4	0	0	
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	4	7	4	36	4	39	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	18	25	25	4	0	0	0	0	0	0	0	

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	12	17	Finland
Internet use by firms	22	14	UK
Internet use by individuals	26	15	Denmark
Government ICT	28	15	Finland
Human resources, skills and creativity			
General education	25	8	Finland
Human resource in S&T education	28	16	Finland
Skills	26	11	Sweden
Creativity	21	16	Netherlands
Mobility	23	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	26	16	Sweden
Patents	24	13	Finland
Bibliometrics	20	9	Sweden
Knowledge flows	20	8	Finland
Total investment in intangibles	6	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	1	10	Hungary
Demand for innovative products	22	16	Sweden
Financing of innovation	23	20	Denmark
Market innovation outputs	28	12	Malta
Organisational indicators	2	15	Slovakia
Economic outputs			
Income	21	25	Luxembourg
Productivity	25	14	Luxembourg
Employment	28	19	Cyprus
Social performance			
Environmental	9	6	Latvia
Employment and economic welfare	12	18	Japan
Quality of life indicators	22	16	Belgium
Internationalisation			
Trade	19	12	Luxembourg
Knowledge production and diffusion	24	8	Luxembourg
Economic structure	17	1	EU25
Human resources	24	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
4	Above the EU25 average
5	Close to the EU25 average
20	Below the EU25 average

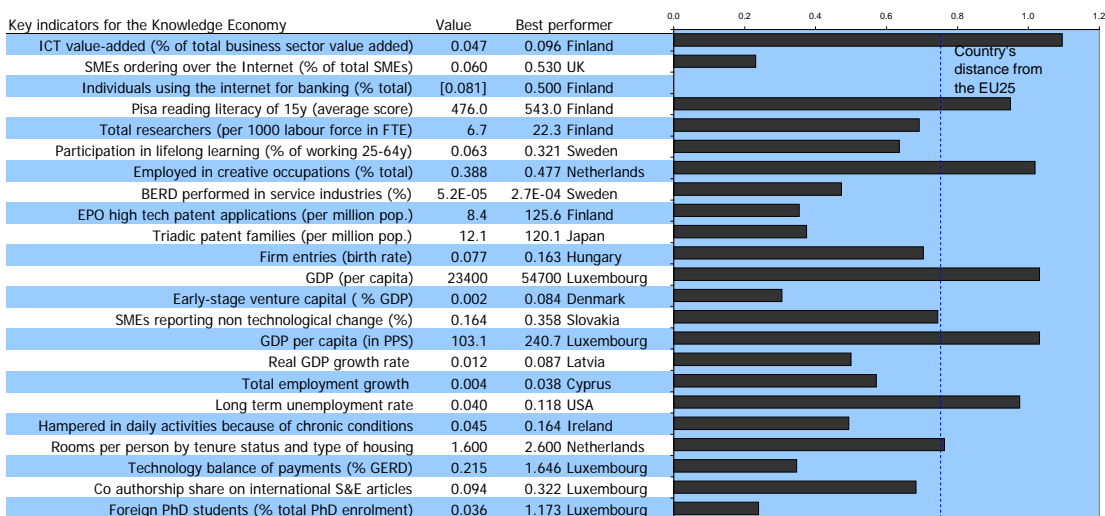


Italy

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	18	9	29	9	7	0	0	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	4	4	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	64	25	4	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	11	14	4	7	0	14	29	4	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	32	57
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	71	25	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	18	0	4	43	0	21	7	0	7	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	14	43	25	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	20	17	Finland
Internet use by firms	23	14	UK
Internet use by individuals	18	15	Denmark
Government ICT	8	15	Finland
Human resources, skills and creativity			
General education	21	8	Finland
Human resource in S&T education	24	16	Finland
Skills	19	11	Sweden
Creativity	13	16	Netherlands
Mobility	21	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	24	16	Sweden
Patents	18	13	Finland
Bibliometrics	17	9	Sweden
Knowledge flows	29	8	Finland
Total investment in intangibles	17	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	26	10	Hungary
Demand for innovative products	29	16	Sweden
Financing of innovation	22	20	Denmark
Market innovation outputs	21	12	Malta
Organisational indicators	8	15	Slovakia
Economic outputs			
Income	27	25	Luxembourg
Productivity	11	14	Luxembourg
Employment	25	19	Cyprus
Social performance			
Environmental	13	6	Latvia
Employment and economic welfare	21	18	Japan
Quality of life indicators	15	16	Belgium
Internationalisation			
Trade	13	12	Luxembourg
Knowledge production and diffusion	23	8	Luxembourg
Economic structure	23	1	EU25
Human resources	26	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
2	Above the EU25 average
8	Close to the EU25 average
19	Below the EU25 average

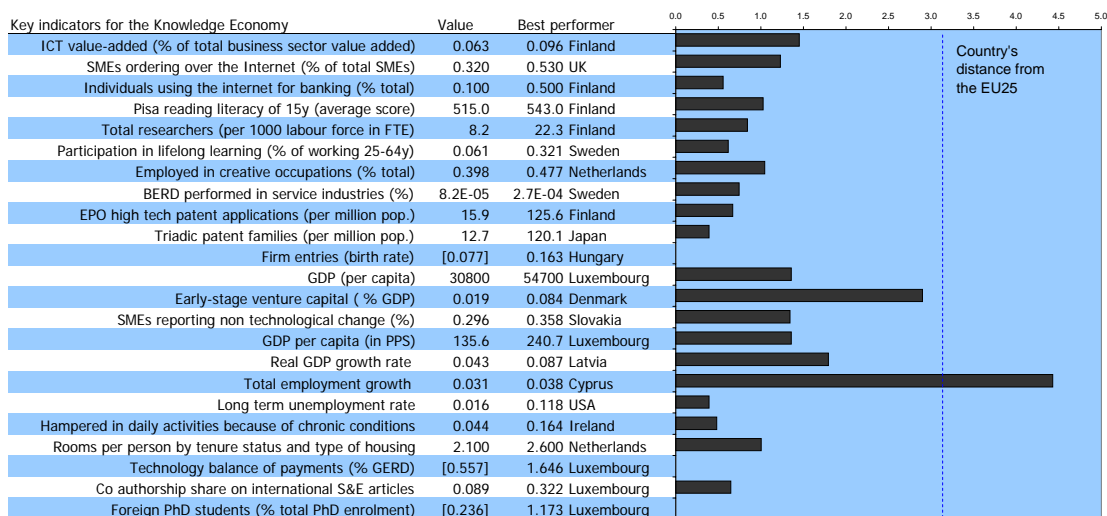


Ireland

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	4	0	6	14	4	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	36	11	32	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	18	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	4	11	0	7	0	18	11	14	7	7	7	4	4	4	4	4	4	0	0	0	
Economic outputs	29	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	4	7	0	4	7	25	18	4	4	11	4	0	4	0	0	7	0	0	4	0	0	0	0	0	0	0	
Internationalisation	0	0	4	0	14	11	4	4	21	0	14	14	11	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	10	17	Finland
Internet use by firms	7	14	UK
Internet use by individuals	22	15	Denmark
Government ICT	14	15	Finland
Human resources, skills and creativity			
General education	3	8	Finland
Human resource in S&T education	7	16	Finland
Skills	20	11	Sweden
Creativity	11	16	Netherlands
Mobility	9	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	21	16	Sweden
Patents	17	13	Finland
Bibliometrics	16	9	Sweden
Knowledge flows	22	8	Finland
Total investment in intangibles	3	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	24	10	Hungary
Demand for innovative products	3	16	Sweden
Financing of innovation	11	20	Denmark
Market innovation outputs	18	12	Malta
Organisational indicators	24	15	Slovakia
Economic outputs			
Income	3	25	Luxembourg
Productivity	2	14	Luxembourg
Employment	2	19	Cyprus
Social performance			
Environmental	28	6	Latvia
Employment and economic welfare	7	18	Japan
Quality of life indicators	2	16	Belgium
Internationalisation			
Trade	2	12	Luxembourg
Knowledge production and diffusion	11	8	Luxembourg
Economic structure	25	1	EU25
Human resources	8	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
16	Above the EU25 average
3	Close to the EU25 average
10	Below the EU25 average

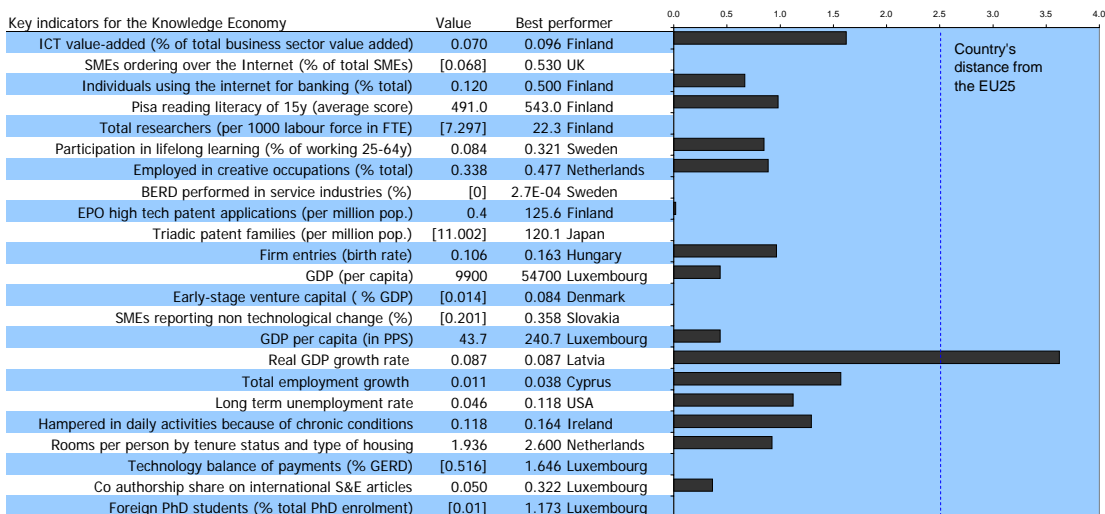


Latvia

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	36	11	21	7	0	5	0	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	25	4	14	21	14	0	7	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	43	36	0	4	11	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	11	18	11	4	36	7	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	7	7	0	7	29	21	14	7	0	0	0
Economic outputs	0	0	0	0	4	0	0	0	0	0	0	0	0	0	14	39	29	7	7	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	14	4	4	29	32	7	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	68	14	

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	5	17	Finland
Internet use by firms	26	14	UK
Internet use by individuals	23	15	Denmark
Government ICT	29	15	Finland
Human resources, skills and creativity			
General education	24	8	Finland
Human resource in S&T education	19	16	Finland
Skills	15	11	Sweden
Creativity	22	16	Netherlands
Mobility	14	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	20	16	Sweden
Patents	23	13	Finland
Bibliometrics	28	9	Sweden
Knowledge flows	3	8	Finland
Total investment in intangibles	20	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	6	10	Hungary
Demand for innovative products	20	16	Sweden
Financing of innovation	14	20	Denmark
Market innovation outputs	27	12	Malta
Organisational indicators	12	15	Slovakia
Economic outputs			
Income	4	25	Luxembourg
Productivity	26	14	Luxembourg
Employment	17	19	Cyprus
Social performance			
Environmental	1	6	Latvia
Employment and economic welfare	23	18	Japan
Quality of life indicators	28	16	Belgium
Internationalisation			
Trade	28	12	Luxembourg
Knowledge production and diffusion	17	8	Luxembourg
Economic structure	24	1	EU25
Human resources	25	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
6	Above the EU25 average
8	Close to the EU25 average
15	Below the EU25 average

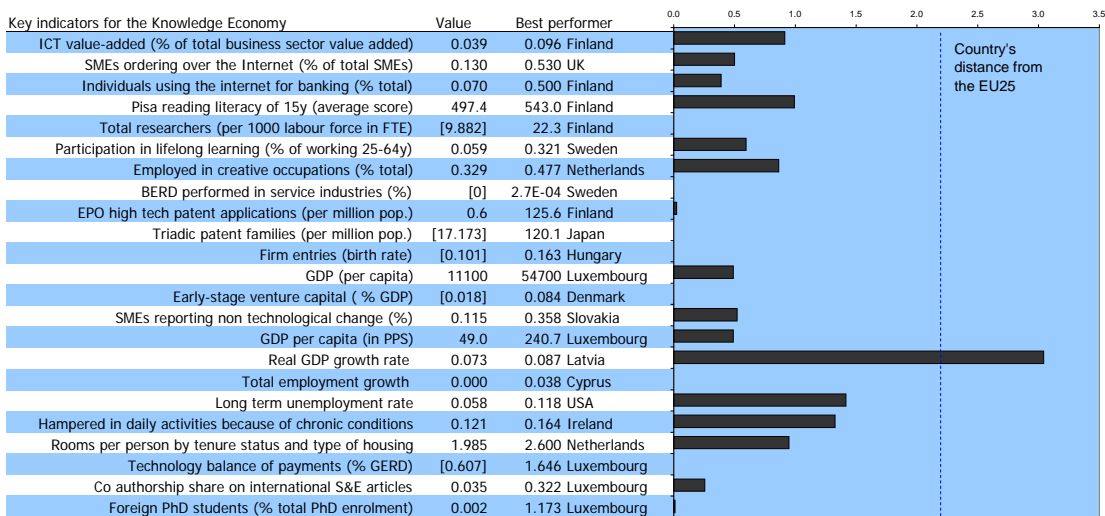


Lithuania

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	13	32	11	0	0	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	43	36	7	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	43	4	7	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	29	7	7	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	7	4	14	29	18	14	7	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	14	54	4	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	86	7	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	50	29	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	23	17	Finland
Internet use by firms	24	14	UK
Internet use by individuals	24	15	Denmark
Government ICT	21	15	Finland
Human resources, skills and creativity			
General education	12	8	Finland
Human resource in S&T education	15	16	Finland
Skills	21	11	Sweden
Creativity	24	16	Netherlands
Mobility	15	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	13	16	Sweden
Patents	21	13	Finland
Bibliometrics	27	9	Sweden
Knowledge flows	10	8	Finland
Total investment in intangibles	20	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	12	10	Hungary
Demand for innovative products	18	16	Sweden
Financing of innovation	12	20	Denmark
Market innovation outputs	24	12	Malta
Organisational indicators	4	15	Slovakia
Economic outputs			
Income	7	25	Luxembourg
Productivity	28	14	Luxembourg
Employment	24	19	Cyprus
Social performance			
Environmental	21	6	Latvia
Employment and economic welfare	25	18	Japan
Quality of life indicators	26	16	Belgium
Internationalisation			
Trade	25	12	Luxembourg
Knowledge production and diffusion	19	8	Luxembourg
Economic structure	21	1	EU25
Human resources	27	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
4	Above the EU25 average
5	Close to the EU25 average
20	Below the EU25 average

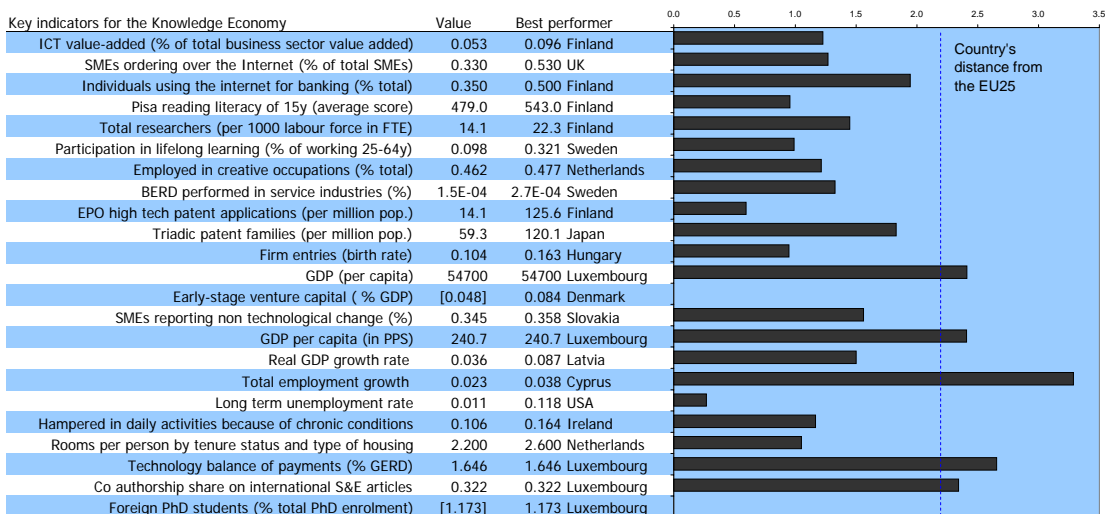


Luxembourg

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	36	4	14	25	4	7	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	14	61	11	4	4	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	14	50	21	0	4	4	0	0	7	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	32	46	14	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	11	32	39	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	71	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	4	46	18	18	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	86	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	14	17	Finland
Internet use by firms	13	14	UK
Internet use by individuals	4	15	Denmark
Government ICT	9	15	Finland
Human resources, skills and creativity			
General education	18	8	Finland
Human resource in S&T education	4	16	Finland
Skills	12	11	Sweden
Creativity	2	16	Netherlands
Mobility	21	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	11	16	Sweden
Patents	8	13	Finland
Bibliometrics	15	9	Sweden
Knowledge flows	16	8	Finland
Total investment in intangibles	2	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	11	10	Hungary
Demand for innovative products	4	16	Sweden
Financing of innovation	5	20	Denmark
Market innovation outputs	5	12	Malta
Organisational indicators	27	15	Slovakia
Economic outputs			
Income	1	25	Luxembourg
Productivity	1	14	Luxembourg
Employment	8	19	Cyprus
Social performance			
Environmental	19	6	Latvia
Employment and economic welfare	11	18	Japan
Quality of life indicators	7	16	Belgium
Internationalisation			
Trade	1	12	Luxembourg
Knowledge production and diffusion	1	8	Luxembourg
Economic structure	22	1	EU25
Human resources	1	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
17	Above the EU25 average
5	Close to the EU25 average
7	Below the EU25 average

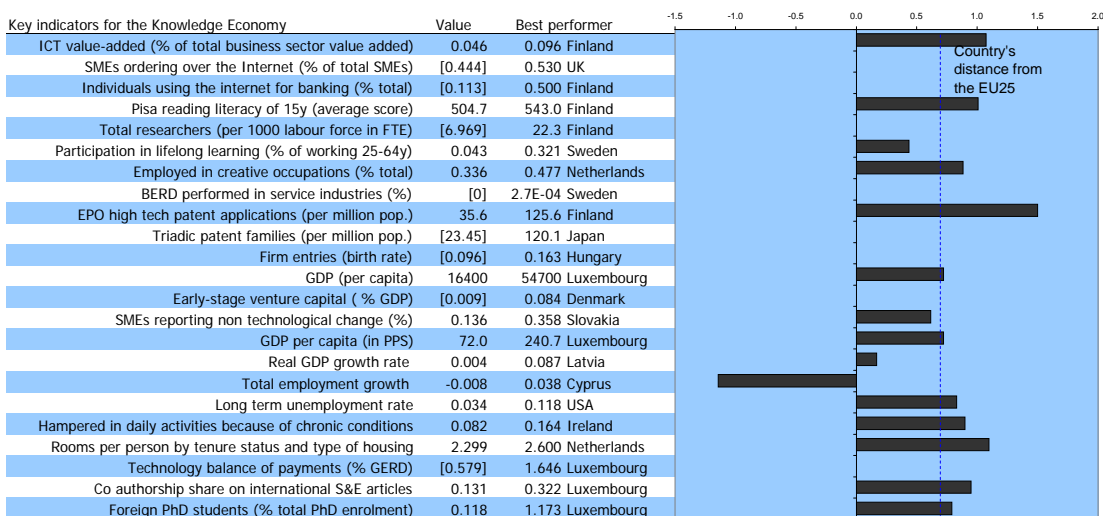


Malta

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	13	9	21	23	27	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	18	32	39	11	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	36	21	14	21	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	7	7	0	11	7	4	7	7	36	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	4	0	32	7	7	0	11	11	4	14	4	0	4	0	0	0	0	0	4	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	14	32	32	14	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	11	14	39	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	22	17	Finland
Internet use by firms	5	14	UK
Internet use by individuals	17	15	Denmark
Government ICT	13	15	Finland
Human resources, skills and creativity			
General education	15	8	Finland
Human resource in S&T education	22	16	Finland
Skills	25	11	Sweden
Creativity	23	16	Netherlands
Mobility	18	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	17	16	Sweden
Patents	16	13	Finland
Bibliometrics	12	9	Sweden
Knowledge flows	24	8	Finland
Total investment in intangibles	1	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	17	10	Hungary
Demand for innovative products	27	16	Sweden
Financing of innovation	16	20	Denmark
Market innovation outputs	1	12	Malta
Organisational indicators	6	15	Slovakia
Economic outputs			
Income	29	25	Luxembourg
Productivity	22	14	Luxembourg
Employment	29	19	Cyprus
Social performance			
Environmental	23	6	Latvia
Employment and economic welfare	14	18	Japan
Quality of life indicators	18	16	Belgium
Internationalisation			
Trade	22	12	Luxembourg
Knowledge production and diffusion	9	8	Luxembourg
Economic structure	11	1	EU25
Human resources	18	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
5	Above the EU25 average
9	Close to the EU25 average
15	Below the EU25 average

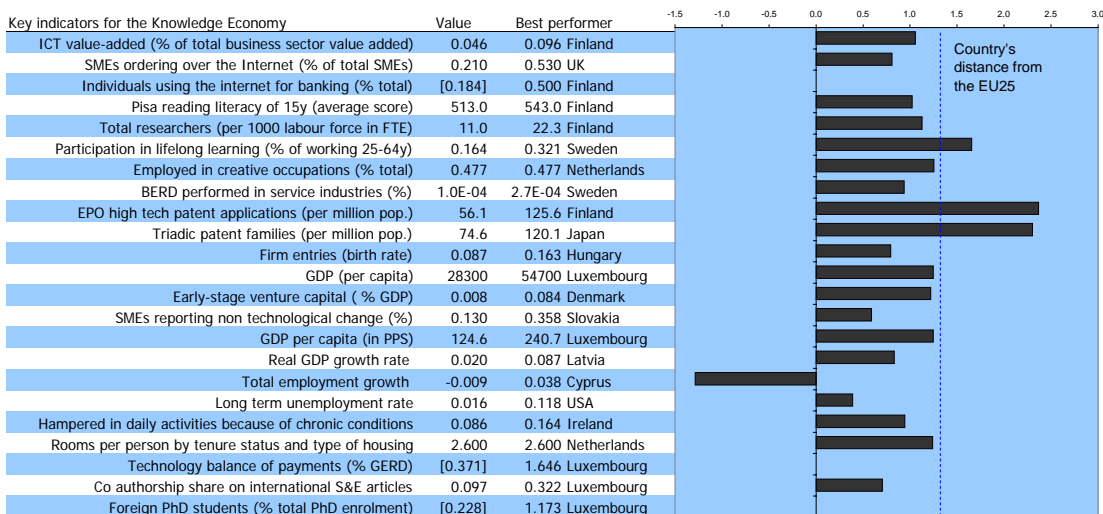


Netherlands

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	86	4	0	4	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	14	57	18	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	11	71	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Knowledge production and diffusion	0	0	0	0	82	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	4	4	7	0	4	4	36	25	11	7	0	0	0	0	0	0	
Economic outputs	0	0	0	0	0	0	0	0	0	0	36	50	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Social performance	0	0	14	71	4	0	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Internationalisation	0	0	0	0	0	0	18	21	36	21	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	6	17	Finland
Internet use by firms	11	14	UK
Internet use by individuals	5	15	Denmark
Government ICT	18	15	Finland
Human resources, skills and creativity			
General education	7	8	Finland
Human resource in S&T education	21	16	Finland
Skills	5	11	Sweden
Creativity	1	16	Netherlands
Mobility	11	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	10	16	Sweden
Patents	5	13	Finland
Bibliometrics	5	9	Sweden
Knowledge flows	14	8	Finland
Total investment in intangibles	8	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	21	10	Hungary
Demand for innovative products	21	16	Sweden
Financing of innovation	18	20	Denmark
Market innovation outputs	16	12	Malta
Organisational indicators	5	15	Slovakia
Economic outputs			
Income	15	25	Luxembourg
Productivity	9	14	Luxembourg
Employment	12	19	Cyprus
Social performance			
Environmental	12	6	Latvia
Employment and economic welfare	3	18	Japan
Quality of life indicators	6	16	Belgium
Internationalisation			
Trade	6	12	Luxembourg
Knowledge production and diffusion	7	8	Luxembourg
Economic structure	19	1	EU25
Human resources	12	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
12	Above the EU25 average
13	Close to the EU25 average
4	Below the EU25 average

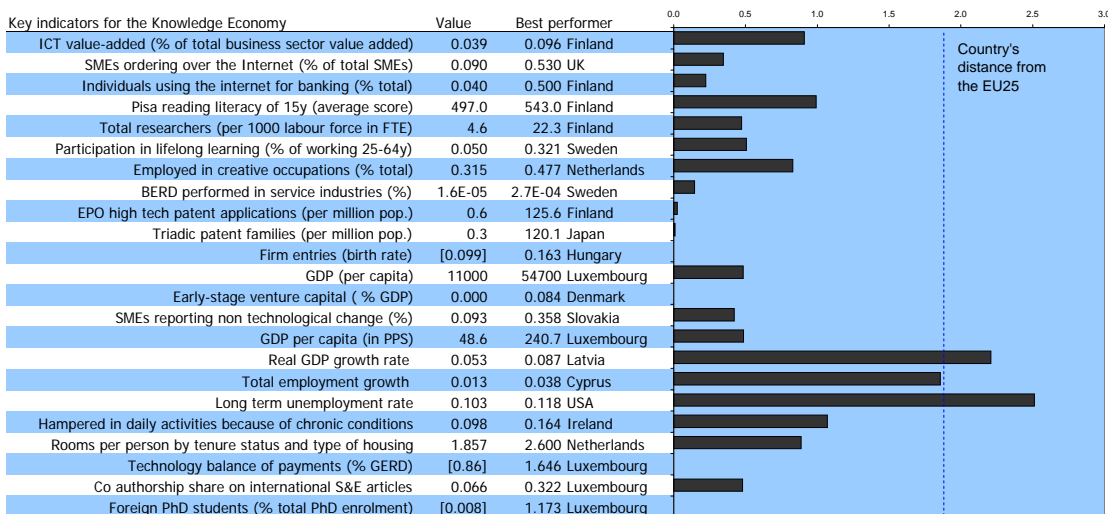


Poland

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	43	54
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	7	0	4	0	0	4	0	11	4	0	7	14	0	11	11	7	14	7	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	93	0
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	61
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	26	17	Finland
Internet use by firms	25	14	UK
Internet use by individuals	25	15	Denmark
Government ICT	25	15	Finland
Human resources, skills and creativity			
General education	22	8	Finland
Human resource in S&T education	25	16	Finland
Skills	23	11	Sweden
Creativity	26	16	Netherlands
Mobility	22	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	27	16	Sweden
Patents	29	13	Finland
Bibliometrics	26	9	Sweden
Knowledge flows	17	8	Finland
Total investment in intangibles	20	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	7	10	Hungary
Demand for innovative products	26	16	Sweden
Financing of innovation	23	20	Denmark
Market innovation outputs	23	12	Malta
Organisational indicators	3	15	Slovakia
Economic outputs			
Income	24	25	Luxembourg
Productivity	29	14	Luxembourg
Employment	26	19	Cyprus
Social performance			
Environmental	20	6	Latvia
Employment and economic welfare	27	18	Japan
Quality of life indicators	25	16	Belgium
Internationalisation			
Trade	16	12	Luxembourg
Knowledge production and diffusion	22	8	Luxembourg
Economic structure	16	1	EU25
Human resources	28	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
1	Above the EU25 average
3	Close to the EU25 average
25	Below the EU25 average

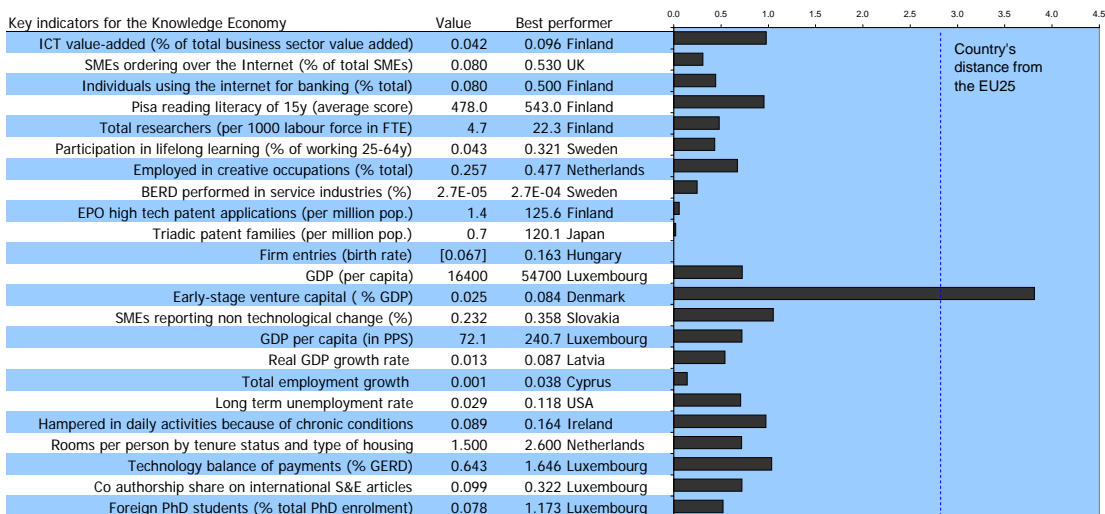


Portugal

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	7	11	6	14	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	50	14	7	14	0	0	0	0
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	29	64
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	32	18	4	36	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	7	32	50	4	4
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	7	0	0	43	43	0	4	0	4
Social performance	0	0	0	0	0	0	0	0	0	0	0	4	0	4	21	11	29	18	7	7	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	4	0	11	4	4	4	36	11	18	4	7	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	24	17	Finland
Internet use by firms	27	14	UK
Internet use by individuals	20	15	Denmark
Government ICT	22	15	Finland
Human resources, skills and creativity			
General education	28	8	Finland
Human resource in S&T education	26	16	Finland
Skills	25	11	Sweden
Creativity	28	16	Netherlands
Mobility	16	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	25	16	Sweden
Patents	27	13	Finland
Bibliometrics	24	9	Sweden
Knowledge flows	6	8	Finland
Total investment in intangibles	16	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	25	10	Hungary
Demand for innovative products	28	16	Sweden
Financing of innovation	9	20	Denmark
Market innovation outputs	26	12	Malta
Organisational indicators	17	15	Slovakia
Economic outputs			
Income	28	25	Luxembourg
Productivity	24	14	Luxembourg
Employment	13	19	Cyprus
Social performance			
Environmental	14	6	Latvia
Employment and economic welfare	13	18	Japan
Quality of life indicators	21	16	Belgium
Internationalisation			
Trade	27	12	Luxembourg
Knowledge production and diffusion	15	8	Luxembourg
Economic structure	4	1	EU25
Human resources	21	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
2	Above the EU25 average
5	Close to the EU25 average
22	Below the EU25 average

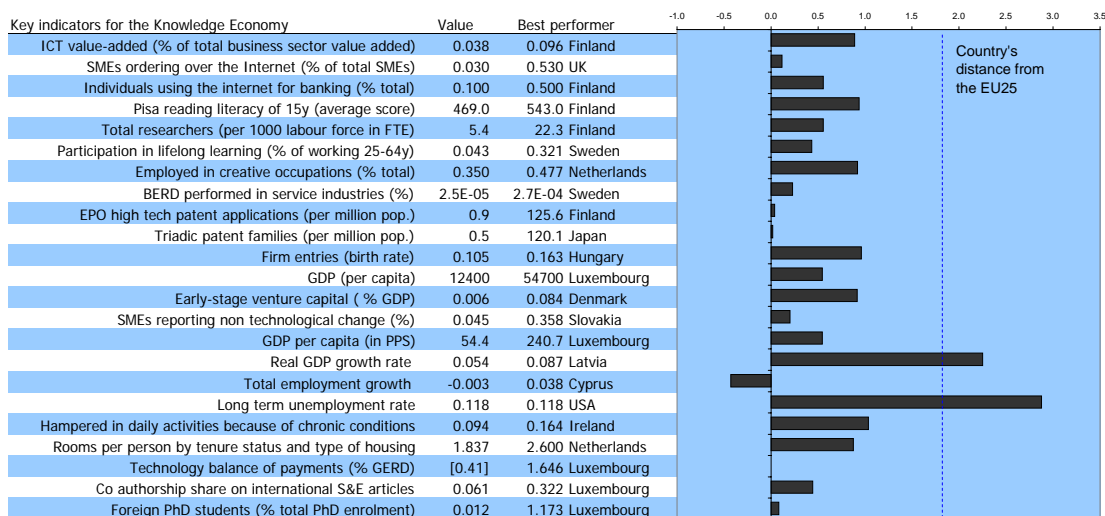


Slovakia

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29		
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	18	71	0	
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	14	79	0	0	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	7	14	61	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	54	0	0	0	
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	32	57
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	4	4	21	0	0	18	39	4	0	4	0	0	

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	25	17	Finland
Internet use by firms	29	14	UK
Internet use by individuals	21	15	Denmark
Government ICT	26	15	Finland
Human resources, skills and creativity			
General education	26	8	Finland
Human resource in S&T education	18	16	Finland
Skills	25	11	Sweden
Creativity	20	16	Netherlands
Mobility	24	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	28	16	Sweden
Patents	28	13	Finland
Bibliometrics	25	9	Sweden
Knowledge flows	2	8	Finland
Total investment in intangibles	19	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	5	10	Hungary
Demand for innovative products	6	16	Sweden
Financing of innovation	21	20	Denmark
Market innovation outputs	7	12	Malta
Organisational indicators	1	15	Slovakia
Economic outputs			
Income	17	25	Luxembourg
Productivity	23	14	Luxembourg
Employment	27	19	Cyprus
Social performance			
Environmental	18	6	Latvia
Employment and economic welfare	28	18	Japan
Quality of life indicators	27	16	Belgium
Internationalisation			
Trade	21	12	Luxembourg
Knowledge production and diffusion	26	8	Luxembourg
Economic structure	9	1	EU25
Human resources	29	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
3	Above the EU25 average
6	Close to the EU25 average
20	Below the EU25 average

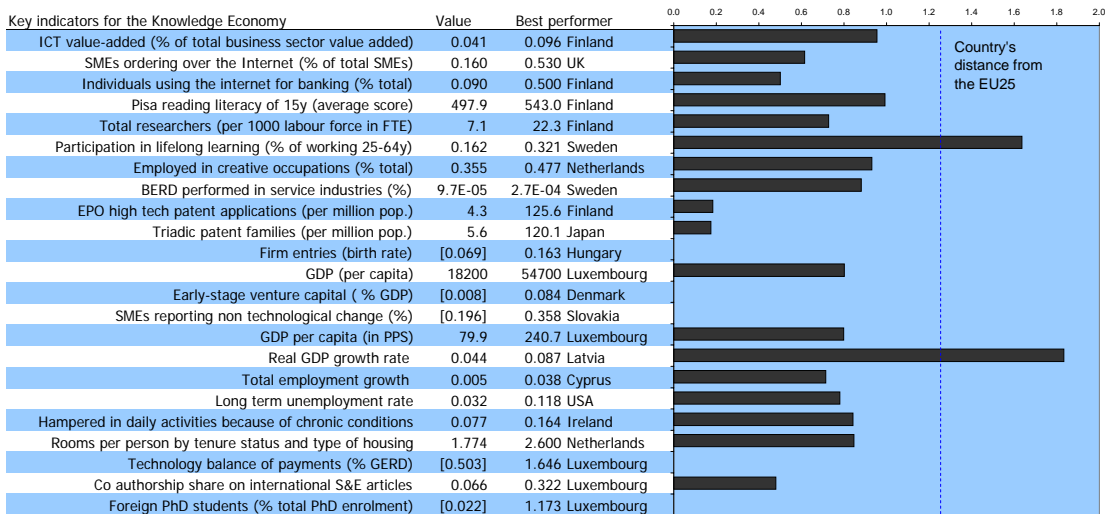


Slovenia

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	41	38	14	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	32	36	21	0	4	0	0	0	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	7	14	14	14	14	29	7	0	0	0	0	0	0	0	0	0	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	21	4	4	0	0	0	0	0	0	0	
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	21	11	0	7	11	21	14	7	4	0	0	0	0	0	
Economic outputs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	14	71	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	4	0	0	4	7	0	25	39	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	4	4	4	0	0	11	21	29	29	0	0	0	0	0	0	0	0	0	

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	27	17	Finland
Internet use by firms	17	14	UK
Internet use by individuals	19	15	Denmark
Government ICT	24	15	Finland
Human resources, skills and creativity			
General education	17	8	Finland
Human resource in S&T education	20	16	Finland
Skills	6	11	Sweden
Creativity	19	16	Netherlands
Mobility	12	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	19	16	Sweden
Patents	19	13	Finland
Bibliometrics	19	9	Sweden
Knowledge flows	4	8	Finland
Total investment in intangibles	19	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	28	10	Hungary
Demand for innovative products	17	16	Sweden
Financing of innovation	17	20	Denmark
Market innovation outputs	3	12	Malta
Organisational indicators	11	15	Slovakia
Economic outputs			
Income	14	25	Luxembourg
Productivity	19	14	Luxembourg
Employment	16	19	Cyprus
Social performance			
Environmental	5	6	Latvia
Employment and economic welfare	10	18	Japan
Quality of life indicators	24	16	Belgium
Internationalisation			
Trade	17	12	Luxembourg
Knowledge production and diffusion	21	8	Luxembourg
Economic structure	12	1	EU25
Human resources	23	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
7	Above the EU25 average
8	Close to the EU25 average
14	Below the EU25 average

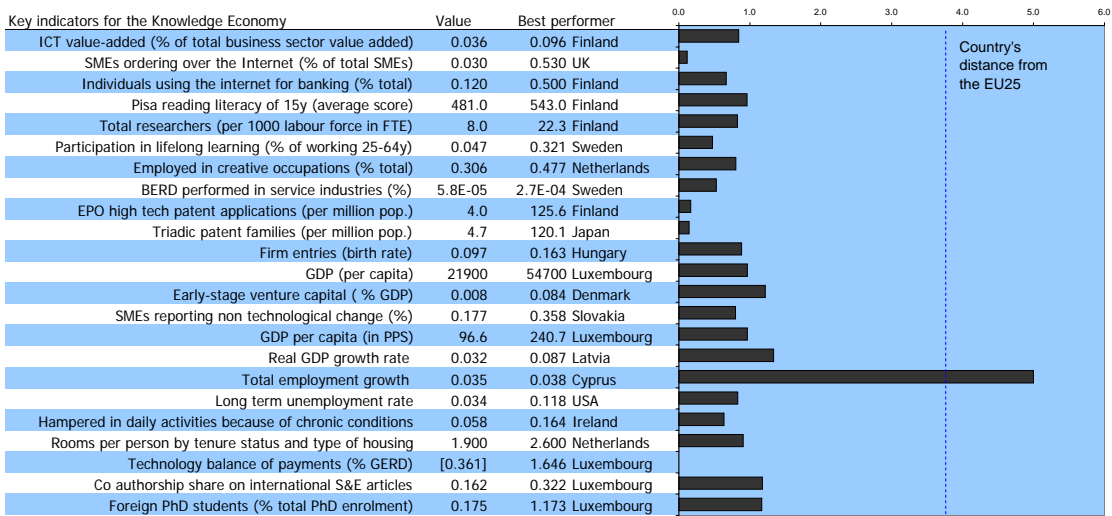


Spain

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	32	25	29	7	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	7	43	21	7	7	0	0	
Human resources, skills and creativity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	7	0	0	0	21	18	43	7	0	0	0	
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14	14	14	14	18	21	18
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	4	18	32	18	21	0	0	7	0	0	0	0	0	0	0	0	0	0	0	
Economic outputs	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Social performance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21	18	21	18	11	0	4	0	0	0	0	0	
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	21	25	18	25	11	0	0	0	0	0	0	0	0	0	0	

	country rank	EU25 rank	Best performer (rank 1)
Knowledge Economy sub-indices			
Production and diffusion of ICT			
Economic impact of ICT	29	17	Finland
Internet use by firms	28	14	UK
Internet use by individuals	16	15	Denmark
Government ICT	16	15	Finland
Human resources, skills and creativity			
General education	29	8	Finland
Human resource in S&T education	12	16	Finland
Skills	24	11	Sweden
Creativity	27	16	Netherlands
Mobility	6	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	23	16	Sweden
Patents	22	13	Finland
Bibliometrics	18	9	Sweden
Knowledge flows	25	8	Finland
Total investment in intangibles	18	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	9	10	Hungary
Demand for innovative products	15	16	Sweden
Financing of innovation	18	20	Denmark
Market innovation outputs	22	12	Malta
Organisational indicators	9	15	Slovakia
Economic outputs			
Income	19	25	Luxembourg
Productivity	4	14	Luxembourg
Employment	3	19	Cyprus
Social performance			
Environmental	26	6	Latvia
Employment and economic welfare	22	18	Japan
Quality of life indicators	4	16	Belgium
Internationalisation			
Trade	23	12	Luxembourg
Knowledge production and diffusion	14	8	Luxembourg
Economic structure	8	1	EU25
Human resources	15	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
5	Above the EU25 average
10	Close to the EU25 average
14	Below the EU25 average

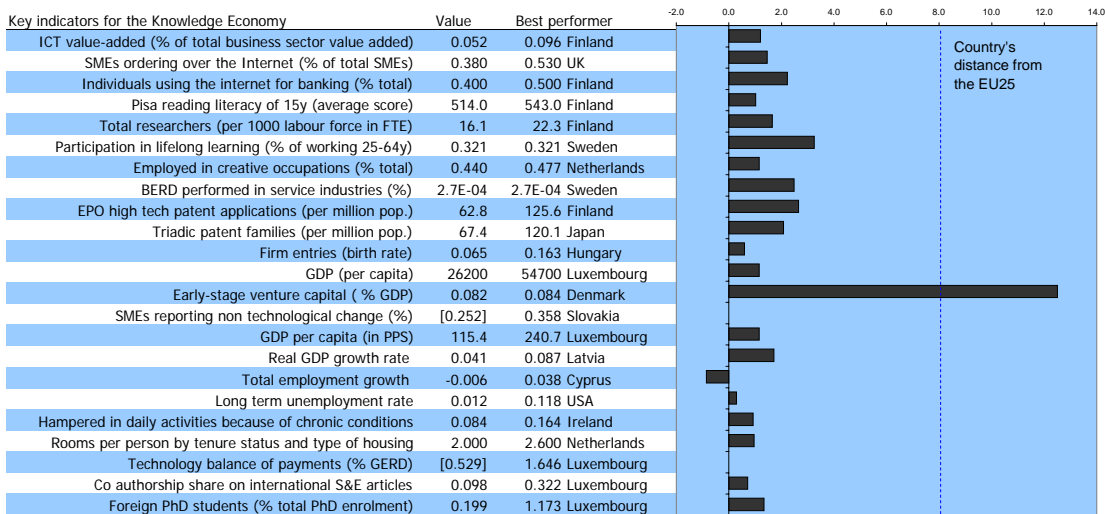


Sweden

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29	
Knowledge Economy Index	54	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Production and diffusion of ICT	46	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Human resources, skills and creativity	0	50	0	21	14	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	64	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	14	21	7	21	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	0	0	7	7	0	0	36	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	71	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	14	50	0	0	0	7	21	0	7	0	0	0	0	0	0	0	0	0	0

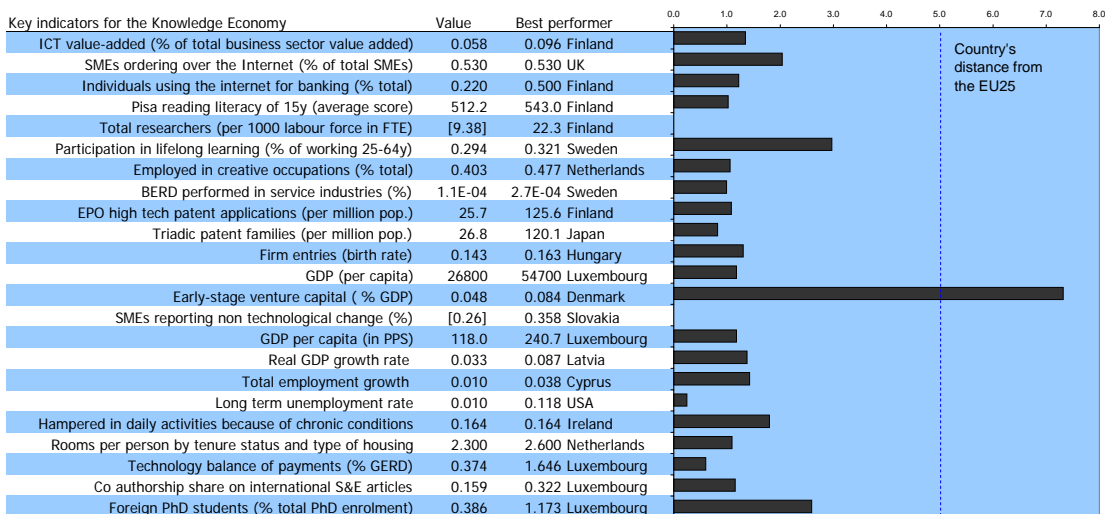
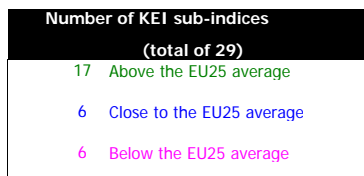
Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	2	17	Finland
Internet use by firms	4	14	UK
Internet use by individuals	2	15	Denmark
Government ICT	2	15	Finland
Human resources, skills and creativity			
General education	2	8	Finland
Human resource in S&T education	2	16	Finland
Skills	1	11	Sweden
Creativity	4	16	Netherlands
Mobility	25	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	1	16	Sweden
Patents	3	13	Finland
Bibliometrics	1	9	Sweden
Knowledge flows	5	8	Finland
Total investment in intangibles	13	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	27	10	Hungary
Demand for innovative products	1	16	Sweden
Financing of innovation	2	20	Denmark
Market innovation outputs	9	12	Malta
Organisational indicators	19	15	Slovakia
Economic outputs			
Income	6	25	Luxembourg
Productivity	20	14	Luxembourg
Employment	10	19	Cyprus
Social performance			
Environmental	2	6	Latvia
Employment and economic welfare	6	18	Japan
Quality of life indicators	9	16	Belgium
Internationalisation			
Trade	3	12	Luxembourg
Knowledge production and diffusion	12	8	Luxembourg
Economic structure	20	1	EU25
Human resources	16	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
19	Above the EU25 average
5	Close to the EU25 average
5	Below the EU25 average



	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	2	5	16	38	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	39	43	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	21	54	18	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	0	0	0	0	0	0	21	18	32	14	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	79	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	4	64	29	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	0	0	0	0	0	7	4	57	14	11	4	4	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	18	11	11	7	39	11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	Best performer (rank 1)
Production and diffusion of ICT		
Economic impact of ICT	4	17 Finland
Internet use by firms	1	14 UK
Internet use by individuals	9	15 Denmark
Government ICT	19	15 Finland
Human resources, skills and creativity		
General education	4	8 Finland
Human resource in S&T education	10	16 Finland
Skills	2	11 Sweden
Creativity	9	16 Netherlands
Mobility	2	20 Japan
Knowledge production and diffusion		
Research and experimental development (R&D)	18	16 Sweden
Patents	14	13 Finland
Bibliometrics	6	9 Sweden
Knowledge flows	12	8 Finland
Total investment in intangibles	5	9 Malta
Innovation, entrepreneurship and creative production		
Entrepreneurship	2	10 Hungary
Demand for innovative products	7	16 Sweden
Financing of innovation	4	20 Denmark
Market innovation outputs	2	12 Malta
Organisational indicators	21	15 Slovakia
Economic outputs		
Income	9	25 Luxembourg
Productivity	18	14 Luxembourg
Employment	5	19 Cyprus
Social performance		
Environmental	15	6 Latvia
Employment and economic welfare	8	18 Japan
Quality of life indicators	20	16 Belgium
Internationalisation		
Trade	20	12 Luxembourg
Knowledge production and diffusion	3	8 Luxembourg
Economic structure	15	1 EU25
Human resources	2	17 Luxembourg

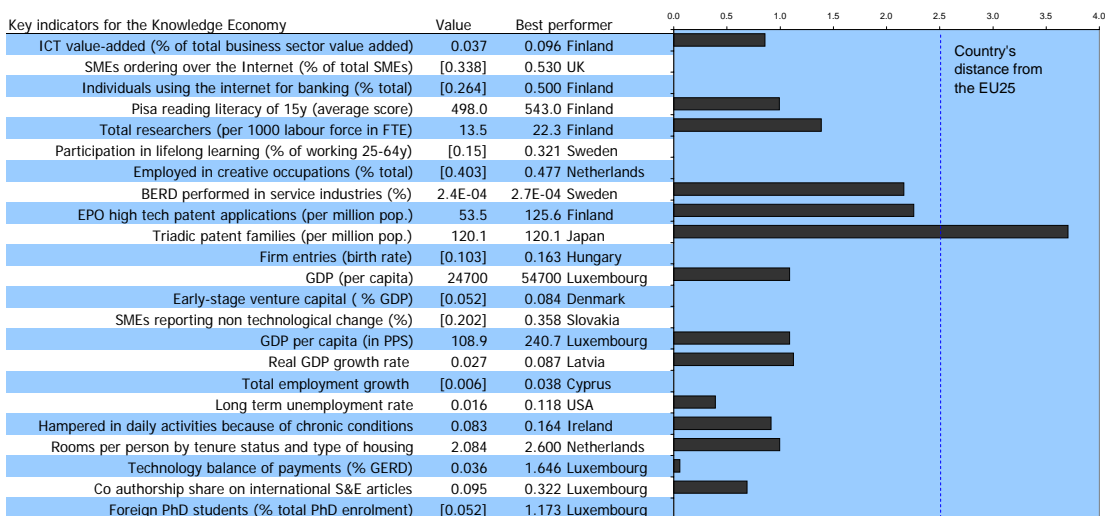


Japan

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	0	0	4	7	18	32	36	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	0	7	21	57	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	0	18	36	43	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	36	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	43	18	29	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic outputs	0	0	0	0	0	61	4	25	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	0	0	71	14	4	4	0	4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Internationalisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	0	18	46	25	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	7	17	Finland
Internet use by firms	8	14	UK
Internet use by individuals	7	15	Denmark
Government ICT	7	15	Finland
Human resources, skills and creativity			
General education	14	8	Finland
Human resource in S&T education	6	16	Finland
Skills	8	11	Sweden
Creativity	10	16	Netherlands
Mobility	1	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	3	16	Sweden
Patents	2	13	Finland
Bibliometrics	7	9	Sweden
Knowledge flows	7	8	Finland
Total investment in intangibles	6	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	13	10	Hungary
Demand for innovative products	9	16	Sweden
Financing of innovation	3	20	Denmark
Market innovation outputs	4	12	Malta
Organisational indicators	13	15	Slovakia
Economic outputs			
Income	16	25	Luxembourg
Productivity	8	14	Luxembourg
Employment	9	19	Cyprus
Social performance			
Environmental	16	6	Latvia
Employment and economic welfare	1	18	Japan
Quality of life indicators	12	16	Belgium
Internationalisation			
Trade	10	12	Luxembourg
Knowledge production and diffusion	29	8	Luxembourg
Economic structure	19	1	EU25
Human resources	9	17	Luxembourg

Number of KEI sub-indices	
(total of 29)	
18	Above the EU25 average
7	Close to the EU25 average
4	Below the EU25 average

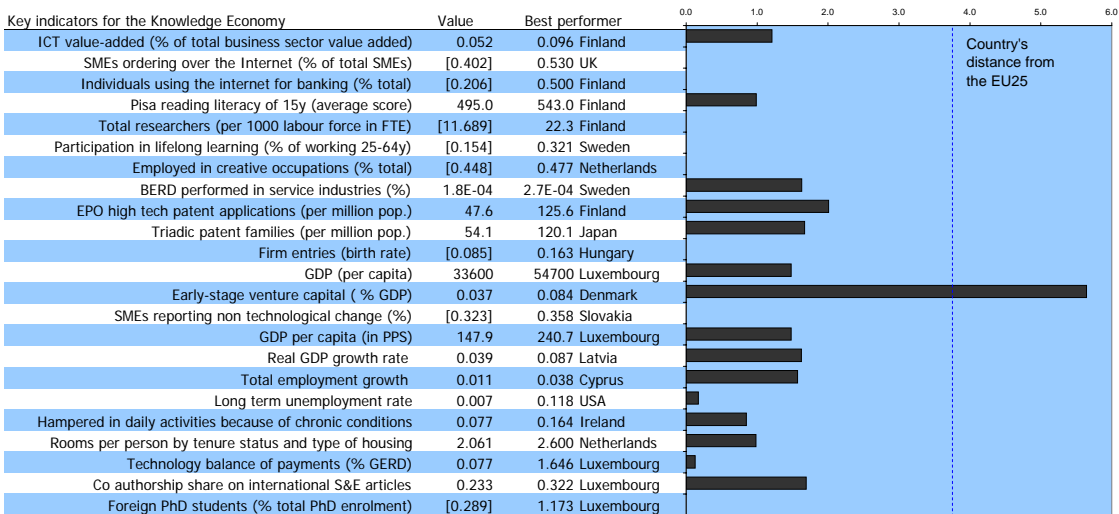


USA

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	Rank 13	Rank 14	Rank 15	Rank 16	Rank 17	Rank 18	Rank 19	Rank 20	Rank 21	Rank 22	Rank 23	Rank 24	Rank 25	Rank 26	Rank 27	Rank 28	Rank 29
Knowledge Economy Index	11	32	2	4	39	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Production and diffusion of ICT	0	0	11	54	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resources, skills and creativity	0	0	11	32	21	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Knowledge production and diffusion	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Innovation, entrepreneurship, creative production	0	0	0	0	0	0	0	0	0	0	0	0	14	4	25	14	4	18	7	0	0	4	4	0	4	4	0	0	0
Economic outputs	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social performance	0	0	0	11	79	7	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Internationalisation	0	7	4	4	43	21	7	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Knowledge Economy sub-indices	country rank	EU25 rank	Best performer (rank 1)
Production and diffusion of ICT			
Economic impact of ICT	8	17	Finland
Internet use by firms	6	14	UK
Internet use by individuals	6	15	Denmark
Government ICT	4	15	Finland
Human resources, skills and creativity			
General education	6	8	Finland
Human resource in S&T education	9	16	Finland
Skills	7	11	Sweden
Creativity	3	16	Netherlands
Mobility	7	20	Japan
Knowledge production and diffusion			
Research and experimental development (R&D)	4	16	Sweden
Patents	7	13	Finland
Bibliometrics	2	9	Sweden
Knowledge flows	11	8	Finland
Total investment in intangibles	4	9	Malta
Innovation, entrepreneurship and creative production			
Entrepreneurship	23	10	Hungary
Demand for innovative products	8	16	Sweden
Financing of innovation	6	20	Denmark
Market innovation outputs	14	12	Malta
Organisational indicators	26	15	Slovakia
Economic outputs			
Income	2	25	Luxembourg
Productivity	5	14	Luxembourg
Employment	4	19	Cyprus
Social performance			
Environmental	10	6	Latvia
Employment and economic welfare	4	18	Japan
Quality of life indicators	8	16	Belgium
Internationalisation			
Trade	18	12	Luxembourg
Knowledge production and diffusion	10	8	Luxembourg
Economic structure	6	1	EU25
Human resources	3	17	Luxembourg

Number of KEI sub-indices (total of 29)	
19	Above the EU25 average
6	Close to the EU25 average
4	Below the EU25 average



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European Commission

EUR 23486 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: Knowledge Economy: measures and drivers

Author(s): Michaela Saisana and Giuseppe Munda

Luxembourg: Office for Official Publications of the European Communities

2008 – 84 pp. – 21 x 29.70 cm

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

ISBN 978-92-79-09703-4

DOI 10.2788/92075

Abstract

In the Knowledge-based Economy conceptual framework that was developed by MERIT a total of 115 individual indicators have been selected to measure the sub-dimensions of the KBE. The high number of individual indicators raises the issue of robustness of the ranking obtained by their aggregation into one composite measure. To tackle this issue a sensitivity analysis is a fundamental step of the KEI composite indicator. In particular, in building the KEI composite an innovative methodological assumption has been made, i.e. it is considered as the final composite index the frequency of all rankings obtained by means of all the simulations carried out. This allows us to deal with the criticism, often made to composite indicators that rankings are presented as they were under conditions of certainty while it is well known that this is not true in general terms. Most practitioners compute a composite indicator by a simple weighted summation mathematical model. Sometimes it is acknowledged that the ranking obtained is subject to some uncertainty, but this issue is treated as a kind of mathematical appendix for technical readers, and all policy suggestions are derived under the assumption of the linear aggregation model. Here the ranking presented is the one derived by considering the whole spectrum of uncertainty. It is important to note that this is a peculiar characteristic of the KEI composite.

The scenarios, simulations and indicators developed by the JRC team answer five main research questions:

1. Is it possible to measure the knowledge economy?
2. What are the drivers of the knowledge economy?
3. How does knowledge economy relate to other complex dimensions?
4. Is it possible to reduce the total number of individual indicators of KEI conceptual framework without losing any relevant information?
5. Are rankings useful at all for deriving policy suggestions?.

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LB-NA-23486-EN-C



ISBN 978-92-79-09703-4

