# Sensitivity Analysis of the e-Business Readiness Composite Indicator

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**Abstract:** The initiative "e-Readiness of European enterprises" is part of the European Commission "e-Europe 2005" action plan. As part of this initiative, the European Council of ministers has requested the compilation of a composite indicator to assess the preparedness of the internet business environment of European Countries. Underlying data for the component indicators have been obtained through enterprise surveys. The Joint Research Centre, as part of the European Commission, has been asked to carry out a pilot study on this composite indicator for the year 2002. The study includes the testing for robustness and sensitivity, as recommended by the European Commission guidelines for impact assessment. We illustrate here the uncertainty and sensitivity tests that have been carried out for this pilot study.

**Keywords:** e-business, robustness, uncertainty, weights, imputation.

## 1. INTRODUCTION

Composite indicators are weighted combinations of selected sub-indicators into single aggregated measures, via underlying models of the policy domains of interest. Discussion on the legitimacy of such indicators is incessant. Composites are increasingly used by media and policy makers to communicate information on the situation of countries or regions in various policy fields such as environment, economy or technological development (reviews in [1,2]). Opponents lament that composites are mixes of dubious interpretation yet expensive to obtain. Organisms such as the UN, the OECD and the European Commission make use of such measures. In particular the OECD and the JRC have recently undertaken the joint preparation of a handbook of good practices of composite indicators building [3].

In this paper we study the construction of a composite indicator of e-business readiness (see Section 2). This composite indicator is aimed at measuring the progress of Member States towards a more extensive take up and use of digital technologies. We report part of the results of a pilot study commissioned to JRC by the Directorate General Enterprise of the European Commission. In particular, we focus our analysis on the weighting scheme used to aggregate sub-indicators, and on the sensitivity of the composite indicator to different weighting schemes and to incomplete data.

As far as weighting is concerned, JRC suggested and deployed a participatory technique, called "budget allocation", which allows any expert of a panel to express, from a policy perspective, their opinion upon the relative importance of sub-indicators (see Section 4).

The issue of sensitivity is crucial for the characterisation of composites. The Communication from the European Commission on Structural Indicators [4] recognises the importance to assess the sensitivity of the message provided by composites with respect to the weights employed. Here we consider an additional source of uncertainty in the evaluation of the composite indicator, the uncertainty due to missing data.

As we shall see in Section 3 we use a *Multiple Imputation* technique (based on Markov Chain Monte Carlo algorithms) for the treatment of missing data. This is appealing in that it provides confidence bounds for the imputed data [5,6]. Imputed data are, indeed, estimated values. Different imputed data may result in different values for the composite indicator. Thus their effect on the resulting composite indicator must be acknowledged using both uncertainty and sensitivity analysis.

## 2. THE e-READINESS COMPOSITE INDICATOR

The eEurope 2005 Action Plan [7] calls for a benchmarking of the target that 'by 2005, Europe should have (…) a dynamic e-business environment', specifying that 'e-business comprises both e-commerce (buying and selling on-line) and restructuring of business processes to make best use of digital technologies'. Besides proposing guidelines for the benchmarking, the resolution sets out a number of policy indicators to monitor progress in the implementation of the Action Plan.

One of these benchmarking indicators is the composite indicator on e-business readiness. According to the Council's recommendation, this is made of two core groups (see Table 1): (a) *Adoption of ICT* by business, and (b) *Use of ICT* by business; each group is composed by six sub-indicators.

The composite indicator, $Y_c$, for a given country $c$, is a weighted sum of $k$ sub-indicators $X_{ic}$ (5 available for *Adoption* and 6 for *Use of ICT*) and $k$ weights $w_i$ : $Y_c = \sum_{i=1}^{k} X_{ic} \cdot w_i$ . The analysis is conducted using an incomplete dataset (data availability is 81%) for the year 2002. Therefore, the first step in our analysis is that of "filling up" empty spaces.

*Table 1. List of sub-indicators for the composite indicator on e-business readiness*

| | |
|---|---|
| *Adoption of ICT by business* | |
| a1 | % of enterprises that use Internet |
| a2 | % of enterprises that have a web site/home page |
| a3 | % of enterprises that use at least two security facilities at the time of the survey |
| a4 | % of total number of persons employed using computers in their normal work routine (at least once a week) |
| a5 | % of enterprises having a broadband connection to the Internet |
| a6 | % of enterprises with a LAN and using an Intranet or Extranet |
| *Use of ICT by business* | |
| b1 | % of enterprises that have purchased products / services' via the internet, Electronic Data Interchange or any other computer mediated network where these are >1% of total purchases |
| b2 | % of enterprises that have received orders via the internet, Electronic Data Interchange or any other computer mediated network where these are >1% of total turnover |
| b3 | % of enterprises whose IT systems for managing orders or purchases are linked automatically with other internal IT systems |
| b4 | % enterprises whose IT systems are linked automatically to IT systems of suppliers or customers outside their enterprise group |
| b5 | % of enterprises with Internet access using the internet for banking and financial services |
| b6 | % of enterprises that have sold products to other enterprises via a presence on specialised internet market places |

## 3. MULTIPLE IMPUTATION OF MISSING DATA

### 3.1 Methodology

We do not attempt any imputation for countries and sub-indicators that are totally missing. Therefore, Belgium, France, The Netherlands, Portugal and the sub-indicator *a3* were not included in the analysis (see Table 2).

The explanation of the MCMC-based technique for multiple imputation is given in Refs. 5 and 6. The technique yields, simultaneously, one estimate for each of the 22 missing data. This process is repeated M=50 times. Against the prevailing practice of using, for each of the 22 cells, the mean over the M individual estimates, we use their full distribution in our study. The gray values in Table 2 are the medians of the (normal) distributions. The sample means and standard deviations, calculated over the M values, are given in Table 3. The dataset in Table 2 is the starting point for the calculation of the composite indicator.

*Table 2. Data set for the e-business readiness composite indicator. The50-th percentiles of the distribution of the imputed values are marked in grey. NA stands for 'not available'.*

| 2002 | a1 | a2 | a3 | a4 | a5 | a6 | b1 | b2 | b3 | b4 | b5 | b6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| DK | 95% | 76% | NA | 59% | 56% | 53% | 24% | 12% | 5% | 9% | 68% | 2% |
| D | 84% | 66% | NA | 51% | 28% | 45% | 39% | 16% | 11% | 11% | 55% | 1% |
| EL | 64% | 34% | NA | 43% | 3% | 25% | 7% | 6% | 7% | 8% | 39% | 1% |
| E | 82% | 38% | NA | 34% | 45% | 31% | 3% | 1% | 3% | 9% | 64% | 0% |
| F | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| IRL | 83% | 53% | NA | 42% | 9% | 41% | 23% | 11% | 6% | 10% | 57% | 3% |
| I | 74% | 46% | NA | 42% | 15% | 39% | 3% | 3% | 1% | 1% | 38% | 0% |
| L | 78% | 51% | NA | 44% | 18% | 69% | 22% | 11% | 5% | 10% | 42% | 1% |
| NL | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| A | 85% | 64% | NA | 51% | 29% | 50% | 27% | 17% | 6% | 12% | 58% | 2% |
| P | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| FIN | 96% | 69% | NA | 57% | 44% | 51% | 30% | 13% | 6% | 14% | 81% | 2% |
| S | 95% | 80% | NA | 72% | 33% | 62% | 31% | 16% | 8% | 16% | 71% | 2% |
| UK | 74% | 67% | NA | 57% | 20% | 39% | 18% | 12% | 14% | 18% | 45% | 1% |

## 4. SELECTION OF WEIGHTS

A rather common way to assign weights is to involve experts opinion. In the *budget allocation* method [8], each expert is given a "budget" of 100 points, and is asked to distribute the budget over the sub-indicators by allotting more points to those indicators which are felt as more important. For each sub-indicator, the average weight across the experts (last row in Tables 4 and 5) is used in the aggregation procedure.

*Table 3. Mean and standard deviation of the 22 imputed data over M values*

| Indicator | Country | Mean | Standard deviation |
|---|---|---|---|
| a4 | FIN | 53% | 11% |
| a5 | D | 32% | 31% |
| b1 | S | 38% | 16% |
| b1 | UK | 20% | 11% |
| b2 | UK | 10% | 5% |
| b3 | DK | 16% | 5% |
| b3 | D | 13% | 9% |
| b3 | E | 10% | 5% |
| b3 | L | 12% | 8% |
| b3 | A | 12% | 8% |
| b3 | FIN | 16% | 9% |
| b3 | S | 13% | 8% |
| b4 | DK | 20% | 8% |
| b4 | D | 16% | 7% |
| b4 | E | 14% | 8% |
| b4 | L | 8% | 4% |
| b4 | A | 11% | 4% |
| b4 | FIN | 19% | 8% |
| b4 | S | 16% | 8% |
| b5 | UK | 56% | 9% |
| b6 | DK | 1% | 8% |
| b6 | UK | 2% | 11% |

The budget allocation method was employed at the steering group meeting of the e-business support network (e-BSN), held in Paris on October, 28th, 2003. Fourteen experts coming from the European Union and the Accession Countries were involved in the exercise. The sets of weights obtained, for each core group, are given in Tables 4 and 5.

Contrarily to the common use of average weights, where the information from the single expert vanishes, we believe it is important to retain the identity of the experts and acknowledge, in our model of composite indicator, the uncertainty to due expert selection.

*Table 4. Results of the budget allocation exercise for 'Adoption of ICT'. Data for a3 not available. Weights originally attributed to indicator a3 have been equally distributed over the remaining 5 indicators, and re-scaled so that the sum is 100.*

| Expert's Nationality | a1 | a2 | a4 | a5 | a6 | SUM |
|---|---|---|---|---|---|---|
| UK | - | 15 | 15 | 35 | 35 | 100 |
| NL | - | 20 | 20 | 50 | 10 | 100 |
| LV | 35 | 35 | 10 | 20 | - | 100 |
| L | 30 | 25 | 30 | 15 | - | 100 |
| DK | 25 | 25 | 25 | 25 | - | 100 |
| SL | - | 30 | 20 | 30 | 20 | 100 |
| F | - | 25 | 25 | 25 | 25 | 100 |
| LT | - | 10 | 20 | 40 | 30 | 100 |
| IRL | - | - | 31.2 | 50 | 18.8 | 100 |
| N | - | - | 42.9 | 35.7 | 21.4 | 100 |
| S | 11.2 | - | - | 44.4 | 44.4 | 100 |
| HU | 16.7 | 16.7 | 16.7 | 22.2 | 27.7 | 100 |
| EL | - | 15 | 25 | 30 | 30 | 100 |
| E | 40 | 40 | 10 | 10 | - | 100 |
| **Average** | **11.7** | **19.2** | **20.3** | **30.4** | **18.4** | |

*Table 5. Results of the budget allocation exercise for 'Use of ICT'.*

| Expert's Nationality | b1 | b2 | b3 | b4 | b5 | b6 | SUM |
|---|---|---|---|---|---|---|---|
| UK | 15 | 15 | 35 | 35 | - | - | 100 |
| NL | 10 | 30 | - | 30 | - | 30 | 100 |
| LV | 35 | 30 | 20 | 15 | - | - | 100 |
| L | 25 | 25 | - | - | 25 | 25 | 100 |
| DK | 25 | 25 | 25 | 25 | - | - | 100 |
| SL | 40 | 20 | - | - | 30 | 10 | 100 |
| F | 25 | 25 | 25 | 25 | - | - | 100 |
| LT | - | 10 | - | 30 | 20 | 40 | 100 |
| IRL | 15 | 15 | 30 | 40 | - | - | 100 |
| N | 15 | 35 | 35 | 15 | - | - | 100 |
| S | 10 | 30 | - | 40 | - | 20 | 100 |
| HU | 5 | 10 | 20 | 20 | 20 | 25 | 100 |
| EL | 20 | - | 30 | 30 | 20 | - | 100 |
| E | 40 | - | 40 | - | 20 | - | 100 |
| **Average** | **20** | **19.3** | **18.6** | **21.8** | **9.6** | **10.7** | |

## 5. UNCERTAINTY ANALYSIS

Given the variability of expert selection, and the uncertainty coming from the imputation of the missing data, the composite indicator for the different countries is also affected by uncertainty. We have carried out the following tests:

- uncertainty analysis to assess how the variability in the weights and the uncertainty in the imputed data influence the composite indicator of e-readiness;
- sensitivity analysis of the composite indicator to assess how much uncertainty is due to choice of weights and how much to imputation errors. This is helpful to know whether collecting more data permits drawing more accurate inferences.

The variability in expert selection has been accounted for by considering a trigger factor ω, i.e. a discrete random variable uniformly distributed between 1 and 14 (the number of experts). For example, for ω=7 the expert from France is chosen (see Tables 4 and 5).

The uncertainty coming from imputation of missing data depends on how many imputations have been done for a given country. For example, for Denmark three imputations have been made. Therefore, we define one uncertain factor for each imputed data. The factors are normal distributions with means and standard deviations given in Table 3. For Denmark we have four uncertain factors; for Italy only one uncertain factor (ω), hence no sensitivity analysis can be carried out. Let Y be the composite indicator for a given country:

$$Y = w_1 a_1 + w_2 a_2 + w_3 a_3 + w_4 a_4 + w_5 a_5 + w_6 a_6 + w_7 b_1 + w_8 b_2 + w_9 b_3 + w_{10} b_4 + w_{11} b_5 + w_{12} b_6$$

where $\omega \equiv ( w_1 , w_2 ,..., w_{12} )$ is the set of weights proposed by a given expert (a given row in Tables 4 and 5). For UK, for example, the composite has five sources of uncertainty: ω, b1, b2, b5 and b6; for Greece the composite has only one source of uncertainty: ω.

Different countries have different (number of) uncertainty sources; this implies that the uncertainty analysis is carried out independently for each country. For each country, a LHS sample of size $N = 1500$ is generated for the uncertain factors based on their distributions, and the composite indicator is evaluated N times. Figure 1 displays the empirical distributions of composite indicators for the eight countries that had both uncertainty on weights and on data. The other countries, Greece, Ireland, and Italy have a complete dataset, thus the uncertainty analysis is a histogram with 14 bins, one for each expert in the budget allocation exercise.

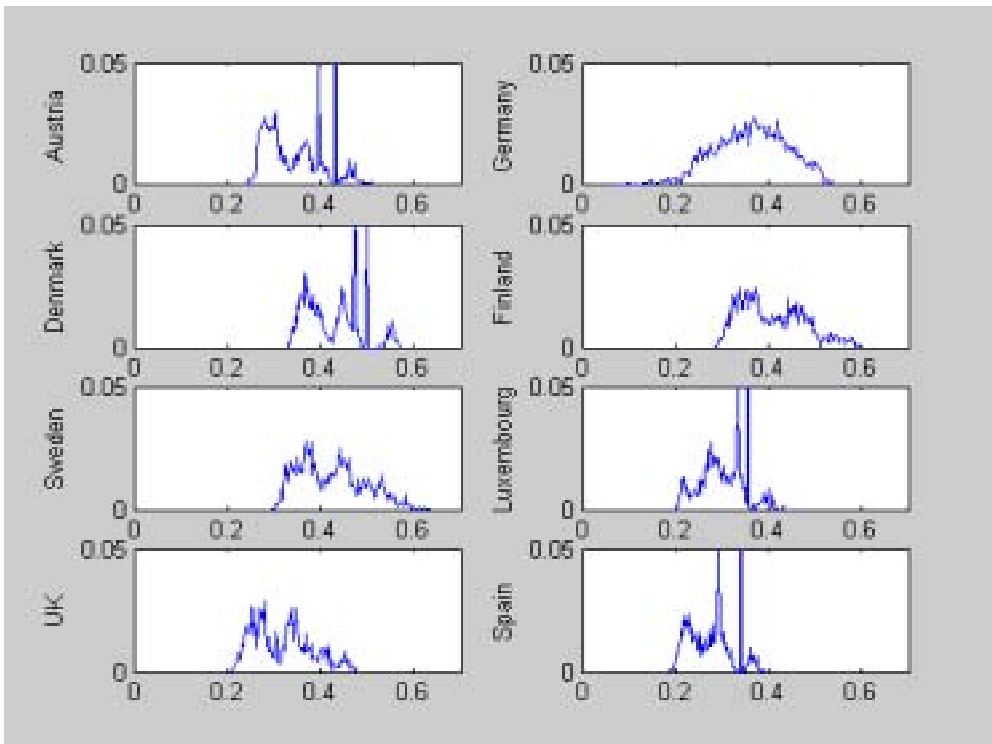
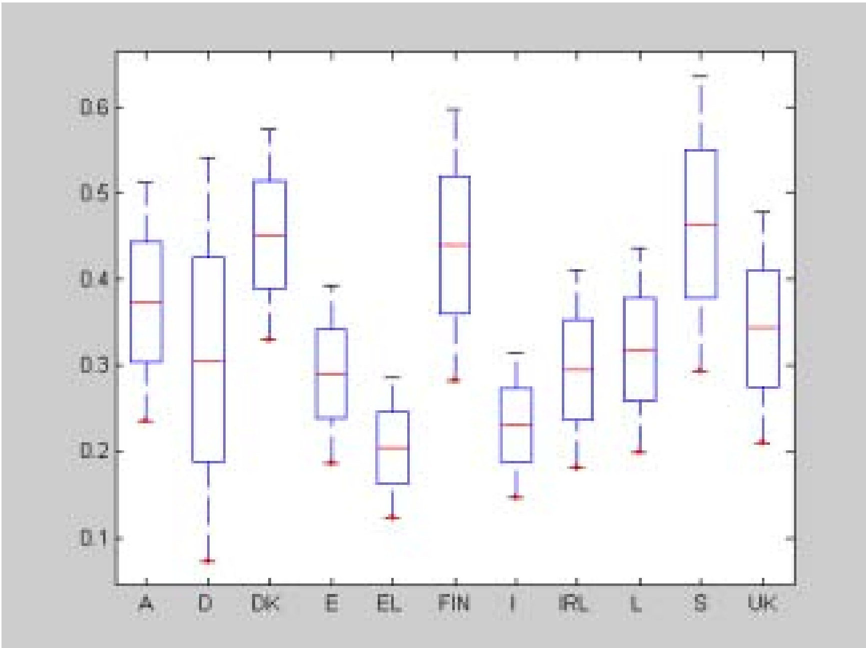



*Figure 1. Uncertainty analysis of the composite indicator of e-business readiness for eight countries, based on a LHS sample of size 1,500. On the horizontal axis the values of the composite indicator; on the vertical axis their frequency of occurrence.*

For Austria, b3 and b4 are imputed, and experts 4 (from Luxembourg) and 6 (from Slovenia) give zero weight to both b3 and b4. This causes the presence of two peaks for Austria (the left one due to expert 4, the right one due to expert 6). Similar peaks occur for Luxembourg, Denmark, and Spain. Figure 1 displays multi-modal distribution functions for most countries. Each modal function is the result of the convolution of particular combinations of weights with uncertainty in imputation. Discrete distributions are obtained for Greece, Ireland and Italy. While for Ireland uncertainty on weights does not favour any particular output value, for Greece and Italy medium and low values respectively of e-business are more likely.

Figure 2 displays the composite indicator of e- readiness with its confidence bounds for all countries in terms of box-plots. Sweden and Italy have non overlapping bounds: the policy inference is robust, no matter uncertainty in weights or in data. When the box plots of two countries overlap, the degree of uncertainty determines the relative score of the countries considered. Spain, Greece, and Italy unambiguously have lower e-readiness than Denmark, Finland and Sweden. Germany overlaps with almost all other countries pointing to the crucial effects played by uncertainty in weights and data (mainly a5, see Table 3) for this country.

*Figure 2. Box plots of the composite indicator on e-business readiness. Uncertainty is due to different weighting schemes as well as to imputation of missing data.*




Also Sweden and Finland have large boxes. For Greece, Spain and Italy the boxes are narrower, indicating a less important role for uncertainty in data and weights. For UK, with 4 indicators imputed (b1, b2, b5, b6), the box is not so large (very low weight associated to b5 and b6). How much of the uncertainty in the composite indicators is due to different weighting schemes rather than to imputation of missing data values? This will be the object of the sensitivity analysis.

## 6. SENSITIVITY ANALYSIS

### 6.1 Methodology

The question answered by the sensitivity analysis is how much of the uncertainty on the composite indicator Y for a given country depends on the uncertainty on its input factors **X** (imputed data and weight selection). Using the variance of Y as yardstick of importance, the issue becomes, how much does the prediction variance, V(Y), decrease, on average, when some components of **X** are held fixed. The starting point of the variance-based methods is the variance decomposition $V(Y)=V(E(Y|X_i))+E(V(Y|X_i))$, where $X_i$ is any uncertain factor. The first order sensitivity indices can be calculated as $S_i=V(E(Y|X_i))/V(Y)$, for each uncertain factor. The higher $S_i$, the higher the importance of $X_i$, as the larger the average drop in variance $V(Y)$ obtained when fixing $X_i$ within its range.

The method used here to evaluate the sensitivity indices is a generalisation of that proposed in [9] (a review is also offered in [10]) at no extra cost for the analysis. We illustrate the generalisation briefly here. The first order indices are calculated by:

$$\hat{S}_j=\frac{\hat{U}_j-\hat{E}^2(Y)}{\hat{V}(Y)} \quad (1)$$

where Monte Carlo estimates for $U_j$, $E(Y)$ and $V(Y)$ are computed as:

$$\hat{U}_j = \frac{1}{n-1}\sum_{r=1}^{n} f(x_{r1}, x_{r2},..., x_{rk}) f(x'_{r1}, x'_{r2},..., x'_{r(j-1)}, x_{rj}, x'_{r(j+1)},..., x'_{rk}) \quad (2)$$

$$\hat{E}^2(y) = \left\{\frac{1}{n}\sum_{r=1}^{n} f(x_{r1}, x_{r2},..., x_{rk})\right\}^2 \quad (3)$$

$$\hat{V}(y) = \frac{1}{n}\sum_{r=1}^{n} f(x_{r1}, x_{r2},..., x_{rk})^2 - \frac{1}{n^2}\left(\sum_{r=1}^{n} f(x_{r1}, x_{r2},..., x_{rk})\right)^2 \quad (4)$$

Let us simplify the notation by setting:

$$y_A = f(x_1, x_2, ..., x_k) = f(A) \qquad y_C = f(x_{r1}', x_{r2}', ... x_{r(j-1)}', x_{rj}, x_{r(j+1)}', ... x_{rk}') = f(C) \quad (5)$$

$$y_B = f(x_1', x_2', ..., x_k') = f(B) \qquad y_D = f(x_{r1}, x_{r2}, ... x_{r(j-1)}, x'_{rj}, x_{r(j+1)}, ... x_{rk}) = f(D)$$

*A* and *B* are independent sample matrices; *C* and *D* are independent re-sample matrices as well. Ref. 9 suggests that, when calculating $U_j$ as sum of products $y_A y_C$, more accurate estimates for $S_j$ are obtained when $E^2(y)$ is based on products of independent matrices:

$$\hat{E}^2(y) = \frac{1}{n}\sum_{r=1}^{n} f(x_{r1}, x_{r2},..., x_{rk}) f(x'_{r1}, x'_{r2},..., x'_{rk}) = \frac{1}{n}\sum_{r=1}^{n} y_A y_B \quad (6)$$

Therefore, it is also legitimate to estimate $E^2(y)$ using products of $y_C y_D$, which are also independent. When (6) is employed, the denominator of (1) can then be calculated from either $y_A y_A$ or $y_B y_B$. Similarly, when $E^2(y)$ is estimated using products of $y_C y_D$, the denominator in (1) can be estimated from either $y_C y_C$ or $y_D y_D$. We end up with four sensitivity indices:

| | |
|---|---|
| $S_j^I = \left(\sum y_A y_C - \sum y_A y_B\right) / \sum y_A y_A$ | $S_j^{III} = \left(\sum y_A y_C - \sum y_C y_D\right) / \sum y_C y_C$ |
| $S_j^{II} = \left(\sum y_A y_C - \sum y_A y_B\right) / \sum y_B y_B$ | $S_j^{IV} = \left(\sum y_A y_C - \sum y_C y_D\right) / \sum y_D y_D$ |

Exploiting the symmetry property of the design (Ref. [9]), we obtain additional indices:

| | |
|---|---|
| $S_j^V = \left(\sum y_B y_D - \sum y_A y_B\right) / \sum y_A y_A$ | $S_j^{VII} = \left(\sum y_B y_D - \sum y_C y_D\right) / \sum y_C y_C$ |
| $S_j^{VI} = \left(\sum y_B y_D - \sum y_A y_B\right) / \sum y_B y_B$ | $S_j^{VIII} = \left(\sum y_B y_D - \sum y_C y_D\right) / \sum y_D y_D$ |

The indices $S_j^I, S_j^{II}, S_j^{III}, S_j^{IV}$ are positively correlated. So are the indices $S_j^V, S_j^{VI}, S_j^{VII}, S_j^{VIII}$. The two groups of indices are negatively correlated. Comparison tests between the indices used in [9] and the average of the eight estimates confirm that the convergence of this latter is generally more rapid. Same symmetry properties allow the estimation of four total indices.

## 7. RESULTS

We test the sensitivity of the composite indicator for each country to both weights and imputation results using the method illustrated so far. A total cost of about 1,000 model runs has been required to estimate both the (eight) first order indices and the (four) total effects for all the factors with an accuracy of 1% on the indices. The time required to execute one model run is approximately nil, as the model output is a weighted average of the input. Is uncertainty coming from imputation (other than for Greece, Italy and Ireland) more relevant than the uncertainty due to choice of weights?

*Table 5. First order and total effects of uncertain factors (weights trigger and imputed indicators) on e-business readiness for eight countries. Calculations performed with the enhanced version of the method of Saltelli.*

| | A | D | DK | E | FIN | L | S | UK |
|---|---|---|---|---|---|---|---|---|
| Weights | 0.97 | 0.56 | 0.95 | 0.91 | 0.91 | 0.95 | 0.91 | 0.94 |
| $a_4$ | | | | | 0.03 | | | |
| $a_5$ | | 0.38 | | | | | | |
| $b_1$ | | | | | | | 0.04 | 0.03 |
| $b_2$ | | | | | | | | 0.01 |
| $b_3$ | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 | |
| $b_4$ | 0.00 | 0.01 | 0.03 | 0.05 | 0.02 | 0.01 | 0.01 | |
| $b_5$ | | | | | | | | 0.00 |
| $b_6$ | | | 0.00 | | | | | 0.00 |

| | A | D | DK | E | FIN | L | S | UK |
|---|---|---|---|---|---|---|---|---|
| Weights | 0.98 | 0.61 | 0.97 | 0.93 | 0.93 | 0.97 | 0.94 | 0.96 |
| $a_4$ | | | | | 0.04 | | | |
| $a_5$ | | 0.42 | | | | | | |
| $b_1$ | | | | | | | 0.06 | 0.04 |
| $b_2$ | | | | | | | | 0.01 |
| $b_3$ | 0.02 | 0.01 | 0.06 | 0.02 | 0.02 | 0.04 | 0.01 | |
| $b_4$ | 0.00 | 0.01 | 0.08 | 0.07 | 0.03 | 0.02 | 0.02 | |
| $b_5$ | | | | | | | | 0.01 |
| $b_6$ | | | 0.05 | | | | | 0.00 |

Table 5 shows that for all countries a large fraction of the composite indicator variability is due to the set of weights used. The uncertainty brought by weights is an implicit part of the participatory approach used to build the composite indicator. In other terms a "true value" for weights cannot exist because of different objectives, viewpoints and interests at stake; uncertainty in the composite indicator due to weights cannot be eliminated and has a visible impact on the results.

The uncertainty due to the imputation of missing data does not account for more than 5% of the e-business readiness variance for all countries but Germany. For Germany indicator $a_4$ accounts for 38% of the composite indicator variance. This means that, being able to find the real value of $a_4$, would reduce (on average) the variance of the composite indicator of 38%.

The total indices look very similar to those of the first order. This highlights the additive structure of the model. Some indicators (e.g., $b_3$ and $b_4$ for Germany; $b_2$, $b_5$ and $b_6$ for UK) have total effect index lower than, or equal to, 0.01. This means that it is worthless to spend resources collecting data for those indicators and those countries, because this would not help improving the accuracy of the composite indicator.

## 8. CONCLUSIONS

Media and policy-makers look with increasing interest at composite indicators as appealing tools to attract the attention of the community and to help focusing policy debates. But methodological gaps in their design and construction may invite politicians to draw simplistic conclusions or the press to communicate misleading information. That is why national and international organisations believe that it is important to focus on methodological issues in the design of composite indicators [3].

This study focuses on the design stage of composite indicators, where rarely robustness and sensitivity analysis are applied. Yet, quite recently, the European Commission has recognised the role of such investigation and requires the use of sensitivity analysis in the development of any new composite indicator. The Joint Research Centre supports various Directorates General of the European Commission in a number of projects that involve the development and use of composite indicators. The case of e-business readiness presented in this paper is the latest exercise carried out so far.

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