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# Selected composite indicators in the field of advanced technologies and the Internet as a support of SMART cities and their impact on tourism

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**Abstract.** The article discusses the possible relationships between the outbound tourism of the European Union countries and selected composite indicators from the social, economic and environmental areas. Three indicators have been selected, analyzed and evaluated. The choice of the indicators was based on their relation to the use of advanced technologies and the Internet and to their close interconnectedness with SMART cities. Namely following Indices were analyzed: the Social Progress Index, part of the Wellbeing of Nations Index – the Human Wellbeing Index and the Index of Quality of Life and Sustainable Development. The first part of the paper explains the different concepts of tourism, sustainable development, indices and statistics. Then three examined indicators are described. The core part is devoted to the research on the relationships between relative outbound tourism of individual European Union countries and the three indicators. The analysis is performed using the Pearson correlation coefficient. The highest correlation between outbound tourism and three analyzed indices was reached in the Social Progress Index which was closely followed by the Index of Quality of life and Sustainable Development. In both cases we speak about strong dependence.

**Keywords:** Advanced technologies, Composite indicator, Internet, Smart cities, Sustainable development.

## 1 Introduction

The article discusses the possible relationships between the outbound tourism of the European Union countries and selected composite indicators from the social, economic and environmental areas. Three indicators have been selected, analyzed and evaluated. The choice of the indicators was based on their relation to the use of advanced technologies and the Internet and to their close interconnectedness with SMART cities.

The structure of the paper follows: the methodological frame, description of the analyzed indices: the Social Progress Index, part of the Wellbeing of Nations Index – the

Human Wellbeing Index and the Index of Quality of Life and Sustainable Development, the core part - correlation of the outbound tourism and the composite indicators and conclusion.

### 1.1 Composite indicator

The definitions of the composite indicator were drawn from globally accepted Organisation for economic cooperation and development (OECD) documents and from the Czech author whose categorisation of composite indicators is presented, as well as, an entry into the issue. Definition given by OECD follows: "A composite indicator is formed when Indicators are compiled into a single index, on the basis of an underlying model of the multi-dimensional concept that is being measured (e.g. competitiveness, e-trade or environmental quality)". [1]

According to Hák [2] composite indicators group more variables or different variables into one index. The goal of compiling variables with the same properties into a single figure is to describe their aggregate properties. Composite indicators can be constructed by different methodologies and include different components. Changes in the index construction often cause confusion, as indices can give different information as compared to one another or when referring to long-term trends." Hák [2] states that composite indicators are further divided into aggregated, compounded and indices.

- Aggregated indicator

Aggregated indicators compile together several components or indices which are in the same units. They are created, for example, by summing or averaging the results of individual components. GDP is a typical example of this kind of indicator.

- Compounded indicator

Compounded indicators combine various aspects of an individual phenomenon into one numeral expression. The result is usually a number with a common unit. The author illustrates this kind of indicator on the following examples: global hectares in ecological trail or amount of years in life expectancy. [2]

- Index

Indices are composite indicators which are at the top of the information pyramid. The index is a dimensionless number for which the data are often transformed before counting, for example, in the form of a deviation from the average. As an example might be give the human development index, the environmental performance index or the air quality index. [2]

### 1.2 SMART cities and advanced technologies

According to Duran [22] a city is smart when the social investment, human resources, communications and the building infrastructure, coexist harmoniously and get systematically developed through the use of Information and Communication Technologies

(ICT). All that generates better quality of life and natural resources; efficient management is conducted through the citizens' participation.

As already highlighted above, utilization of the Internet and latest technologies play the crucial role in the development of SMART cities. Based on this matter of fact, researchers have focused, analyzed and explained a set of selected composite indicators which contain utilization of advanced technologies and communication channels, like Access to basic knowledge, Access to information and communication, Technology and information sharing, communication - accessibility and reliability of the telephone connection, Internet access.

## **2 Methodology and the objective of the paper**

A set of composite indicators which comprise a component on utilization of advanced technologies and the Internet, which represent one of fundamental basis for smart cities, was selected.

The objective of this paper was to find out which of selected composite indicators relate to tourism.

### **2.1 Structure of the research**

Firstly, selected indices are introduced. Secondly, the degree of correlation between the indicators and the relative outbound tourism is examined. Finally, the findings are presented and explained.

#### **Statistical data processing**

Statistical correlation was used for statistical data processing.

Skalská [3] argues that correlation analysis deals with the measurement of relations between variables. Correlation analysis is used to quantify the association between two continuous variables i.e. between an independent and a dependent variable or between two independent variables. [4]. But Skalská [3] explains that the correlation is the degree of linear association between variables, when none of the variables needs to be labeled as dependent or independent.

Crossman [5] explains the Correlation as a term that refers to the strength of a relationship between two variables. A strong, or high, correlation means that two or more variables have a strong relationship with each other, while a weak or low correlation means that the variables are hardly related. Correlation analysis is the process of studying the strength of that relationship with available statistical data.

According to Litschmann [6] the tightness of linear dependence is assessed by a correlation coefficient. "The assessed relationship is the stronger and the regression function is the better, the more the monitored values of the variable are concentrated around the estimated regression function, and contrary the weaker, the more the values  $y_i$  are distant from balanced values."

### **Pearson correlation coefficient**

The correlation coefficient is a measure of the linear dependence and is denoted. It can be explained as a share of covariance and the square root of the product of the scattering of variables, where the covariance expresses the relationship X and Y, and the population scattering describes how much the data are scattered around the population average. [3], [7].

Formula for calculating the correlation coefficient:

$\rho(X, Y) = (C(X, Y)) / \sqrt{(D(X)D(Y))}$ , where  $D(x)$ ,  $D(Y)$  denote population scattering.

According to Skalská [13], the range of values is approximately

$0,1 < |\rho| \leq 0,3$  indicates a weak dependence,

$0,3 < |\rho| \leq 0,6$  mean medium dependence,

$0,6 < |\rho| \leq 0,8$  we speak of strong dependence

$0,8 < |\rho| \leq 0,9$  suggests a very strong dependence

$|\rho| \geq 0,9$  almost linear dependence direct or indirect, according to the sign of the correlation coefficient. "

Skalská [3] warns that the general problem of observation and measurement can be the assumption of an association between two variables if the changes of both variables prove a certain connection. Skalská [3] points out that "the observed association (link) may be true, or it may be mediated by another variable (s) that is hidden". The author also states that a variable that is hidden or not included in the observation can affect the observed variables, which then appear to be related. For the interpretation of associations, it is necessary to know the context and the events that may influence the data compared.

## **3 Description of composite indicators**

14 composite indicators of sustainable development and one indicator of economic performance were selected for the research. Dependency between these indicators and relative outbound tourism for the year 2014 was examined. The results of the correlation of each indicator as well as the results of the ranking of countries within the individual indicators were analyzed in detail and described in the following subchapters.

Only three indicators were used in the comparison because only these three contain utilization of technologies, the Internet and other Smart cities support.

Online banking or online shopping might be presented as areas, apart from plenty of others, where the Internet and advanced technologies can be used to efficiently support SMART.

### **3.1 The Social Progress Index**

As stated by Wikipedia [8], the Social Progress Index (SPI) evaluates how much each country satisfies the social and environmental needs of its citizens. According to Bishop [9], the authors were encouraged to create an index that would interpret social progress differently than all the existing indicators. As noted on the Social Progress Imperative [10], the authors believe that combining economic and social factors can not properly

explain the relationship between economic and social progress. Therefore, it was desirable to develop an indicator that would put emphasis on the social and environmental spheres. Thus, the Social Progress Index does not include any economic measurement. By measuring social progress independently of economic development, it differs from all other indicators.

As stated in the Social Progress Index 2: "SPI focuses exclusively on indicators of social impacts and outcomes from results, instead of input measurements, of the country's efforts. It focuses on the level of social progress that countries have already achieved. For example, how much money countries spend on health care is far less important than the level of health actually achieved by the state." [11]

The Web further states [11], that the Social Progress Index is an aggregate index comprised of social and environmental indicators that capture the three dimensions of social progress. Individual dimensions consist of four indicators. Overall, the index is composed of 56 indicators.

This Index was selected because it contains Foundations of Wellbeing section with the subsection Access to Information and Communications. Within this section mobile telephone subscriptions, internet users and press freedom index were assessed.

**Table 1.** Construction of the Social Progress Index. Source: Social Progress Index [10]

| Basic Human Needs                        | Basics of well-being                           | Opportunities                          |
|--|--|--|
| Nutrition and basic medical care         | <i>Access to basic knowledge</i>               | Personal rights                        |
| Water cleanliness and hygiene facilities | <i>Access to information and communication</i> | Access to higher education             |
| The roof overhead                        | Overall health                                 | Personal freedom and freedom of choice |
| Personal security                        | Sustainability of the ecosystem                | Justice and inclusion                  |

The Social Progress Imperative [12] explains that the resulting SPI is calculated by the average of the values of each dimension.

As stated in the Social Progress Imperative [13], the social progress index was first published in 2014 and rated 133 countries. Since then, the index has been updated and published annually. The Social Progress Imperative [12] explains that the annual results of the surveyed countries are ranked according to the social progress from highest to lowest and further categorized into six categories: very high social progress, high social progress, moderate, medium, low and very low social progress.

### 3.2 Wellbeing of Nations Index

The Wellbeing of Nations (WN) was created by the International Union for Conservation of Nature (IUCN). As IUCN [14] states that this is the first global sustainability rating. The index compares a total of 180 countries. WN consists of four indicators that together provide a comprehensive picture of sustainable development. The IUCN [14] claims, that WN's main goal is to promote a high level of human and ecosystem well-

being. It is striving to show the practicality and potential of this method of assessing well-being and, last but not least, aims to persuade states, communities and associations to run evaluation of their well-being.

Nováček [15] explains that the rating scale ranges from 0 to 100 where the value of 100 means the maximum sustainability of a given country."

### Wellbeing Index

According to the International Union for Conservation of Nature [14], Wellbeing Index (WI) consists of two parts:

- the Human Wellbeing Index (HWI) and
- the Index of Ecosystem Wellbeing (EWI).

The same weight is attributed to both components. Wellbeing Index shows the point at which the HWI and EWI values intersect. This point is depicted on the so-called sustainability barometer.

#### *Human Wellbeing Index*

The International Union for Conservation of Nature [14] argues that Human Wellbeing Index is a much more accurate indicator of socio-economic conditions than gross Domestic Product (GDP) or HDI (Human Development Index), as GDP is focused on monetary indicators only, and HDI does not include as many aspects of human well-being as Human Wellbeing Index (HWI).

**Table 2.** Construction of the Human Wellbeing Index. Source: [14]

| Health and population                        | Wealth   | Knowledge and culture   | Community  | Equality  |
|--|--|---|--|---|
| Life expectancy in good health (1 indicator) | The degree of satisfaction of needs relating to income, food, safe water and sanitary equipment (6 indicators) | Education (basic, secondary, higher education) and <i>communication - accessibility and reliability of the telephone connection, Internet access</i> (6 indicators) | Freedom and good governance - political rights, civil liberties, freedom of the press, corruption (4 indicators)                 | Equality of households - difference in income among the richest and poorest fifth of the population (1 indicator) |
| Family size stability (1 indicator)          | Size and status of national economy, inflation, unemployment, debt ratio (8 indicators)                        |   | Peace coexistence - army spending, deaths due to military conflicts and terrorism (2 indicators)<br>Violent crime (4 indicators) | Gender Equality - Gender in Income, Education and Representation in Legislative Bodies (3 indicators)             |

Human Wellbeing index consists of five thematic areas; gained results are consequently averaged in the overall HWI rating. Altogether it contains 36 indicators which are compared. Three indicators out of them are of key importance to us; they are found in the section Knowledge culture, to be precise they are placed in the sub-section Communication – accessibility and reliability of the telephone connections and internet access.

Ecosystem Wellbeing Index will not be discussed in this paper. It doesn't contain analysed topics. [14]

### 3.3 Index of Quality of Life and Sustainable Development

The most successful attempt to compare quality of life and sustainable development from the home environment seems to be the Index of Quality of Life and Sustainable Development, the so-called SD Index. As reported by Viturka [16] and Nováček [15], the Sustainable Development Index was developed by Nováček, Mederly and Topercer in 1999 -2004 for a total of 179 countries and is an alternative to the HDI indicator.

The goal of the index is to express the state's progress towards sustainable development, based on generally available data, so that the results can be regularly evaluated Nováček [15]. According to the author, the results make it possible to compare countries in the seven areas of sustainable development. Each area consists of two sub-areas that contain a total of 64 examined indicators. This indicator was selected because it contains technology and information segment.

**Table 3.** Construction of the Quality of Life Index and Sustainable Development. Source: [15]

|                                  |   |                               |  |                                       |  |  |
|----------------------------------|---|-------------------------------|--|---------------------------------------|--|--|
| Human rights, free-dom. Equality | Demo-graphic indicators and life expectancy | Health status and health care | Education, <i>technology and information</i> | Economic Development and Foreign Debt | Consumption of resources and ecological efficiency | Quality of the environment                           |
| Politics and human rights        | Demo-graphic indicators                     | Health care                   | Education                                    | Economy                               | Economy - net domestic savings                     | Environment - natural resources, land use            |
| Equality                         | Life expectancy, mortality                  | Dis-eases and Nutrition       | <i>Technology and information sharing</i>    | Indebtedness                          | Economy - Consumption of resources                 | Environment - problems of cities and rural landscape |

The calculation of the overall index is based on averaged results of individual areas. As the author states, sub-indices for individual areas are to be transformed into one scale in the range from zero to one, with zero being equal to the least favorable value and one equals the most favorable, and then the values are to be averaged Nováček [15].

Nováček [15] appreciates that the advantage of this method of calculation is in its simplicity and comprehensibility for the wider public; it enables the public to apprehend the results. On the other hand, significant simplification of reality can lead to misleading results.

## 4 Correlation of composite indicators

### 4.1 Correlation of relative outbound tourism and the Social Progress Index

The data for the Social Progress Index were obtained from the Social Progress Imperative site and are related to 2014. The Web unfortunately does not provide data for the states Cyprus, Luxembourg and Malta. Thus, the correlation of the EU states was done without their influence. Data for the relative outbound tourism were drawn from Eurostat and then they were processed by authors.

**Table 4.** Correlation of relative outbound tourism with the Social Progress Index. Source: [17]

| Country        | Relative out-<br>bund tourism | SPI    | Country     | Relative out-<br>bund tourism | SPI   |
|----------------|-------------------------------|--------|-------------|-------------------------------|-------|
| Austria        | 2,64141646                    | 85,11  | Ireland     | 2,586063379                   | 84,05 |
| Belgium        | 1,16309194                    | 82,63  | Italy       | 0,904744585                   | 73,93 |
| Bulgaria       | 0,520833751                   | 70,24  | Latvia      | 2,308240545                   | 73,91 |
| Croatia        | 1,924605662                   | 73,31  | Lithuania   | 1,505686265                   | 73,76 |
| Cyprus         | 2,907724432                   |        | Luxembourg  | 3,357062686                   |       |
| Czech Republic | 3,109905016                   | 80,41  | Malta       | 1,199364198                   |       |
| Denmark        | 5,63962351                    | 86,55  | Netherlands | 2,512258005                   | 87,37 |
| Estonia        | 3,038291812                   | 81,28  | Poland      | 1,279130596                   | 77,44 |
| Finland        | 6,898412248                   | 86,91  | Portugal    | 1,405518987                   | 80,49 |
| France         | 3,433958429                   | 81,11  | Romania     | 0,87621287                    | 67,72 |
| Germany        | 2,933234972                   | 84,61  | Slovakia    | 1,30416196                    | 78,93 |
| Great Britain  | 2,477244213                   | 84,56  | Slovenia    | 2,198127086                   | 81,65 |
| Greece         | 0,57971176                    | 73,43  | Spain       | 2,75053499                    | 80,77 |
| Hungary        | 1,753224974                   | 73,87  | Sweden      | 4,039785131                   | 87,08 |
| Correlation    |                               | 0,6885 |             |                               |       |

As can be seen from the correlation result, the coefficient denotes direct linear dependence and reached the value of 0.69. According to theoretical rules, this shows a strong dependence. In addition, the SPI indicator achieved the second highest correlation rate of all composite indicators examined.

- Thus, it can be interpreted that with the increasing Social progress Index of individual EU countries, the number of people traveling abroad also increases.
- Based on the composition of the index, it is also possible to state that the number of trips is related to the quality of basic human needs, well-being and the opportunities of the population.

Table 19 shows that the top level of the Social Progress Index in the EU countries was reached by the Northern countries in the order of Sweden, Finland and Denmark. Of the remaining countries, Austria was best placed. The last places were occupied by Romania and Bulgaria. Before them there were Croatia, Greece, Lithuania, Hungary and Latvia ranked within one point.

#### 4.2 Correlation of relative outbound tourism and the Wellbeing Index

Data for Wellbeing Index for all EU countries were drawn from The Wellbeing of Nations book. [18] The data are from 1996-1999. Newer data could not be retrieved. The data for the relative outbound tourism refer to 2014. The data were processed by authors who used the data on the Eurostat website. [19]

**Table 5.** Correlation of the relative outbound tourism with the Wellbeing Index. Source: Own processing based on data drawn from PRESCOTT-ALLEN [20]

|                | Relative out-<br>bund tour-<br>ism |        |        | Relative out-<br>bund tour-<br>ism |             |      |    |
|----------------|------------------------------------|--------|--------|------------------------------------|-------------|------|----|
|                | WI                                 | HWI    |        | WI                                 | HWI         |      |    |
| Austria        | 2,64141646                         | 61     | 80     | Ireland                            | 2,586063379 | 54   | 76 |
| Belgium        | 1,16309194                         | 51,5   | 80     | Italy                              | 0,904744585 | 52   | 74 |
| Bulgaria       | 0,520833751                        | 44,5   | 58     | Latvia                             | 2,308240545 | 54   | 62 |
| Croatia        | 1,924605662                        | 45     | 57     | Lithuania                          | 1,505686265 | 52,5 | 61 |
| Cyprus         | 2,907724432                        | 52,5   | 67     | Luxembourg                         | 3,357062686 | 50,5 | 77 |
| Czech Republic | 3,109905016                        | 51,5   | 70     | Malta                              | 1,199364198 | 42   | 70 |
| Denmark        | 5,63962351                         | 56     | 81     | Netherlands                        | 2,512258005 | 50   | 78 |
| Estonia        | 3,038291812                        | 48     | 62     | Poland                             | 1,279130596 | 47,5 | 65 |
| Finland        | 6,898412248                        | 62,4   | 81     | Portugal                           | 1,405518987 | 51,5 | 72 |
| France         | 3,433958429                        | 42     | 75     | Romania                            | 0,87621287  | 40   | 50 |
| Germany        | 2,933234972                        | 56,5   | 77     | Slovakia                           | 1,30416196  | 50,5 | 61 |
| Great Britain  | 2,477244213                        | 51,5   | 73     | Slovenia                           | 2,198127086 | 53   | 71 |
| Greece         | 0,57971176                         | 51,5   | 70     | Spain                              | 2,75053499  | 46,5 | 73 |
| Hungary        | 1,753224974                        | 49     | 66     | Sweden                             | 4,039785131 | 64   | 79 |
| Correlation    |                                    | 0,5591 | 0,5602 |                                    |             |      |    |

The final value of the correlation coefficient is 0.56. According to the theory, it shows the direct linear moderate dependence.

- It can be interpreted that the growing number of Wellbeing in individual EU countries corresponds to growing number of people traveling abroad.
- On the other hand, the resulting value of the correlation rate belongs to the lowest ones among the all 14 analyzed indicators.

As for the results, Sweden reached the very top; it was followed by Finland, Austria occupied the third highest position. The worst Wellbeing Index among the EU countries had Romania, but Malta with France with the same score got only one place better.

### 4.3 Correlation of relative outbound tourism with the Index of quality of life and sustainable development

Data for the Sustainable Development index for all EU countries were obtained from the Quality of Life and Sustainable Development Indicators. Data are from 1998-2001. Since then, the SD index has not been re-evaluated. The relative outbound tourism data related to 2014 were processed by the authors and were based on data from Eurostat. [19]

**Table 6.** Correlation of relative outbound tourism with the Sustainable Development index. Source: Custom processing based on data from [15]

| Country        | Relative out-<br>bund tour-<br>ism | SD Index | Country     | Relative out-<br>bund tour-<br>ism | SD Index |
|----------------|------------------------------------|----------|-------------|------------------------------------|----------|
| Austria        | 2,64141646                         | 0,847    | Ireland     | 2,586063379                        | 0,855    |
| Belgium        | 1,16309194                         | 0,826    | Italy       | 0,904744585                        | 0,803    |
| Bulgaria       | 0,520833751                        | 0,663    | Latvia      | 2,308240545                        | 0,758    |
| Croatia        | 1,924605662                        | 0,714    | Lithuania   | 1,505686265                        | 0,74     |
| Cyprus         | 2,907724432                        | 0,79     | Luxembourg  | 3,357062686                        | 0,873    |
| Czech Republic | 3,109905016                        | 0,763    | Malta       | 1,199364198                        | 0,793    |
| Denmark        | 5,63962351                         | 0,858    | Netherlands | 2,512258005                        | 0,848    |
| Estonia        | 3,038291812                        | 0,782    | Poland      | 1,279130596                        | 0,725    |
| Finland        | 6,898412248                        | 0,882    | Portugal    | 1,405518987                        | 0,781    |
| France         | 3,433958429                        | 0,832    | Romania     | 0,87621287                         | 0,678    |
| Germany        | 2,933234972                        | 0,843    | Slovakia    | 1,30416196                         | 0,783    |
| Great Britain  | 2,477244213                        | 0,817    | Slovenia    | 2,198127086                        | 0,824    |
| Greece         | 0,57971176                         | 0,755    | Spain       | 2,75053499                         | 0,821    |
| Hungary        | 1,753224974                        | 0,773    | Sweden      | 4,039785131                        | 0,885    |
| Correlation    |                                    | 0,67787  |             |                                    |          |

The final value of the correlation coefficient value is 0.68. According to the theory, it shows direct strong linear dependence. In addition, the final correlation value is one of the highest among the indicators presented.

- It can be interpreted that with the rising Sustainable Development Index of individual EU countries the number of people traveling abroad also increases.
- Based on the SD index track, it can be deduced that the outbound tourism of the given country will increase with the increasing quality of its environment, with greater eco-efficiency, economic development, better healthcare and health state of

its population, with access to education, technology and information, with a longer life expectancy and with freedom and equality of the population.

The results of the index came first in Sweden, followed by Finland and Luxembourg was the third highest. The worst Sustainable development index among the EU states gained Bulgaria, before Bulgaria only one place better was Romania trying to overtake Croatia and Poland. [21]

## **5 Discussion, limitations and future research**

The outputs, here presented findings are limited by the composition of each composite indicator. Each of the three selected composite indicators encompasses in itself a kind of advanced technology. Given that the indicators are complex, technologies and their use play only a partial role in them. The key phenomenon in the issue of SMART cities is and will be the Internet. Another area that might be of interest for the future research is, for example, the idea to link the research with the use of online banking, online purchase or some other activity connected to the use of Internet or IT. Gained data could be processed via other statistical methods. As for the future, it would be certainly interesting to correlate data of the outbound tourism which are not counted on the population with the composite indicators of sustainable development and compare the results with the correlation of the outbound tourism and GDP. In the further research, it would be appropriate to work with the data of all EU countries.

## **6 Conclusion**

Predominately northern countries like Denmark, Finland and Sweden achieved the best results in individual Sustainable Development Indicators. This reflects their complex maturity, high quality of life and good sustainable development. Romania and Bulgaria mostly gained the worst ranking; these countries should aim at improvement of their economic, social and environmental situation.

The analysis was performed using the Pearson correlation coefficient. The highest correlation between outbound tourism and three analyzed indices was reached by the Social Progress Index, closely followed by the Index of Quality of Life and Sustainable Development. In both cases it is possible to speak about strong dependence. The Human Wellbeing Index as the last analyzed index reached medium dependence but if it reached just a few tenths more we could also speak about strong dependence.

The ideal situation would be if the data were available for the current year or the previous year. However, such an ideal situation is likely to remain only a pious desire.

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