

Original article

## Analysis of the differentiated Internet use in the activity of the EU enterprises in 2014

Agnieszka Skowronek-Gradziel 

Faculty of Management,

General Tadeusz Kosciuszko Military University of Land Forces, Wrocław, Poland,

e-mail: Agnieszka.Skowronek-Gradziel@awl.edu.pl

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### ABSTRACT

The article aims at identification of dependencies occurring in relation to the Internet use in the activities of enterprises in the European Union countries in 2014.

The research hypothesis assumed that the spatial diversity exists in the European Union in the area under study.

The article presents the results of research conducted on the basis of data from the European Statistical Office regarding the use of the Internet in the activities of enterprises in 2014. The study covered 28 countries in the European Union. On account of the nature of research, the methods of Multidimensional Comparative Analysis were employed.

The acquired knowledge has a cognitive dimension and can be applied in practice to set tasks for leveling out the development differences with regard to the European regional policy in the subsequent financial perspectives.

### KEYWORDS

level of corporate communication, the European Union countries with similar patterns of using the Internet, classification of the European Union countries in relation to the Internet use by enterprises



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## Introduction

The study covered countries of the European Union (EU), which are characterized by different levels of economic, social and territorial growth. In order to eliminate the developmental differences existing in the European Union, the cohesion policy has been implemented almost from the beginning of the EU<sup>1</sup>. Against this background, it seemed interesting to determine whether there are also differences between the EU countries in the use of the Internet in the activities of enterprises, and if so, which

<sup>1</sup> The cohesion policy was first mentioned in the Treaty of Rome, 1957.

countries in the area are similar. The specified research problems became the basis for formulating the objective of the article as well as the hypothesis verified during the work. The research hypothesis assumes that there are differences between the EU countries in relation to the Internet use in business operations. As a result, the cognitive purpose has become the main objective of the work. The aim was to detect dependencies existing in the analyzed area of investigation.

When deciding on the European regional policy concerning the use of the Internet in the activities of enterprises, a comprehensive look at the issue of spatial development of the EU is necessary. For this reason, the methods of Multidimensional Comparative Analysis (WAP) were applied for the implementation of the task. Through to the WAP methods, it is possible to rank the examined objects in the order from the most to the least developed in the studied area or classify them into groups of similar objects due to the studied features. Based on the results of the conducted analyzes, one can conclude about the development of objects.

The Pattern Development Method (MWR) was applied for ranking countries. For comparison, an analogous study was performed using the Standardized Sum Method (MSS). The degree of convergence of results obtained from both methods was checked by estimating the value of the Spearman's rank correlation coefficient.

The Ward Method (MW) belonging to the Hierarchical Agglomerative Procedures (HPA) was used and the development measures received from the MWR were adopted to divide the countries into groups of similar objects. The results of the two groupings were verified using the similarity indicators postulated in the literature on the subject [E.g.: 1].

The classification of countries was also carried out by comparing the obtained measurements for development in relation to GDP *per capita* expressed in the purchasing power parity in EUR.

All analyzes were conducted based on the data from the European Statistical Office – Eurostat (ESO). During the calculations, *Excel* and *Statistica* computer packages were used.

## **1. Selection of diagnostic characteristics**

The research on the use of the Internet in the activities of enterprises covered a group of twenty-eight EU countries.

The year 2014 was selected for the research as the first year of implementation of the existing EU development strategy and, at the same time, the most up-to-date year in terms of available data.

When selecting variables for the study, it was attempted to implement the substantive and formal criteria postulated in the literature [2-8].

The use of specialized information from ESO was considered as a guarantee of correctness on the level of content. Admittedly, the data published by ESO do not

provide information on the structural differences between the objects under examination, however, they are comparable, because they are expressed in the form of indicators. The indicators were defined as a fraction of enterprises implementing specific assumptions among all enterprises in the analyzed country. From the group of variables initially selected for the study, characteristics that met the statistical requirements – were stimulants and were characterized by appropriately high variability – were qualified for further analysis. Thanks to the compliance with the postulated assumptions, the variables were suitable for the discrimination of the examined objects. The set of examined diagnostic characteristics is presented in Table 1. For the needs of the work, the characteristics selected for the analysis were considered as one diagnostic area. The area was called the corporate communication.

**Table 1.** Diagnostic variables selected for the analysis

Symbol of variable	Name of variable
$X_1$	Broadband access indicator [in %]
$X_2$	E-sale rate via the website, mobile applications or EDI messages [in %]
$X_3$	E-shopping indicator via website, mobile applications, EDI type messages [in %]
$X_4$	The rate of using services in the calculation cloud [in %]
$X_5$	Employment rate of ICT specialists [in %]

*Source: Own elaboration.*

## 2. Research method

The work began with assessing the suitability of the variables for testing. To this end, the means and standard deviations were determined, on the basis of which the coefficients of variation were estimated. Considering the number of potential variables, a critical value of the variance coefficient of the discriminating characteristic at the level of 5% was adopted<sup>2</sup>.

The key research was conducted using two groups of the WAP methods<sup>3</sup> [E.g.: 2-6; 8-10]:

- MPL
- and HPA.

The MPL methods are used to determine the order of objects consistent with the increase or decrease in the level of a complex phenomenon. During the research, the MWR and MSS were used.

<sup>2</sup> The minimum value of the coefficient of variation allowed in the case of a small number of characteristics describing the studied phenomenon.

<sup>3</sup> The applied methods are widely described in the literature on the subject, therefore the article does not include detailed characteristics of methods.

The MWR is based on determining the measurement of development on the basis of which the examined objects will be ranked in order in accordance with the increase of the level of the complex phenomenon.

In addition to the MWR, the ordering of the surveyed countries was executed with the help of the MSS. In order to check the correctness of the obtained results, the Spearman's rank correlation coefficient was determined.

The HPA is used to determine the similarity of the examined objects, without stating the ordering. The MW was the HPA employed during the study.

In the MW, the coefficient of the maximum quotient of agglomeration distances was used to divide the countries into typological groups [11]. The first highest value of the specified measurement was read after the twenty-seventh iterations, which allowed for distinguishing only two categories of countries, within which there could be highly diversified objects. In order to increase the number of categories, the delimitation was performed based on the second largest value of the coefficient. As a result, three homogeneous – in relation to the patterns of using the Internet – groups of countries were distinguished.

The results of ordering with the help of the MWR were used to verify whether fulfilling the task with the help of a different procedure will result in obtaining groups with a similar composition of countries. The number of previously identified categories were adopted for the division. As a result, the following three groups of objects were obtained:

- countries with the highest levels of development measurements – in the range from 0.50 to 0.87 – were qualified to Group I,
- Group II includes countries in cases of which average values of indicators were reported – in the range from 0.31 to 0.47,
- in Group III, the level of the estimated development measurements was defined as the lowest: from 0.09 to 0.25.

Owing to the adoption of the same number of categories in the methods used, it was possible to compare the results obtained. The similarity of the grouping of objects was determined by estimating the value of the indicator proposed by M. Salamaga [7], assuming that all variables have the same influence on the level of the studied phenomenon.

When analyzing the problem of the diversity of EU countries with regard to the use of the Internet in the activities of enterprises, it seemed interesting to examine the level of communication in the context of economic development. For this purpose, the development measures obtained were compiled in relation to GDP *per capita* expressed in the purchasing power parity in EUR in individual countries.

Based on the division obtained so far and if the value of GDP *per capita* expressed in the purchasing power parity in EUR, below 100% it is lower than the average in the European Union, and in the case of 100% and more, it is higher than the average, a matrix was created based on which countries were classified into six groups:

Two groups in which the level of development measurements ranged from 0.50 to 0.87: the first one with GDP *per capita* expressed in purchasing power parity in EUR higher than the European average, and the second one with GDP *per capita* lower than the European average.

Two groups, with the development scale at the level of 0.31-0.47 and GDP *per capita* expressed in the purchasing power parity in the EUR higher (Group III) or lower than the European average (Group IV).

Two groups (V and VI), in which the values of development measurements were estimated at the level of 0.09 to 0.25, and the GDP ratios were, respectively, below 100% of GDP *per capita* in purchasing power parity in EUR in Group V over 100% of GDP *per capita* in purchasing power parity in EUR and in Group VI.

### **3. Results**

#### **3.1. Ordering countries with the use of the MPL**

The study of the EU countries with regard to the use of the Internet in the activities of enterprises commenced with organizing countries in the order from the most to the least developed. For this purpose, the MWR was employed, and for comparison purposes a similar study was conducted using the MSS. The obtained results are presented in Table 2.

Regardless of the applied research method, the highest position, and therefore the highest level of corporate communication, was recorded in the case of Denmark, while Romania was rated the lowest. In both summaries, the next ranking places after Denmark were awarded to Finland, Ireland and Sweden. Rumania, Poland and Greece were ranked before Romania. Irrespective of the ordering method used, fifteen countries similar positions were reported. Slight differences in the ranking were noticed in the case of thirteen countries. The Spearman's rank correlation coefficient was determined to compare the results obtained by means of the applied methods. The value of the measurement was estimated at the level of 0.987, which was interpreted as a high convergence of both rankings.

#### **3.2. Classification of countries using the HPA**

The classification of countries was conducted using the HPA, according to the grouping scheme by J.H. Ward. By dividing objects on grounds of the second largest value of the ratio of the agglomeration distance coefficient, three groups of countries with different patterns of the Internet use were obtained (Fig. 1).

Twelve countries were classified into Group I: Italy, the Netherlands, Finland, Sweden, Denmark, Germany, the Czech Republic, Great Britain, Ireland, Belgium, Luxembourg and Austria.

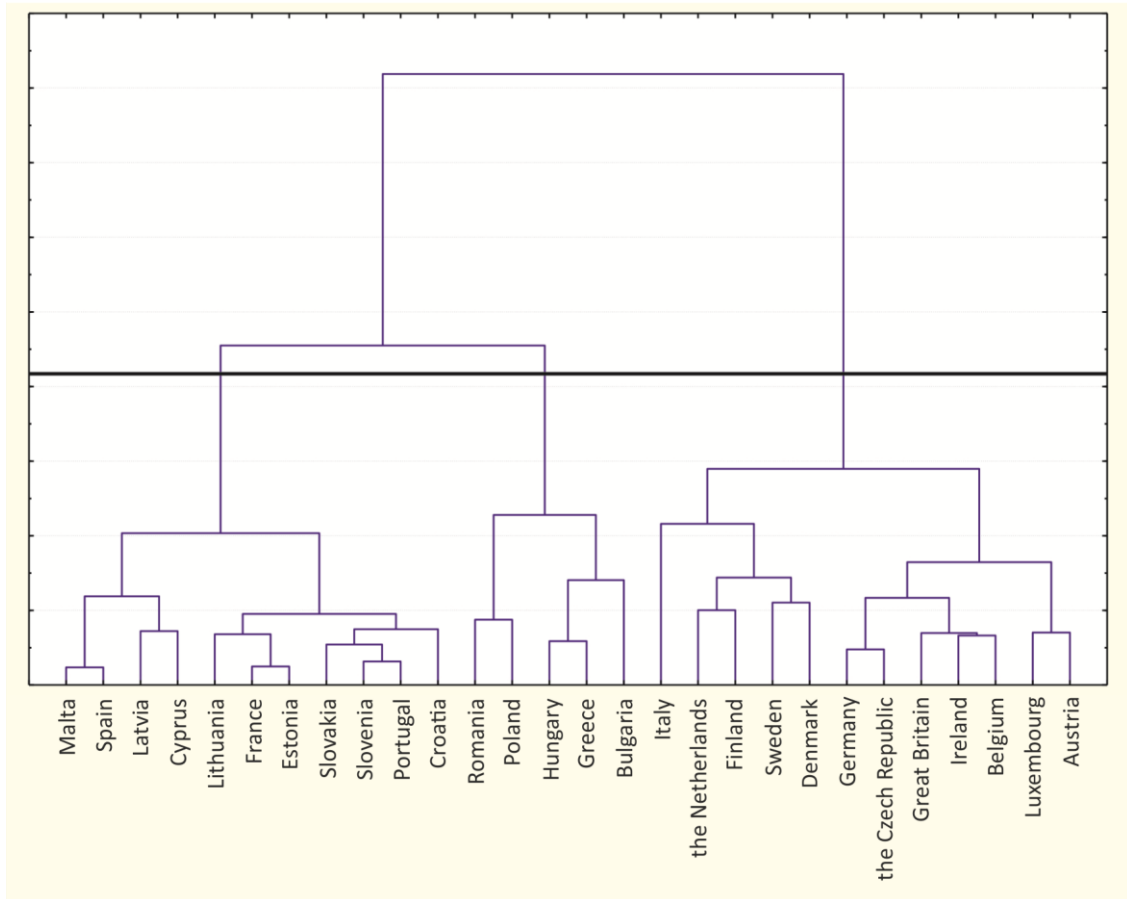
Group II comprised the eleven following countries: Malta, Spain, Latvia, Cyprus, Lithuania, France, Estonia, Slovakia, Slovenia, Portugal and Croatia.

**Table 2.** The ranking of countries in relation to the level of corporate communication based on the value of development measurements and standardized sums (data from 2014)

Country	Development measurement	Standardized sum
Denmark	1	1
Finland	2	2
Ireland	3	3
Sweden	4	4
Great Britain	5	7
the Netherlands	6	5
the Czech Republic	7	6
Belgium	8	8
Germany	9	10
Austria	10	9
Luxembourg	11	12
Spain	12	11
Croatia	13	14
Malta	14	13
Slovenia	15	16
Lithuania	16	17
Italy	17	15
Portugal	18	18
Slovakia	19	22
Estonia	20	20
Hungary	21	21
Cyprus	22	19
France	23	24
Latvia	24	23
Greece	25	25
Poland	26	26
Bulgaria	27	27
Romania	28	28

*Source: Own elaboration based on [12].*

The least number, i.e. five countries, belonged in Group III: Romania, Poland, Hungary, Greece and Bulgaria.



**Fig. 1.** The course of the agglomeration and the place of division of the European Union countries into typological groups in relation to similar patterns of using the Internet in the activities of enterprises (data from 2014)

*Source: Own elaboration based on [12].*

### 3.3. Division of countries into groups with the use of the MWR

In the next step, the utilization of the information obtained using the MWR and dividing countries into such a number of categories as resulted from the application of the MW, enabled the following groups of countries to be constituted:

Group I: Denmark, Finland, Ireland, Sweden, Great Britain, the Netherlands, the Czech Republic, Belgium, Germany, Austria, and Luxembourg.

Group II: Spain Croatia, Malta, Slovenia, Lithuania, Italy, Portugal, Slovakia, Estonia, Hungarian, Cyprus, France and Latvia.

Group III: Greece, Poland, Bulgaria and Romania.

Information on the composition of individual groups and measurements of development estimated for countries are presented in Table 3.

**Table 3.** Groups of countries by the level of corporate communication based on the value of the development measurements (data from 2014)

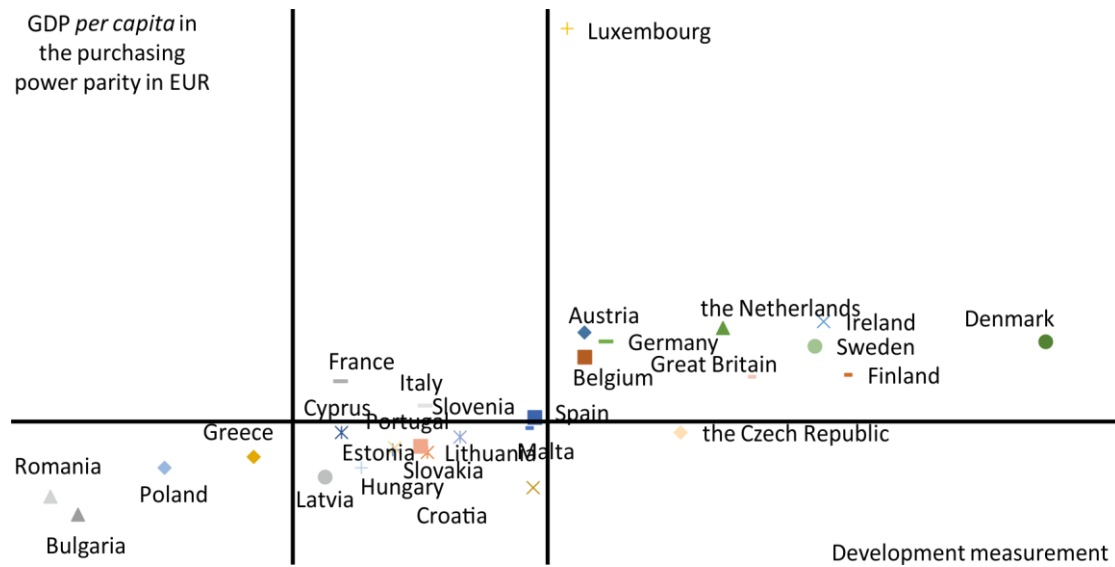
Group number	Country	Development measurement
I	Denmark	0.87
	Finland	0.71
	Ireland	0.69
	Sweden	0.69
	Great Britain	0.64
	the Netherlands	0.62
	the Czech Republic	0.58
	Belgium	0.57
	Germany	0.52
	Austria	0.51
	Luxembourg	0.50
II	Spain	0.47
	Croatia	0.47
	Malta	0.46
	Slovenia	0.41
	Lithuania	0.39
	Italy	0.38
	Portugal	0.38
	Slovakia	0.36
	Estonia	0.36
	Hungarian	0.33
	Cyprus	0.32
	France	0.32
	Latvia	0.31
	III	Greece
Poland		0.18
Bulgaria		0.11
Romania		0.09

Source: Own elaboration based on [12].

### 3.4. Division of countries by the size of their development and GDP *per capita* in purchasing power parity in EUR

To supplement the scope of the analyses carried out, the measurements obtained due to the application of the MWR were compared with the GDP *per capita* indexes expressed in the purchasing power parity in EUR. A graphic presentation of the dependencies is presented in Figure 2.





**Fig. 2.** The division of countries into groups due to the level of corporate communication based on the value of development measurements and GDP *per capita* according to the purchasing power parity in EUR (data from 2014)  
 Source: Own elaboration based on [12].

Group I comprised Austria, Belgium, Denmark, Finland, the Netherlands, Ireland, Luxembourg, Germany, Sweden and Great Britain, i.e., countries with GDP *per capita* expressed in purchasing power parity in EUR higher than the European average and the highest levels of the specified development measurements.

Group II included the Czech Republic – a country with a high level of development measurement and GDP *per capita* expressed in the purchasing power parity in EUR lower than the European average.

Group III was created separately for France, since it was characterized by the measurement of development at the level of 0.32 and higher than the European average level of GDP *per capita* expressed in the purchasing power parity in EUR.

Twelve countries were classified to Group IV: Croatia, Cyprus, Estonia, Spain, Lithuania, Latvia, Malta, Portugal, Slovakia, Slovenia, Hungary and Italy. The afore-mentioned objects were characterized by measurements of development ranging from 0.31 to 0.47 and GDP *per capita* expressed in the purchasing power parity in EUR below the European average.

The countries in which the analyzed measurements were the lowest – i.e., Bulgaria, Greece, Poland, Romania – were classified into Group V.

## Conclusion

The research hypothesis verified in the course of the work was the statement that in the EU there is spatial diversity in the area of the use of the Internet in business operations. Based on the results of the analyzes carried out, the discussed assumption has been considered true.

By ordering the countries in the order from the most to the least developed with the help of the MWR and the MSS, convergent results were obtained.<sup>4</sup> In both summaries, the countries from the north of the EU: Denmark, Finland, Ireland and Sweden were ranked at the top places. Whereas countries from the southern and eastern parts of the EU: Greece, Bulgaria, Romania and Poland were qualified at the bottom of the created rankings.

As a result of the MWR application, the maximum value of the estimated development rate – 0.87 – was recorded in the case of Denmark, and the minimum – 0.09 – in the case of Romania. The applied development measurement was normalized in the range from 0 to 1. The values close to zero are interpreted as a lower level of a complex phenomenon, while those close to one as a higher level, i.e. that a given real object is less distant from the development pattern.

Using the properties of the MWR and information obtained from the application of the method, the countries were divided into three groups using the Internet in enterprises in different ways. Similar results were obtained by classifying the countries using the HPA, according to J.H. Ward's grouping scheme.

The convergence of the composition of the groups of countries selected in both analyzes was confirmed by determining the measurement, normed in the range from 0 to 1, of the similarity of grouping objects, the value of which was estimated at 0.86.

When analyzing the values of the variables selected for the study, it was noted that in the MW classification, in the case of countries in the first and second group, the percentage of enterprises with access to the broadband Internet was high – from 93 to 100%. When it comes to the four remaining variables, in the case of the first group, the average values of characteristics for individual objects were defined as medium and high. The second group was assessed in terms of medium and low values. The level of e-purchases was considered to be clearly differentiating both groups of countries. In the first group online purchases were made in the case of 32 to 72% of the surveyed enterprises, and in the second group – from 15 to 32%. The lowest levels of the examined characteristics were recorded in the third group of countries (Bulgaria, Greece, Poland, Romania, Hungary).

Finally, based on the findings of the analyses carried out, the names obtained from both methods were given to the groups of countries:

- Group I – countries with a high level of corporate communication,
- Group II – countries with an average level of corporate communication,
- Group III – countries with a low level of corporate communication.

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<sup>4</sup> From the comparison of the results of groupings obtained using the MW and the MWR the differences for two countries – Italy and Hungary were recorded. As a result of applying the MWR to the examination, both countries were classified to the group with an average level of communication of enterprises. In the MW classification, Italy went to the first group and Hungary to the third group. In the context of the analyzed characteristics, the first group was the strongest and the third group was the weakest. However, in the case of Italy, the lowest values in the group were recorded in three of five areas. Hungary, in turn, achieved four maximum levels of variables in the group.

The high level of corporate communication was characteristic for countries from the north of the EU (Denmark, Sweden, Finland, Great Britain and Ireland). In the north and west of the EU, there were no countries in which the level of corporate communication would be defined as low.

Even more detailed information was gathered by analyzing groups of countries separated due to the communication rates of enterprises against the background of GDP *per capita* expressed in the purchasing power parity in EUR.

Countries in which the GDP ratio is identified as above the European average are ones from the north and west of the EU, where the level of communication of enterprises is high<sup>5</sup>.

In countries with GDP *per capita* expressed in purchasing power parity in EUR below the European average, the level of corporate communication was assessed as average or low<sup>6</sup>. The first case concerned countries from the south and east of the EU, the second one only the countries from the eastern border of the EU.

The results obtained during the work should prove useful during the evaluation of the results of the seven-year implementation phase of the EU strategy launched in 2014, in which the elimination of developmental differences between the EU countries at the level of information and communication technologies was among the designated priority areas of action. However, it should be borne in mind that reducing disparities between the EU areas<sup>7</sup> is a process that is influenced by various factors<sup>8</sup> [See: 10]. The factors whose significance in the study on the use of the Internet in the activities of enterprises in the EU countries cannot be overestimated are the economic development of countries and the technological advances.

### **Acknowledgement**

No acknowledgement and potential founding was reported by the author.

### **Conflict of interests**

The author declared no conflict of interests.

### **Author contributions**

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

### **Ethical statement**

The research complies with all national and international ethical requirements.

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<sup>5</sup> It does not apply to France.

<sup>6</sup> It does not apply to the Czech Republic

<sup>7</sup> The reduction of differences between the EU areas was understood as development, while intensifying the activities of the most developed countries.

<sup>8</sup> Endogenous, exogenous, and those that make countries react differently to changes in the macroenvironment.

## ORCID

Agnieszka Skowronek-Gradziel  <https://orcid.org/0000-0003-1296-9663>

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## Biographical note

**Agnieszka Skowronek-Gradziel** – Ph.D., gained a doctoral degree in economic sciences in the Department of Econometrics under the supervision of Prof. Dr. hab. Jozef Dziechciarz, and her doctoral thesis was recognized by reviewers and awarded by the Council of the Faculty of Management and Computer Science of the Wrocław University of Economics. She is a member of the Polish Statistical Association (PTS) and a statistical editor of the *Journal of Science of General Tadeusz Kosciuszko Military University of Land Forces*. In her scientific publications she has been dealing with the use of statistical methods of multidimensional comparative analysis for the study of environmental protection expenditures, or the analysis of advertising expenditure on a macro scale. The author's scientific interests also include the dimensions of risk estimation, research on the organization's identity, and recently the issue of using the Internet in the corporate practice.

### **Analiza zróżnicowania wykorzystania Internetu w działalności przedsiębiorstw Unii Europejskiej w 2014 roku**

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#### **STRESZCZENIE**

Celem badawczym artykułu było zidentyfikowanie zależności występujących na płaszczyźnie wykorzystania Internetu w działalności przedsiębiorstw państw Unii Europejskiej w 2014 roku. Testowaną hipotezą było stwierdzenie, że w Unii Europejskiej w badanym obszarze istnieje zróżnicowanie przestrzenne.

W artykule zaprezentowano wyniki badań przeprowadzonych na podstawie danych pochodzących z Europejskiego Urzędu Statystycznego, dotyczących wykorzystania Internetu w działalności przedsiębiorstw w 2014 roku. Badaniem objęto 28 państw Unii Europejskiej. Ze względu na charakter badań, w pracy zastosowano metody Wielowymiarowej Analizy Porównawczej.

Pozyskana wiedza ma wymiar poznawczy, a zastosowana w praktyce może zostać wykorzystana do ustalania zadań dotyczących wyrównywania różnic rozwojowych na płaszczyźnie europejskiej polityki regionalnej w kolejnych perspektywach finansowych.

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#### **SŁOWA KLUCZOWE**

stopień skomunikowania przedsiębiorstw, państwa Unii Europejskiej o podobnych wzorcach wykorzystania Internetu, klasyfikacja państw Unii Europejskiej na płaszczyźnie wykorzystania Internetu przez przedsiębiorstwa

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