PRACE NAUKOWE UNIWERSYTETU EKONOMICZNEGO WE WROCŁAWIU
RESEARCH PAPERS OF WROCŁAW UNIVERSITY OF ECONOMICS 2019, vol. 63, nr 6

ISSN 1899-3192
e-ISSN 2392-0041

Katarzyna Cheba

West Pomeranian University of Technology, Szczecin
e-mail: katarzyna.cheba@zut.edu.pl

ORCID: 0000-0001-8753-7764

Katarzyna Szopik-Depczyńska

University of Szczecin
e-mail: katarzyna.szopik-depczynska@usz.edu.pl

ORCID: 0000-0002-3054-0660

SUSTAINABLE COMPETITIVENESS AND RESPONSIBLE INNOVATIONS – THE CASE OF THE EUROPEAN UNION COUNTRIES

ZRÓWNOWAŻONA KONKURENCYJNOŚĆ I ODPOWIEDZIALNE INNOWACJE – PRZYPADEK KRAJÓW UNII EUROPEJSKIEJ

DOI: 10.15611/pn.2019.6.11
JEL Classification: C38, F00, F15

Summary: The main purpose of the study is an assessment of the relationships between sustainable competitiveness of the economy, sustainable development and responsible innovations. For this purpose the indicators from the 2030 Agenda and data published by OECD describing the concept of green growth were used. The results were obtained on the basis of a two-stage procedure. In the first step the rankings of the EU countries in each the considered areas were calculated and in the second one the results of the previous stage were used to create typological groups with the application of correspondence analysis. The outcomes presented in the paper clearly confirm the significant level of differentiation of the results achieved by EU countries in various areas that make up the overall concept of sustainable competitiveness. The value added of the paper comes from the approaches to the evaluation of the relation between various areas sustainable competitiveness.

Keywords: sustainable competitiveness, sustainable development, green growth, multidimensional analysis, responsible innovations.

Streszczenie: Głownym celem artykułu było badanie relacji występujących między zrównoważonym rozwojem i konkurencyjnością gospodarki. W badaniu wykorzystano wskaźniki stosowane przez Komisję Europejską do monitorowania postępów we wdrażaniu Agendy 2030 oraz dane zaczerpnięte z bazy OECD opisujące wyniki krajów w zakresie realizacji koncepcji zielonego wzrostu. Do badania relacji między wskazanymi obszarami wykorzysta-

no dwuetapową procedurę badawczą. W pierwszym kroku wyznaczono rankingi w każdym z obszarów, w drugim na ich podstawie dokonano podziału krajów UE na grupy typologiczne z wykorzystaniem analizy korespondencji. Powtwierdzono znaczne zróżnicowanie krajów UE, czego efektem jest podział aż na siedem grup.

Słowa kluczowe: zrównoważona konkurencyjność, zrównoważony rozwój, zielony wzrost, analiza wielowymiarowa, odpowiedzialne innowacje.

1. Introduction

The competitiveness of the economy has been for many years one of the most important topics present in both scientific considerations and in the political debate undertaken internationally. Its rank, despite its obvious significance and importance, increased even more after the events associated with the global economic crisis that took place in 2007-2008. For many years the governments of most countries around the world have been wondering how to gain lasting competitive advantage on the international stage. In recent years, in light of more and more real threats to the natural environment, increased attention is being directed towards the search for solutions that would eliminate the negative effects of economic growth. The increase in the importance of so-called safe competition is also emphasized in the provisions of the latest Strategy for Sustainable Development – Agenda 2030. This strategy, through numerous references, e.g. to urban development, safe, ecological agriculture or environment-friendly innovations includes sustainable development in various areas important for the further existence of Man on the Earth, e. g. sustainable transport [Borys (ed.) 2008], sustainable agriculture [Altieri 2018], sustainable logistics [Kiba-Janiak 2015], and sustainable finance [Fullwiler 2015]. On the other hand, for the considerations presented in this paper, the relationships between sustainable development and competitiveness of the economy are particularly important.

The study of the relationships between these areas is the main purpose of the work, while competitiveness is considered here both from the perspective of the ability to compete sustainably and the country's sustainable competitive position. It also means the need to compare a complex set of indicators describing the indicated dimensions of competitiveness. For this purpose the indicators used by the European Commission to monitor progress in the implementation of the 2030 Agenda and data from the OECD database describing the results of countries in the implementation of the concept of green growth were used. The taxonomic measure of development based on the Weber median vector and analysis of correspondence were applied to comparative analyses of the results achieved in these areas. The work was divided into five parts. The first one contains an introduction in which the main purpose of the work is presented. The next part describes the concept of the study from the theoretical side. The third section presents the statistical data used in the work and the next describes the research methods used. The fourth part contains the results

of the research and the last – the summary and conclusions. The value added of the deliberations presented in the paper is the approach to the evaluation of the relation between different areas of the ability to compete sustainably and the positions in the ranking calculated on the basis of the indicators which may be utilized to calculating the sustainable position of EU countries.

2. Sustainable development, competitiveness and responsible innovations

For several years, in the literature on the subject [Schwab, Sala-i-Martin 2012; *The Global*… 2012; Aiginger et al. 2013; Cheba 2019], attempts have been made to include sustainable development in the research on competitiveness considered in various perspectives, ranging from the level of enterprises (level of micro-analysis) to the level of national economies (level of macro-analysis). The result of combining these two research perspectives is the emergence of a new economic category which is referred to as sustainable competitiveness [Schwab, Sala-i-Martin 2012]. This term in the literature on the subject is defined in various ways. Aiginger at al. [2013] proposed to define this kind of new concept of competitiveness as the "ability of a country (region, location) to deliver the beyond-GDP goals for its citizens today and tomorrow". At national level, the issue of sustainable competitiveness was first presented by Blanke et al. [2011]. According to their proposal the Global Competitiveness Index was supplemented with a social and environmental pillar. In a further developed version of the index, Corrigan et al. [2014] define "[...] sustainable competitiveness as the set of institutions, policies, and factors that make a nation productive over the longer term while ensuring social and environmental sustainability". The relationship between competitiveness, social conditions, and environmental responsibility was also presented by Aiginger and Vogel [2015], Balkyte and Tvaronavičiene [2011], Huggins et al. [2013]. In graphic form, these relationships can be represented as follows [Balkyte, Tvaronavičiene 2011]:

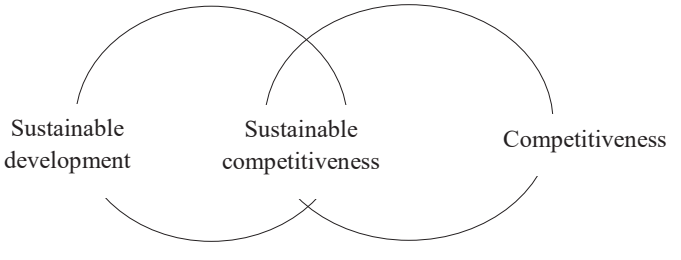

Fig. 1. The main components of the sustainable competitiveness

Source: [Balkyte, Tovaronavičiene 2011].

In the works of these authors, the measurement of the achieved level of sustainable competitiveness is usually limited to assessing the ability of the examined objects (e.g. countries, regions) to compete sustainably. The result of the study is usually a synthetic measure obtained by averaging the partial results describing the results in various areas, e.g. social, economic and environmental. On the other hand, it was assumed in the study that such a method of assessment would lead to overgeneralization, in particular in the case of economically more developed countries, which may cause greater pressure on the natural environment. It was also assumed that the overall concept of sustainable competitiveness considered on a macroeconomic scale should take into account both the dimension of the ability to compete sustainably as well as the sustainable competitive position achieved by the studied object. If we assume, in accordance with the assumptions presented by Cheba [2019], that sustainable competitiveness is the result of a) the ability of a given country to compete sustainably in the international arena, taking into account not only the economic dimension of this competition, but also the social and environmental dimensions, and b) a given country's achieved sustainable competitive position, which can be defined [Misala 2011] as "the state and changes in the share of a given economy in the broadly understood international turnover". When implemented with care for the environment and society, the indicators of the country's ability to compete sustainably used by, e.g., the European Commission to monitor the progress in the implementation of the Agenda 2030 strategy can be assumed, and the position of a given country in the broadly understood international turnover carried out with care for the environment and society can be indicative of its engaging in creating environmentally safe technologies and the so-called responsible innovations.

According to R. Von Schomberg [2013], responsible innovation can be defined as "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other regarding the ethical acceptability, sustainability and social desirability of the innovation process and its marketable products". Blok and Lemmens [2015] indicated that the main purposes of this kind if innovation is to prevent or deal with problems that arise by "taking social and ethical aspects into account and by balancing economic, socio-cultural and environmental aspects". Burget et al. [2016] are convinced that "responsible innovation is essentially an attempt to implement research and development in the early stages of research and development". The responsible approach in business and activities in this area are increasingly the daily practice of companies. In the United States and throughout the Anglo-Saxon world, references to business ethics are the most common, in Europe it is more often said about corporate social responsibility and at the macroeconomic level about sustainable development. The most important element of these concepts is the awareness that merely caring for the quality of goods and services is no longer sufficient. The effect is, for example, including the concept of Responsible Research and Innovation, to assumptions 5, 6 and 7 of the EU Framework Program and Horizon 2020. Changes in the approach to perceiving social and environmental development

as important elements determining the comprehensive assessment of the level of competitiveness of EU countries have also been included in the concept of the study presented in this paper.

3. The statistical data and methods

Due to the fact that the work compares the results in two areas: the ability to compete in a balanced way, and a sustainable competitive position, owing to the availability of data, in particular in the latter, the values of the 2015 indicators were taken into account. To assess the ability of European Union countries to compete in a sustainable way, indicators monitoring the progress in implementing the 2030 Agenda for Sustainable Development were used in the Eurostat database. The European Commission uses 100 different indicators for this purpose, of which 65 are available for all EU countries. In the study these indicators were assigned to the order of sustainable development: economic, social, environmental and institutional and political, which were separated from the indicators describing the social order [Cheba 2019]. It has been assumed that each of these areas is equally important and the proper implementation of the concept of sustainable development requires striving to achieve improvement in each of these areas. Thus the results obtained by EU countries were analyzed separately for each of them. For the selection of diagnostic characteristics within each of the highlighted pillars, the method of reverse matrix coefficient of correlation was applied. A detailed description of this method can be found in [Malina, Zeliaś 1998; Lira et al. 2002; Malina 2004; Młodak 2006]. From among 65 indicators describing the various areas selected for the study, the next stage included[1]:

- 13 indicators that describe the economic dimension of the ability to compete sustainably (E): $x_{1.1S}$ – agricultural factor income per annual work unit (AWU), chain linked volumes, $x_{1.2S}$ – government support to agricultural research and development, Euro *per capita,* $x_{1.3S}$ – area under organic farming, % of utilised agricultural area, $x_{1.4D}$ – inactive population due to caring responsibilities, % of inactive population aged 20 to 73, $x_{1.5S}$ – real GDP per capita, chain linked volumes (2010), Euro *per capita,* $x_{1.6D}$ – young people neither in employment nor in education, % of population aged 15 to 37, $x_{1.7D}$ – involuntary temporary employment, % of employees aged 20 to 72, $x_{1.8D}$ – people killed in accidents at work, number per 100 000 employees, $x_{1.9S}$ – gross domestic expenditure on R&D, % of GDP, $x_{1.10S}$ – employment in high- and medium-high technology manufacturing sectors and knowledge-intensive service sectors, % of total employment, $x_{1.11D}$ – volume of freight transport relative to GDP, index (2005 =

[1] $x_{i,j}$ is assigned to each of the highlighted features, where i is the number of the area in which the feature is located, while j is the number of the feature, where S – stimulant and D – destimulant.

100), $x_{1.12D}$ – general government gross debt, % of GDP, $x_{1.13S}$ – shares of labour taxes in total tax revenues, %,

- 18 indicators highlighted in the framework of the social dimension of the ability to compete sustainably (S): $x_{2.1D}$ – people living in households with very low work intensity, % of population aged less than 78, $x_{2.2D}$ – housing cost overburden rate by poverty status, % of population, $x_{2.3D}$ – population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames of floor, % of population, $x_{2.4S}$ – self-perceived health, very good or good, % of population, $x_{2.5D}$ – suicide rate by sex, number per 100 000 persons, $x_{2.6D}$ – self-reported unmet need for medical care, % of population aged 16 and over, $x_{2.7D}$ – early leavers from education and training by sex, % of population aged 18 to 33, $x_{2.8S}$ – tertiary educational attainment, % of population aged 30 to 43, $x_{2.9S}$ – adult participation in learning, % of population aged 25 to 73, $x_{2.10D}$ – final energy consumption in households *per capita*, kg of oil equivalent, $x_{2.11D}$ – population unable to keep home adequately warm, % of population, $x_{2.12S}$ – long term unemployment rate, % of active population, $x_{2.13S}$ – relative median at-risk-of-poverty gap, % distance to poverty threshold, $x_{2.14D}$ – overcrowding rate, % of population, $x_{2.15D}$ – population living in households considering that they suffer from noise, % of population, $x_{2.16D}$ – people killed in road accidents, rate, $x_{2.17D}$ – death rate due to homicide, number par 100 000 persons, $x_{2.18D}$ – population reporting occurrence of crime, violence or vandalism, % of population,
- 8 indicators in the environmental dimension of the ability to compete sustainably (EN): $x_{3.1D}$ – ammonia emissions from agriculture, kilograms per hectare, $x_{3.2D}$ – primary energy consumption, million tonnes of oil equivalent (TOE), $x_{3.3S}$ – energy productivity, Euro per kilogram of oil equivalent (KGOE), $x_{3.4S}$ – share of renewable energy in gross final energy consumption, %, $x_{3.5D}$ – energy dependence % of imports in total energy consumption, $x_{3.6S}$ – recycling rate of municipal waste, % of total waste generated, $x_{3.7D}$ – greenhouse gas emissions – tonnes *per capita,* $x_{3.8D}$ – shares of environmental taxes in total tax revenues, % of total taxes,
- 8 indicators in the institutional and political dimension of the ability to compete sustainably (I): $x_{4.1S}$ – seats held by women in national parliaments, % of seats, $x_{4.2S}$ – seats held by women in national governments, % of seats, $x_{4.3S}$ – positions held by women in senior management positions, board members, % of positions, $x_{4.4S}$ – general government total expenditure on law courts, Euro per inhabitant, $x_{4.5S}$ – population with confidence in EU institutions: European Parliament % of population, $x_{4.6S}$ – population with confidence in EU institutions: European Central Bank, % of population, $x_{4.7S}$ – official development assistance as share of gross national income, %, $x_{4.8S}$ – EU imports from developing countries by country income groups, million EUR *per capita.*

However, to assess the current position of EU countries in terms of the potential to create so-called responsible innovations (RI), four indicators that the OECD

(Organization for Economic Co-operation and Development) uses to monitor progress in the area of green growth in the field of: technology and innovations patents were used. These are: $x_{5.1S}$ – relative advantage in environment-related technology, ratio, $x_{5.2S}$ – development of environment-related technologies, % inventions worldwide, $x_{5.3S}$ – development of environment-related technologies, inventions *per capita*.

A two-stage research procedure was used to examine the relationships between the indicated areas that make up the overall assessment of the sustainable competitiveness of EU countries. In the first stage for each of analysed areas the taxonomic measure of development based on the Weber [1971] median vector was calculated. In the literature on the subject, examples of the use of this method to build rankings of socio-economic objects can be found in [Lira et al. 2002; Młodak 2006; Młodak et al. 2016]. The Weber median is a multi-dimensional generalization of the classic notion of the median, which is about a vector that minimizes the sum of Euclidean distance (Euclidean distance) of the data points representing the considered objects, and therefore is somehow "in the middle" of them, but is also immune to the presence of outliers [Weber 1971]. Based on the results obtained, Pearson's linear correlation coefficients between the determined taxonomic development measures for all analyzed areas and Kendall's τ correlation coefficient for the positions occupied by the examined objects in the constructed rankings were also calculated. However, in the second stage, to assess the relations between the considered areas of the study, the correspondence analysis was used. A detailed description of this method can be found in [Greenacre 1984; and 1993; Goodman 1986; Clausen 1998; Bąk 2013]. In this method the variables measured on the nominal scale and characterized by coexistence, i.e. in the set of examined variables one cannot clearly identify the dependent variable [Bąk 2013], can be used. In the paper the modified version of this method based on markers was applied. Before calculating, the variables were changed into a zero-one variable, where 1 represents the results of these countries which scored the values of taxonomic measure of development at least at the median level in the case of economic, social, institutional and political areas of ability to compete sustainably, as well as for the results of the sustainable position of competitiveness, and the opposite situation (lower than median value) for the environmental area of the sustainable ability to compete, and 0 means the opposite situation in every of these considered areas. The final effect of this method is the graphic presentation of the simultaneous occurrence of the categories of variables [Greenacre, Hastie 1987]. It should be noted that the space with a dimension larger than 3 is the best form of the presentation of variables' coexistence, and another method of analysing the results should be selected. For this purpose one can use classification methods (e.g. Ward's method) in the space of both low and high dimension.

4. Study results

The results of the first stage of the presented research procedure made separately for each of the analyses area are presented in Table 2. In this table also the values of

Pearson (r) and Kendall's τ correlation coefficient were employed. High values of this coefficient mean a relatively good concordance of linear ordering of countries, and, conversely, its low values demonstrate a lack thereof.

Table 1. The results of the classification of EU countries in each analysed area in 2015

Country	Sustainable ability to compete in the area of (value/ rank):				Sustainable position of competitiveness (GI)
	E	S	EN	IP	
Austria	0.668/ 9	0.604/ 9	0.612/ 6	0.643/ 7	0.307/ 14
Belgium	0.684/ 8	0.425/ 19	0.347/ 21	0.705/ 5	0.255/ 21
Bulgaria	0.401/ 26	0.284/ 24	0.494/ 15	0.486/ 17	0.593/ 6
Croatia	0.410/ 24	0.274/ 25	0.487/ 16	0.466/ 18	0.307/ 15
Cyprus	0.457/ 22	0.556/ 13	0.282/ 26	0.249/ 27	–0.176/ 28
Czech Republic	0.615/ 11	0.571/ 12	0.484/ 17	0.418/ 21	0.184/ 25
Denmark	0.878/ 1	0.638/ 6	0.631/ 3	0.730/ 4	0.636/ 4
Estonia	0.534/ 18	0.548/ 16	0.431/ 19	0.413/ 22	0.521/ 7
Finland	0.745/ 4	0.675/ 4	0.619/ 4	0.797/ 3	0.323/ 13
France	0.605/ 12	0.648/ 5	0.567/ 10	0.510/ 14	0.350/ 10
Germany	0.720/ 6	0.515/ 17	0.341/ 24	0.692/ 6	0.922/ 1
Greece	0.391/ 27	0.254/ 26	0.270/ 27	0.333/ 25	0.251/ 22
Hungary	0.640/ 10	0.343/ 21	0.615/ 5	0.150/ 28	0.335/ 11
Ireland	0.549/ 17	0.706/ 2	0.508/ 13	0.535/ 12	0.093/ 26
Italy	0.522/ 20	0.326/ 23	0.428/ 20	0.563/ 10	0.279/ 19
Latvia	0.550/ 16	0.240/ 27	0.581/ 9	0.444/ 20	0.307/ 16
Lithuania	0.443/ 23	0.423/ 20	0.561/ 11	0.509/ 15	0.732/ 3
Luxembourg	0.732/ 5	0.550/ 15	0.346/ 22	0.617/ 8	0.275/ 20
Malta	0.573/ 14	0.676/ 3	0.244/ 28	0.259/ 26	0.765/ 2
Netherlands	0.788/ 3	0.635/ 7	0.342/ 23	0.805/ 2	0.212/ 24
Poland	0.524/ 19	0.552/ 14	0.505/ 14	0.536/ 11	0.434/ 8
Portugal	0.407/ 25	0.338/ 22	0.509/ 12	0.589/ 9	0.307/ 17
Romania	0.220/ 28	0.090/ 28	0.584/ 8	0.333/ 24	–0.002/ 27
Slovakia	0.552/ 15	0.602/ 10	0.643/ 2	0.347/ 23	0.606/ 5
Slovenia	0.596/ 13	0.619/ 8	0.460/ 18	0.508/ 16	0.240/ 23
Spain	0.502/ 21	0.481/ 18	0.331/ 25	0.448/ 19	0.354/ 9
Sweden	0.823/ 2	0.721/ 1	0.765/ 1	0.961/ 1	0.327/ 12
United Kingdom	0.702/ 7	0.574/ 11	0.588/ 7	0.533/ 13	0.307/ 18

Pearson's/ Kendall's τ correlation coefficient					
E	1.000	0.704/ 0.492	0.195/ 0.196	0.641/0.423	0.181/ 0.183
S	0.704/ 0.492	1.000	0.084/ 0.132	0.404/ 0.286	0.100/ 0.045
EN	0.195/ 0.196	0.084/ 0.132	1.000	0.267/ 0.159	0.154/ –0.019
IP	0.641/ 0.423	0.404/ 0.286	0.267/ 0.159	1.000	0.028/ 0.135
RI	0.181/ 0.183	0.100/ 0.045	0.154/ –0.019	0.028/ 0.135	1.000

Source: own calculation.

Firstly, it is worth paying attention to the results of the Scandinavian countries, which in the literature on the subject [Schwab, Sala-i-Martin 2012; *The Global*… 2012; Aiginger et al. 2013; Cheba 2019] are indicated as the only ones in the EU that managed to separate economic growth from the negative impact on the natural environment. This correctness is also confirmed by the results obtained and is particularly visible for Denmark, Finland and Sweden. These countries were highly classified in principle in all the constructed rankings. Similar results (quite high positions primarily in rankings describing the ability to compete sustainably) were achieved only by a few countries located in Western Europe, i.e. Austria, France, and the United Kingdom. The results of other countries are more diverse. Higher positions in rankings describing the ability to compete sustainably in the social and economic areas (in some cases also institutional and political) are often matched by lower results in the ranking describing the ability to compete sustainably in the area of the environment and vice versa. This situation applies primarily to: Hungary, Latvia, Lithuania, Luxembourg, Malta, Portugal, Romania and Slovakia. Confirmation is also found in the assessment of correlation coefficients: Pearson (r) and Kendall (τ), which show the existence of rather moderate relationships between economic and social areas ($r = 0.704$, $\tau = 0.492$) and economic and institutional-political ($r = 0.641$, $\tau = 0.423$) and a definitely lower level in the case of links with the environmental area ($r = 0.195$, $\tau = 0.196$). It is also worth drawing attention to the relatively low assessments of correlation coefficients between all areas describing the ability of EU countries to compete sustainably and the results in terms of achieved sustainable competitive position (all below 0.2; lowest in the case of links with the areas: environmental: $\tau = –0.019$). This means, among others, that the interest of EU countries in introducing innovative environment-friendly solutions is influenced by factors other than those considered in the work. Similar observations can be made by analyzing the results of correspondence analysis obtained in the second stage of the study. Original and modified eigenvalues together with the level of total inertia explanation are presented in Table 5. The set of six analysed variables, apart from five zero-one variables, included the variable: countries which had 28 variants. Due to this fact, the dimension of the genuine coexistence space amounted to 38. In accordance with Greenacre's criterion, main inertias larger than $\frac{1}{Q} = \frac{1}{6} = 0.167$ were taken into account as important for the study. The results for $K > 5$ were ignored because for these dimensions the main inertias did not exceed 0.167, so these dimensions were not important in the study.

For the first five dimensions the level of explanation of inertias amounts to 31.250%, and to 89.984% in the modified version. This measure determines the inertia share of a selected dimension (λ_k) in the total inertia (λ).The results in a graphic form based on Ward's method are presented in Figure 2. The critical value of the distance at which the combination of classes was interrupted (2.83) was determined by applying the measure proposed by T. Grabiński [2003].

Table 2. The results of the original and modified versions

K	Eigen-values γ_k	Singular values λ_k	Percentage of Inertia λ_k / λ	Cumulative Percentage τ_k	Eigen-values $\widetilde{\lambda}_k$	Percentage of Inertia $\widetilde{\lambda}_k / \widetilde{\lambda}$	Cumulative Percentage $\widetilde{\tau}_k$
1	0.697	0.486	9.120	9.120	0.356	34.209	34.209
2	0.628	0.395	7.397	16.518	0.264	25.337	59.546
3	0.535	0.286	5.357	21.875	0.161	15.470	75.017
4	0.529	0.280	5.248	27.122	0.156	14.967	89.984
5	0.469	0.220	4.127	31.250	0.104	10.016	100.000
					$\widetilde{\lambda}_k = 1.042$		

Source: own calculation.

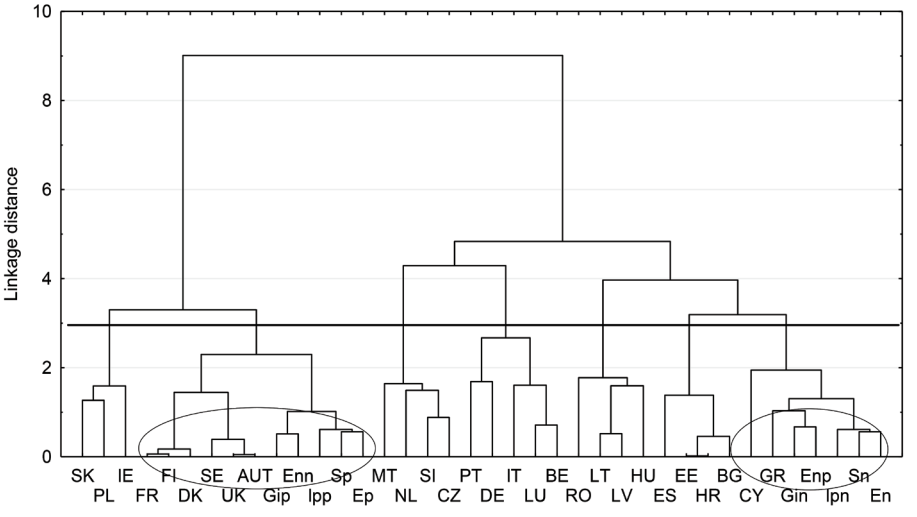

Fig. 2. The results of the correspondence analysis, where the *p* symbol at particular categories means the positive level, while the *n* symbol – the negative level

Source: own elaboration.

The effect of the applied research procedure is the division of EU countries into seven diverse typological groups. From the point of view of the considerations presented

in the thesis, particularly important are those groups in which, apart from individual EU countries, there were also features describing the indicated areas. Two such groups can be identified. The first of them: France, Finland, Denmark, Sweden, the United Kingdom and Austria, are the countries where equal or higher than the median values of taxonomic measures of development are described, showing their ability to compete in a sustainable way in the areas of economic, social, institutional and political and lower in the area of environment. These are also the countries whose the results describing their sustainable competitive position were at least equal to the median; at least in part, they managed to separate economic growth from environmental pressures. At the same time, these countries achieved at least equal median results in terms of sustainable competitive position. However, only two countries qualified to the second group with the opposite results, Cyprus and Greece. The results of the other countries were more diverse and these countries were classified into five different typological groups.

5. Conclusion

The outcomes presented in the paper clearly confirm a significant level of differentiation of the results achieved by EU countries in various areas that make up the overall concept of researching sustainable competitiveness. Both the differences in the results achieved in the areas describing the ability of countries to compete in a sustainable way, as well as the results in the area of achieved competitive position are important. The results are interesting because indicators of the interest of the studied countries in innovative environment-friendly solutions and technologies have been adopted as measures of sustainable competitive position. Based on the analysis of the received rankings, generalizations are not yet eligible, which could indicate that high positions in all the areas included in the description of the ability to compete sustainably correspond to high positions in the rankings describing a sustainable competitive position. Only a few countries managed to separate economic growth from pressure on the environment, in the case of an even smaller group there are also links with the results in the creation of the so-called responsible innovations.

Bibliography

Aiginger K., Bärenthaler-Sieber S., Vogel J., 2013, *Competitiveness under new perspectives*, Working Paper, 44, www.foreurope.eu.

Aiginger K., Vogel J., 2015, *Competitiveness: From a misleading concept to a strategy supporting Beyond GDP goals*, Comp. Rev., 25(5), pp. 497-523.

Altieri M.A., 2018, *Agroecology: The Science of Sustainable Agriculture*, CRC Press, Taylor&Francis.

Balkyte A., Tvaronavičiene M., 2011, *Perception of competitiveness in the context of sustainable development: Facets of sustainable competitiveness*, J. Bus. Econ. Manag., 11(2), pp. 341-365.

Bąk I., 2013, *Statystyczna analiza aktywności turystycznej seniorów w Polsce*, Wydawnictwo Uczelniane Zachodniopomorskiego Uniwersytetu Technologicznego w Szczecinie, Szczecin.

Blanke J., Crotti R., Drezniek Hanouz M., Fidanza B., Thierry G., 2011, *The Long Term View: Developing a Framework for Assessing Sustainable Competitiveness*. *The Global Competitiveness Report 2011-2012*,World Economic Forum, Geneva.

Blok V., Lemmens P., 2015, *The Emerging Concept of Responsible Innovation. Three Reasons Why It Is Questionable and Calls for a Radical Transformation of the Concept of Innovation*, [in:] Koops B.J. et al. (eds.), *Responsible Innovation 2: Concepts, Approaches, and Applications*, Springer.

Borys T. (ed.), 2008, *Analiza istniejących danych statystycznych pod kątem ich użyteczności dla określenia poziomu zrównoważonego rozwoju transportu wraz z propozycją ich rozszerzenia,* Raport z realizacji ekspertyzy, Jelenia Góra–Warszawa.

Burget M., Bardone E., Pedaste M., 2016, *Definitions and Conceptual Dimensions of Responsible Research and Innovation: A Literature Review*, Science and Engineering Ethics, Springer.

Cheba K., 2019, *Zrównoważona międzynarodowa konkurencyjność krajów Unii Europejskiej. Studium teoretyczno-empiryczne*, Wydawnictwo CeDeWu, Warszawa.

Clausen S.E., 1998, *Applied correspondence analysis: An introduction*, Sage Publications, Thousand Oaks.

Corrigan G., Crotti R., Drzeniek M., Serin, C., 2014, *Assessing progress toward sustainable competitiveness*. *The Global Competitiveness Report 2014-2015,* World Economic Forum, Geneva.

Fullwiler S.T., 2015, *Sustainable Finance: Building a More General Theory of Finance*, Working Paper, no. 106, Binzagr Institute for Sustainable Prosperity.

Goodman L.A., 1986, *Some useful extensions of the usual correspondence analysis approach and usual log-linear models approach in the analysis of contingency tables*, International Statistical Review, 543, pp. 243-270.

Grabiński T., 2003, *Analiza taksonomiczna krajów Europy w ujęciu regionalnym*, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

Greenacre M., 1984, *Theory and Applications of Correspondence Analysis*, Academic Press, London.

Greenacre M., 1993, *Correspondence Analysis in Practice*, Academic Press, London.

Greenacre M., Hastie T., 1987, *The geometric interpretation of correspondence analysis*, Journal of the American Statistical Association, 82.398, pp. 437-447.

Huggins R., Izushi H., Thompson, P., 2013, *Regional competitiveness: Theories and methodologies for empirical analysis*, JCC: Bus. Econ. Res. J., 6(2), pp. 155-172.

Kiba-Janiak M., 2015, *A comparative analysis of sustainable city logistics among capital cities in the EU*, Applied Mechanics and Materials, 708, pp. 113-118.

Lira J., Wagner W., Wysocki F., 2002, *Mediana w zagadnieniach porządkowania obiektów wielocechowych*, [in:] Paradysz J. (ed.), *Statystyka regionalna w służbie samorządu lokalnego i biznesu*, Internetowa Oficyna Wydawnicza Centrum Statystyki Regionalnej, Akademia Ekonomiczna w Poznaniu, Poznań, pp. 87-99.

Malina A., 2004, *Wielowymiarowa analiza przestrzennego zróżnicowania struktury gospodarki Polski według województw*, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

Malina A., Zeliaś A., 1998, *Taksonomiczna analiza przestrzennego zróżnicowania jakości życia ludności w Polsce w 1994 r*., Przegląd Statystyczny, 44(1), pp. 11-27.

Misala J., 2011, *Międzynarodowa konkurencyjność gospodarki narodowej*, PWE, Warszawa.

Młodak A., 2006, *Analiza taksonomiczna w statystyce regionalnej*, Centrum Doradztwa i Informacji Difin, Warszawa.

Młodak A., Józefowski T., Wawrowski Ł., 2016, *Zastosowanie metod taksonomicznych w estymacji wskaźników ubóstwa*, Wiadomości Statystyczne, R. LXI (2), pp. 1-24.

Schwab K., Sala-i-Martin X., 2012, *The Global Competitiveness Report 2012-2013*, World Economic Forum, Geneva.

The Global Sustainable Competitiveness Index, 2012, SolAbility, South Korea.

Von Schomberg R., 2013, *A vision of responsible innovation*, [in:] R. Owen, M. Heintz, J. Bessant (eds.) *Responsible Innovation*, John Wiley, London.

Weber A., 1909, reprint 1971, *Theory of Location of Industries*, Russel & Russel, New York.