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THE INTERNATIONAL COMPETITIVENESS OF EUROPEAN UNION COUNTRIES AND STRATEGIES FOR ITS ENHANCEMENT: A TAXONOMIC ANALYSIS

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Abstract: The aim of this article is to identify clusters of countries with similar levels of competitiveness among the EU-27 countries and to identify for each of the 27 EU countries the path of competitiveness growth. The cluster analysis conducted confirms the hypothesis that the European Union is an area with a high differentiation in terms of levels of competitiveness. The analysis shows that the strategy to increase competitiveness should be significantly different for each EU country. It is suggested that in order to increase its international competitiveness each EU country should follow the pattern of the country which stands above it in terms of competitiveness ranking, but at the same time is most similar.

Keywords: global competitiveness index, cluster analysis, competitive strategy, European Union

INTRODUCTION

Competitiveness is one of the most misunderstood concepts in economics [Waheeduzzaman, Ryans, 1996]. The main problem of economists dealing with issues of competitiveness is the lack of a single universally accepted definition of this phenomenon. Even such an expert as Porter in his book "The competitive advantage of nations" does not define competitiveness directly, although the term is used repeatedly [Porter, 1990]. Furthermore, in the literature there is the problem of an excess of definitions, which stems from the fact that the phenomenon is considered at up to four levels, i.e. micro-, mezo-, macro- and mega-competitiveness. Moreover, the concept of competitiveness is derived from at least

three economic theories: those of international trade, of economic growth and microeconomics.

One of the few successful attempts at defining and measuring competitiveness is the methodology proposed by the Word Economics Forum. This approach can be called holistic, and is based on both macro and micro theories and uses both hard and soft data. The Growth Competitiveness Index (GCI) published by the Word Economic Forum aims to quantify crucial pillars of a country's competitiveness [Schwab, 2013]. They are:

- Institutions (I) – the institutional environment, which is determined by the legal and administrative framework;
- Infrastructure (II) – the quality and the extensiveness of infrastructure;
- Macroeconomic environment (III) – the stability of the macroeconomic environment (inflation rate, government spending, public debt);
- Health and primary education (IV) – the quantity and quality of basic education and access to the health care system;
- Higher education and training (V) – the quality of higher education and the intensity of vocational and continuous on-the-job training;
- Goods market efficiency (VI) – the structure of production and its compatibility with national and international demand; the intensity of domestic market competition; the degree of customer orientation and buyer sophistication;
- Labour market efficiency (VII) – the flexibility of the labour force; the transparency of labour law; the adjustment of supply to demand in the labour market;
- Financial market development (VIII) – the level of development and health of the financial system; the trustworthiness and transparency of the banking system;
- Technological readiness (IX) – ICT (Information and Communication Technology) access and use in daily activities and production processes; foreign direct investment intensity (FDI intensity);
- Market size (X) – the size of the domestic market and openness to trade;
- Business sophistication (XI) – the quality of a country's overall business networks and the quality of individual firms' operations and strategies;
- Innovation (XII) – the intensity of technological innovation; R&D expenditure in the private sector.

The GCI calculated for an individual country informs about the level of competitiveness of its economy and allows a comparison of this level with that achieved by other countries.

However, for an integrated group like the EU-27 countries, knowing which country is more competitive than the others does not contribute much to EU growth policy. The previous competitiveness growth strategy for the EU-27, based on a common denominator and employing identical tools for competitiveness support, did not work, which could be evidenced by the failure of the implementation of the

Lisbon Strategy in the period 2000-2010. For this reason, in this paper similarities in the competitiveness of the EU-27 countries will be identified, and then the different path for competitiveness growth will be determined for each EU country. The paths will be determined, based on the principle that to increase the international competitiveness, each EU country should try to follow the path of another EU country which is very similar but stands above it in terms of competitiveness ranking. Rather than advocating the concept of a "two-speed Europe", the paper proposes viewing the strengths of each particular Member State as an engine of growth for the whole EU.

METHODOLOGY

For the analysis, the above-mentioned set of 12 competitiveness indicators (diagnostic variables) is used. First, the usefulness of the diagnostic variables is determined by examining their degree of variation and correlation. The analysis requires variables which have sufficient variation and are not correlated too strongly with each other (Table 1). Only in this case will they be good carriers of information, allowing different processes to be identified [Grabinski at all, 1993]. The desired level of the coefficient of variation and the correlation coefficient, i.e. such that the variables selected can be considered diagnostic variables, is taken from the literature. It is assumed that if the coefficient of variation exceeds 10% the feature has statistically significant variation [Zieliaś, 2000], [Kozłowska 2010]. Due to the very low value of the coefficient of variation for variables IV and VI, they are excluded from the analysis.

To assess whether significant correlations exist between the variables, a matrix of correlation coefficients for pairs of variables is generated. No correlation which could contribute to abnormal results in the analysis (min. r_{xy} = -0.1483, max r_{xy} = 0.913) is found [Nowak, 1990], [GUS, 2012]. However, correlation coefficients do not allow to determine the dependence between variables other than linear. Therefore, the correlation plots for all the pairs of variables are analyzed. It confirms the absence of significant curvilinear correlations.

The next step of analysis should be the data normalization. In our case this is not necessary due to quite similar scales or magnitudes among the variables.

Two taxonomic methods are used to identify similarity in the competitiveness level of the EU-27 countries.

Firstly, to group the countries analyzed into relatively homogeneous groups the cluster analysis is applied. This method allows a determination of the similarity of objects without establishing a hierarchy among them. Classification and separation of the object clusters is carried out by means of a distance matrix. To create this, Ward's method is used. It is based on an analysis of variance to evaluate the distances between clusters, i.e. it attempts to minimize the sum of the squared distances of points from the cluster's centroid.

Table 1. The variables and their basic statistical measures

Name		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
AT	Austria	5,04	5,8	5,35	6,32	5,48	4,91	4,69	4,65	5,7	4,62	5,52	5,07
BE	Belgium	5	5,68	4,66	6,75	5,81	5,12	4,54	4,68	5,57	4,81	5,32	5,09
BG	Bulgaria	3,39	3,79	5,42	5,92	4,31	4,17	4,54	3,97	4,3	3,82	3,62	2,98
CY	Cyprus	4,59	4,8	3,86	6,5	4,98	4,68	4,57	4,56	4,85	2,81	4,18	3,36
CZ	Czech Republic	3,67	4,81	5,19	5,87	4,87	4,53	4,32	4,25	5,06	4,51	4,45	3,81
DK	Denmark	5,4	5,74	5,4	6,19	5,59	5,03	5,22	4,69	6,17	4,22	5,41	5,08
EE	Estonia	4,94	4,72	6,01	6,21	5,17	4,73	5,11	4,51	5,29	2,98	4,2	3,93
FI	Finland	6,03	5,58	5,7	6,82	6,18	5,05	5	5,5	5,92	4,18	5,49	5,75
FR	France	4,83	6,28	4,64	6,32	5,14	4,47	4,41	4,73	5,72	5,76	5	4,91
GR	Greece	3,37	4,7	2,42	6,04	4,74	3,93	3,56	3,13	4,54	4,38	3,74	3
ES	Spain	4,25	5,92	4,17	6,09	5,02	4,37	3,98	3,9	5,29	5,45	4,51	3,77
IE	Ireland	5,22	5,34	3,44	6,46	5,3	5,24	5	3,6	5,82	4,13	5,09	4,66
LT	Lithuania	4,01	4,74	4,57	6,05	5,15	4,36	4,41	3,86	5	3,53	4,16	3,51
LU	Luxemburg	5,6	5,84	6,18	6,2	4,74	5,32	4,65	5,21	6,21	3,07	4,96	4,82
LV	Latvia	4,01	4,11	5,06	5,99	4,78	4,42	4,78	4,4	4,73	3,11	3,89	3,25
MT	Malta	4,61	4,91	4,6	6,34	4,93	4,62	4,14	5,11	5,59	2,38	4,27	3,43
NL	Netherlands	5,72	6,18	5,2	6,6	5,79	5,29	4,99	4,96	5,98	5,11	5,63	5,31
DE	Germany	5,31	6,36	5,48	6,3	5,8	4,92	4,51	4,66	5,71	6,02	5,71	5,42
PL	Poland	4,11	3,89	4,6	6,03	4,92	4,39	4,48	4,59	4,66	5,12	4,06	3,25
PT	Portugal	4,28	5,5	3,87	6,19	4,98	4,31	3,8	3,71	5,27	4,34	4,17	3,86
RO	Romania	3,33	3,22	4,83	5,51	4,36	3,86	4,01	3,98	4,09	4,41	3,47	2,92
SK	Slovakia	3,44	4,23	4,87	6,03	4,5	4,37	4,2	4,45	4,46	4	4,02	2,98
SI	Slovenia	4,05	4,91	4,94	6,29	5,2	4,42	4,15	3,29	4,96	3,46	4,18	3,85
SE	Sweden	5,73	5,69	6,16	6,46	5,75	5,14	4,81	5,29	6,29	4,62	5,56	5,56
HU	Hungary	3,7	4,39	5,15	5,84	4,67	4,28	4,27	4,05	4,43	4,25	3,74	3,61
GB	United Kingdom	5,41	6,22	4,01	6,39	5,57	5,09	5,42	5,16	6	5,78	5,48	5,17
IT	Italy	3,56	5,19	4,23	5,84	4,73	4,29	3,72	3,57	4,71	5,63	4,75	3,73
	min	**3,33**	**3,22**	**2,42**	**5,51**	**4,31**	**3,86**	**3,56**	**3,13**	**4,09**	**2,38**	**3,47**	**2,92**
	max	**6,03**	**6,36**	**6,18**	**6,82**	**6,18**	**5,32**	**5,42**	**5,5**	**6,29**	**6,02**	**5,71**	**5,75**
	median	**4,59**	**5,19**	**4,87**	**6,2**	**5,02**	**4,53**	**4,51**	**4,51**	**5,29**	**4,34**	**4,45**	**3,85**
	average	**4,55**	**5,11**	**4,78**	**6,20**	**5,13**	**4,63**	**4,49**	**4,39**	**5,27**	**4,31**	**4,61**	**4,15**
	standard deviation	**0,86**	**0,88**	**0,94**	**0,32**	**0,51**	**0,43**	**0,50**	**0,66**	**0,67**	**1,02**	**0,72**	**0,94**
	coefficient of variation	**0,19**	**0,17**	**0,20**	**0,05**	**0,10**	**0,09**	**0,11**	**0,15**	**0,13**	**0,24**	**0,16**	**0,23**

Source: own calculations

The error sum of squares and r^2 values are computed using the following formulae:

$$\text{ESS (error sum of squares)} = \sum_i \sum_j \sum_k \left| x_{ijk} - \bar{x}_{ik} \right|^2, \quad (1)$$

$$\text{TSS (total sum of squares)} = \sum_i \sum_j \sum_k \left| x_{ijk} - \bar{x}_k \right|^2, \quad (2)$$

$$\text{R Squared } (r^2) = TSS - ESS/TSS, \quad (3)$$

where: x_{ijk} denotes the value for variable k in observation j belonging to cluster i, $\bar{x}_{ik}$ denotes the cluster mean for variable k, and $\bar{x}_k$ denotes the mean for variable k.

Among very different distance (similarity) matrices, Euclidean distance is chosen, as it is the recommended distance measure for Ward's method [see more Kaufman and Rousseeu, 1990 and Everitt, Landau, Leese, 2001].

Secondly, to create the path of competitiveness growth for an object/ country, an object map is used. To create this, two steps are needed. The first of these is to build the above-discussed matrix of distances, indicating the distance of an object relative to the rest. The second step is to rank all the objects (countries) in a ranking procedure. To create the ranking we calculate a synthetic variable for each country. We follow the methodology proposed by Hellwig. In this method, we first choose an "ideal object" which is described by a set of the maximum values of each variable. The variables must be standardized and they should be stimulants. The synthetic variable uses the following formula:

$$d_i = 1 - \frac{c_{i0}}{c_0}, \quad (4)$$

where

d_i is the taxonomic measure of development proposed by Hellwig,

c_{i0} is the Euclidean distance between the country and the "ideal object",

c_0 is the critical distance between objects and the "ideal object", and

$$c_0 = \bar{c}_0 + 2Sd, \quad (5)$$

$$\bar{c}_0 = \frac{1}{n}\sum_{i=1}^{n} c_{i0}, \quad (6)$$

$$Sd = \left[\frac{1}{n}\sum_{i=1}^{n} (c_{i0} - \bar{c}_0)^2 \right]^{\frac{1}{2}} \quad (7)$$

$$c_{i0} = \left[\sum_{i=1}^{n} (x_{ij} - x_{\max})^2 \right]^{\frac{1}{2}} \quad (8)$$

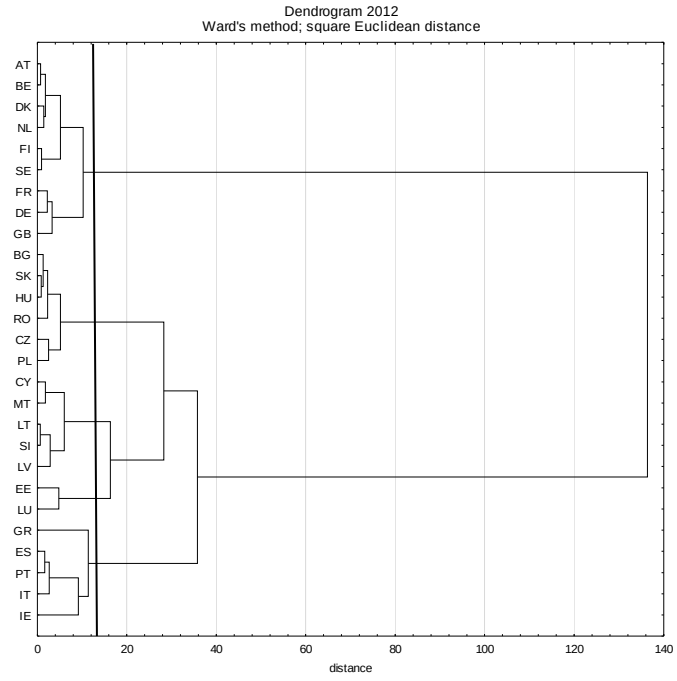
Based on this ranking of the EU-27 countries and on the distance matrix, an object map is created. All the statistical analyses in this article are performed using the statistical software Statistica 11.0, SPSS version 21.0 and R software.

EMPIRICAL ANALYSIS

The above-described similarity matrices of the objects, called distance matrices, are used to create a dendrogram. This shows how many clusters, i.e. homogeneous groups of countries, can be found among the EU-27 countries. The interpretation of the dendrogram, i.e. the identification of the number of clusters, depends on the bond distance chosen . The rule proposed by Mojena, based on the relative size of the different levels of junctions, is chosen to determine the cut-off. The constant in Mojena's inequality has a value of 1.25, which is recommended by Milligan and Cooper [Milligan, Cooper, 1985]. According to the result of this inequality, a cut-off at the level of 12.68 gives a satisfactory division of the 27 countries into clusters.

Using Ward's method, in 2012 five large homogenous groups of countries (clusters) can be distinguished (Figure 1). The basic characteristics of the clusters are presented in table 2.

Figure 1. Dendrogram for 12 competitiveness pillars using square Euclidean distance (27 EU countries)



In cluster 1 we have nine countries, mainly from the EU-15, all with a high level of competitiveness. In this cluster, all the variables not only achieve a better average value compared with the entire EU-27, but 9 of the 10 variables record the

highest average values among the five clusters identified. Because there is no variable with a value clearly differing from the rest, we can regard this cluster as being well-established with a high level of competitiveness.

Table 2. Average values of the variables in each cluster

Cluster number	All countries	1	2	3	4	5
Number of countries in each cluster	27	9	6	5	2	5
Country in each cluster		AT, BE, DK, NL, FI, SE, FR, DE, GB	BG, SK, HU, RO, CZ, PL	CY, MT, LT, SI, LV	EE, LU	GR, ES, PT, IT, IE
Institutions	4,541	5,386	3,607	4,254	5,270	4,136
Infrastructure	5,131	5,948	4,055	4,694	5,280	5,330
Macroeconomic environment	4,815	5,178	5,010	4,606	6,095	3,626
Higher education and training	5,128	5,679	4,605	5,008	4,955	4,954
Labour market efficiency	4,492	4,843	4,303	4,41	4,880	4,012
Financial market development	4,387	4,924	4,215	4,244	4,860	3,582
Technological readiness	5,271	5,896	4,500	5,026	5,750	5,126
Market size	4,315	5,013	4,352	3,058	3,025	4,786
Business sophistication	4,614	5,458	3,893	4,136	4,580	4,452
Innovation	4,151	5,262	3,258	3,480	4,375	3,804

Source: own calculations based on Table 1.

Cluster 2 consists of six countries from Central and Eastern Europe. This group is characterized by a low level of competitiveness, i.e. 6 of the 10 variables have the lowest average level among all the clusters. Any competitive advantage for these countries is based only on above-average development of the size of the domestic market, trade openness and stability of the macroeconomic environment.

Cluster 3 is an interesting case of a group of countries with an average level of competitiveness of their economies. This group comprises Cyprus, Malta, Lithuania, Slovenia and Latvia. The average values of most of the variables differ little from the average value of the competitiveness indicators recorded for the entire group of EU-27 countries. Therefore, this cluster is formed of countries that concentrate on a complex growth of competitiveness in all its aspects (as in cluster 1) rather than on building a competitive advantage based only on two or three selected pillars of competitiveness (as in cluster 2).

Cluster 4 consists of two countries: Estonia and Luxembourg. The main pillar of competitiveness of these countries is an extremely high stability of the macroeconomic environment (inflation rate, government spending and public debt). The level of competitiveness of these two countries can be described as medium-high, because half of the variables analyzed in this cluster have values

greater than the average values of these variables for the entire EU-27 group. Competitive advantage in these countries is also based on an unusually well-developed infrastructure and financial market, a high degree of ICT saturation in the economy and a high intensity of technological innovation.

The last cluster, number 5, consists of four southern European countries (Greece, Spain, Portugal and Italy) and Ireland. These countries are competitive due to a well-developed infrastructure and the large size of the domestic market. Although in this cluster only 2 of the 10 variables have values greater than the average values for the whole EU-27, the majority of the competitiveness indicators vary around the average values for the whole Union. Therefore, the competitiveness level of the countries in this cluster can be described as average.

This cluster analysis confirms the hypothesis that the European Union is an area with high differentiation in terms of levels of competitiveness. We have one cluster of countries with a very high level of economic competitiveness (cluster 1), one of above-average level of competitiveness (cluster 4), two clusters of countries representing the average level of competitiveness, but with different competitiveness bases (clusters 3 and 5), and cluster number 2 consisting of six EU-27 countries with a low level of competitiveness. With such a large differentiation of competitiveness level among the EU economies, it is difficult to build an EU competitiveness strategy based on a single unified growth path.

It is suggested that each of the EU-27 countries, especially in the short term, should follow their individual path to increase competitiveness. In order to determine these paths of competitiveness, all 27 EU countries are ranked according to their competitiveness level. Table 3 shows this ranking of countries based on the value of the synthetic variable, where the "ideal object" is described by a set of the maximum values for each variable.

Table 3. Ranking of 27 EU countries, based on the synthetic variable in 2012

Country		**rank**	**country**		**rank**
NL	0,7733	1	MT	0,2933	15
SE	0,7635	2	PL	0,2885	16
FI	0,7538	3	LT	0,2876	17
DE	0,7062	4	CY	0,2706	18
DK	0,6910	5	PT	0,2658	19
GB	0,6870	6	SI	0,2578	20
AT	0,6422	7	LV	0,2438	21
BE	0,6136	8	IT	0,2201	22
FR	0,5644	9	HU	0,2192	23
LU	0,5097	10	SK	0,1780	24
IE	0,4273	11	BG	0,1203	25
EE	0,4193	12	RO	0,0493	26
ES	0,3469	13	GR	0	27
CZ	0,3406	14			

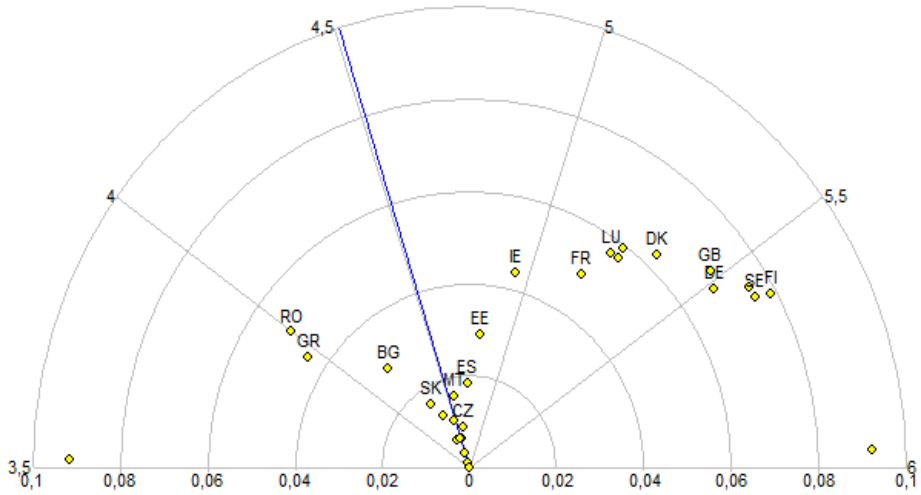
Source: own calculations

The synthetic variable is normalized so that it ranges from 1 (maximum value) to 0 (minimum value). The places of each country in the competitiveness ranking here are slightly different from those in the WEF rankings. This is due to the exclusion from the analysis of variables IV and VI (too low variability). Thus, in the ranking here the following countries gain slightly in competitiveness compared to the WEF rapport: Holland , Denmark, Poland, Malta, Latvia, Slovenia, Cyprus, Bulgaria. On the other hand, these countries lose a little bit: Finland, Sweden, the United Kingdom, the Slovak Rep. and Italy (down by up to 5 places).The best path for increasing the competitiveness of each economy is to follow on the solutions used in countries which are higher in the ranking. However, for example, Luxembourg, which is ranked in 10th place in the competitiveness ranking, does not have to catch up with all the countries ahead of it. The proposal here is to build an easy affordable strategy to improve each country's position in the rankings by adopting the pattern of a country which has a better position in the competitiveness ranking but at the same time is also the most similar. Relying on the experiences of country, which is more competitive but at the same time very similar, ensures easy implementation of the solutions selected. This approach only allows an indication of the countries from which a selected economy should draw patterns. The method does not, however, explain why two countries similar to each other occupy different positions in the competitiveness ranking.

A tool that allows analysis of each country's position in the ranking and allows us to find a better but most similar object, is a map of the objects. The map is a polar diagram, where each point on the map is defined by two values. The first value is the value of the synthetic variable (a measure of angle), with the worst countries on the left and the best objects in the ranking on the right). The second value is the distance matrix for each selected country compared to the other countries (this distance is represented by semi-circles). The country analyzed is always at the bottom of the map, and the bold radius indicates the position of the country analyzed in the ranking. To identify the path to competitiveness growth, we need to pay attention to all the countries on the map lying to the right of the designated radius and at the same time closest to it.

The path of competitiveness growth for the Polish economy is illustrated in Figure 2. The semicircles define the metric distance of all the countries from the country located in the centre at the bottom of the figure (Poland). The radiuses from right to left (anticlockwise) determine the positions of the countries in the ranking. The numbers placed at the end of the last radius of the semi-circle represent the scale of the object values in the rankings. Analysis of this figure shows that to increase the competitiveness of the Polish economy, we should try to implement instruments for competitiveness growth policy based on Czech, Maltese and Estonian experiences.

Figure 2. Paths to competitiveness growth for the Polish economy



Source: own calculations based on calculations from Table 3.

Analogous maps have been drawn for each of the 27 countries. Due to lack of space, only the conclusions which can be drawn from these maps are presented in the table below. Table 4 indicates country to follow for each of the 27 EU countries

Table 4. Paths to competitiveness growth for each of the 27 EU countries

Country analyzed	Country to follow	Country analyzed	Country to follow
NL		MT	Estonia, Luxemburg
SE	Netherlands	PL	Czech Rep., Estonia
FI	Sweden, Netherlands	LT	Poland, Malta
DE	Sweden, Netherlands	CY	Lithuania, Poland
DK	Germany, Netherlands	PT	Spain, Ireland
GB	Netherlands, Germany	SI	Cyprus, Latvia
AT	Denmark, Germany	LV	Slovenia, Lithuania
BE	Austria, Denmark	IT	Portugal, Spain
FR	Germany, United Kingdom	HU	Poland, Czech Rep.
LU	Belgium, Austria	SK	Hungary, Poland
IE	France, Belgium	BG	Hungary, Poland
EE	Luxemburg, France	RO	Slovakia, Hungary
ES	Ireland, Estonia	GR	Italy, Portugal
CZ	Estonia, Luxemburg		

Source: own calculations

CONCLUSIONS

This paper focuses on the identification of similarity in the competitiveness of the EU-27 countries. The cluster analysis has confirmed the hypothesis that the European Union is an area which can be divided into large clusters with very different levels of competitiveness. Therefore, it is suggested that one unified strategy to increase EU competitiveness is not a good solution. A new concept of individual competitiveness growth strategy for each EU country has been proposed, based on the implementation of proven solutions from other EU countries which have a better position in competitiveness ranking but at the same time are the most similar. In order to determine the path to competitiveness growth, the creation of maps based on each country's position in the competitiveness ranking (ranking based on the synthetic variable) and the distance metric of the selected country compared to other countries has been proposed.

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