EUROPEAN UNION MEMBER STATES DISPARITY BASED ON THE EUROPE 2020 AGENDA INDICATORS*

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The paper focuses on the disparity of individual European Union countries. Inequality indicators in the evaluation of the population living in EU countries have a significant impact on the comprehensive assessment of regions. Factor analyses were used for a comprehensive evaluation of the indicators. The article used two different approaches to determine the order of the Member States with an emphasis on economic and environmental data. In the first case, authors used procedure for establishing a mathematical model using linear combination of input variables and the factorial loads for the variable. This variable explains the most variance of original variables. In the second procedure the authors used the value of the number of the newly created variables and in turn reflected the values of all four newly created variables. The most prominent improvement was achieved by Malta. It has been evaluated by both the methods (method A: score 6-1 and the method B: score 21-10). Both methods agree on Bulgaria being on the last place ranking in both years of observation (method A: 27-27, method B: 27-27). Authors applied an index analysis for the changes of the number of persons employed in agriculture sector. Authors used statistical software STATISTICA 9.2.

Europe 2020; differences; environment; agriculture; multivariate statistical methods; factor analysis

INTRODUCTION

The paper focuses on monitoring of regional differences and mapping of disparities between EU countries. Indicators are chosen to represent the Europe 2020 Agenda with an emphasis on economic and environmental data. This agenda builds on the Lisbon Strategy, which was initiated by the European Union in 2000 with the aim to make the EU the most competitive and dynamic knowledge-based economy in the world by 2010.

Europe 2020 foresees three priorities: development of knowledge-based economy, creating more competitive and greener economy, and support of high employment rate and training of people. Goals of the Strategy for jobs and smart, sustainable, and inclusive growth agenda in Europe 2020, which should be achieved in 2020 (published on 3rd March 2010; Document Com., 2010) are as follows:

- 75% of the population aged 20–64 years should be employed,
- 3% of EU GDP should be invested in research and development,
- climate and energy should be achieved by the "20-20-20" (including an increase in commitment to reduce emissions to 30% if the conditions are right),
- the proportion of early school leavers should be below 10% and at least 40% of generation aged 30–34 years should have a tertiary level of education,
- number of persons at risk of poverty in the EU would fall by 20 million.

To achieve these objectives, eleven indicators that are monitored by Member States have been selected: the employment rate in the age group 20–64 years, gross domestic expenditure on research and development, greenhouse gas emissions, the share of energy from renewable sources in gross final energy consumption, energy intensity economy, students dropping out of education and training, university educated people in the age group of 30–34 years, the percentage of the population at risk of poverty and hardship, living in households with low-intensity work, people at risk of poverty if social transfers change, deep material deprivation (the poorest people).

Perhaps the most controversial environmental assessment are the indicators of the environment of a particular state. The reason is the dependence of these economic indicators and economic situation of the Member State. Three possible scenarios of Europe by 2020 in which the development of the EU economy is predicted (Document Com., 2010) were published: optimistic 'Sustainable recovery', pessimistic

* Supported by IGA (Internal Grant Agency of the Faculty of Economics and Managemetn of CULS Prague), Project No. 20121068.

Table 1. Objectives and indicators Europe 2020 Agenda

Target	Pointer
75% of the population aged 20-64 years should be employed	The employment rate in the age group 20 to 64 years. In a more detailed breakdown by gender.
3% of EU GDP should be invested in research and development	Gross domestic expenditure on research and development.
The objectives of the climate and energy '20-20-20'	Emissions of greenhouse gases. The share of renewable sources in gross final energy consumption. Energy intensity of the economy.
Early school leavers ≤ 10 % , higher education ≥ 40 %	Students dropping out of education and training. University educated people in the age group 30-34 years, in a more detailed breakdown by gender.
Reducing poverty and social exclusion by 20 million	Number of persons at risk of poverty and privation. People living in households with low-intensity work. People at risk of poverty in changing social transfers. Severe material hardship. *In June 2010 the European Commission set this : the goal of poverty reduction will be determined using a combination of three indicators (poverty risk, the degree of material deprivation, the proportion of people living in jobless households), Member States may establish national goals. According RILSA - L. Prusa.*

Source: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/europe_2020_indicators/headline_indicators

'Wasted decade', average 'slow recovery'. For the evaluation of this article the method of factor analysis was used. The same procedure was given by Žižka et al. (2009). Navilas and Malakauskaite reported that the most appropriate tool for mapping regional disparities is cluster analysis, being the main tool for the simulation of the growth of regional economies (Navilas, Malakauskaite, 2009). In our case, this procedure is also possible for the evaluation of the EU countries. It does not determine the exact ranking of countries, but it only finds clusters of similar states based on the selected indicators.

A different approach was used by Ivančíková et al. (2010). Their research deals with the measurement of poverty by using binary logistic regression, as one of the five main goals of the Europe 2020 strategy. The overall results derived from this article show that Member States must take more of the national objectives to reach the required limits.

Another possible approach for solving one of the objectives of the Europe 2020 strategy deals with the territorial distribution of the European objective for 2020 of reducing early school leaving by Tolon-Becerra, Lastra-Bravo (2011). Their paper deals with dropping out of school (not finishing the degree or school). The aim of this article was to outline a new look at resolving this issue. The present authors used the methods of 'decentralized weighted decisions' (Tolon-Becerra, Lastra-Bravo, 2011).

METHODS

Table 1 lists the objectives and related indicators to be monitored in the article. The data are freely available from Eurostat databases. The indicators are calculated according to the international methodologies and comparable data are fully representative. For all the calculations the statistical program STATISTICA 9.2 as used.

For a comprehensive assessment of selected indicators multivariate statistical methods – factor analysis – have been selected. The aim of the factor analysis is to reduce the number of variables (to reduce data dimension), and to identify relationships between variables. This method allows for a smaller number of non-measurable variables standing behind that are common to all factors. The authors used the data from agenda Europe 2020 in Table 1.

The main emphasis of this method is given to the validity and meaningfulness of factors. Interpreter provides the best result of the rotated factor analysis solution that is closest to the condition of mutual non-correlation where independence is a common factor in factor analysis model.

Factor analysis can be very useful especially when trying to assign weights for the individual indicators and ranking. (Hendl, 2006), Factor analysis was used for the following reason: factor analysis is a technique of classification of multiple cases using the

Table 2. Basic characteristics of selected variables presents the basic characteristics of selected indicators

Variable	Average		Median		Minimum		Maximum		Coefficient of Variation	
	2000	2009	2000	2009	2000	2009	2000	2009	2000	2009
1)	67,3	69,4	67,8	69,5	55,3	58,7	78,0	78,8	9,1	7,8
2)	1,3	1,6	1,1	1,5	0,2	0,5	4,1	4,0	72,9	62,4
3)	93,0	88,6	98,0	90,0	39,0	40,0	173,0	178,0	34,1	36,4
4)	11,7	12,9	7,4	9,1	0,1	0,2	42,7	44,4	90,6	83,5
5)	366,1	281,2	204,9	186,5	114,0	106,7	1332,9	842,5	83,2	67,4
6)	17,2	13,5	15,1	11,2	5,7	4,9	54,2	36,8	63,1	58,7
7)	23,1	33,3	25,4	32,8	7,4	16,8	42,6	49,0	41,9	32,2
8)	26,9	23,6	24,8	22,0	14,4	14,0	61,3	46,2	43,0	34,3
9)	9,4	8,1	9,4	7,0	4,4	4,0	15,1	19,8	30,7	38,4
10)	14,6	16,0	15,0	15,1	8,0	8,6	21,0	25,7	24,7	25,5
11)	13,6	9,6	6,4	6,1	1,8	1,1	57,7	41,9	106,1	100,7

Source : own processing outputs STATISTICA 9th

1) Employment rate in the age group 20-64 years,

2) gross domestic expenditure on research and development,

3) greenhouse gas emissions,

4) the share of energy from renewable sources in gross final energy consumption,

5) the energy intensity of the economy,

6) students dropping out of education and training,

7) higher education people in the age group 30-34 years,

8) percent of the population at risk of poverty and distress, according VUPSV (Research Institute of Labour and Social Affairs) risk of poverty rate,

9) persons living in households with low labor intensity, according VUPSV proportion of people living in households without a staff person,

10) people at risk of poverty in changing social transfers,

11) severe material deprivation (the poorest people), according VUPSV material deprivation.

number of variables and derived synthetic criteria. And this is also the description of our variables. Factor analysis model always provides outputs for decision – making between classes of nominal variables, the specification of dependencies between numeric variables, and the dependent variables categories. (H e b á k , 2005)The order may be obtained on the basis of model equations according to the procedure of S v a t o š o v á et al. (2005). This paper is based on her procedure. Several newly created variables can assemble the order of monitored objects. It depends on the number of specified importance (weight). For construction of the importance represented by *wi*, relationship $VK \times KK$ was used (*VK* is the importance (load) of components, which aims to characterize the explanation variability of each component, and *KK* is the correlation coefficient of correlation with the components). These two methods were used to show that even a small extension of this procedure could significantly affect the order of the states.

RESULTS

Table 2 presents the basic characteristics of selected indicators. These are the position and variability characteristics that give basic information about the data set examined in 2000 and 2009.

Calculated on the basis of descriptive characteristics for the selected 11 indicators of Europe 2020, it was stated that the average employment rate of the group of people between 20–64 years is approaching the level of 70%. However, to achieve the goal it is necessary to achieve 75% employment rate for this age group. Growth of the monitored indicator was recorded at 2, 4, 7, and 10 variables. The most significant difference was observed in energy-intensive economy. It was decline of 84.9 (kg of oil equivalent per 1000 Euro). When comparing the mean and median, it is possible to isolate those factors that most divide EU countries to the developed and the others. The examples could be above-mentioned energy-intensive economy, the share of energy from renewable sources in gross final energy consumption and heavy material hardship.

Variability is the lowest employment rate at the age group of 20–64 years (2000 = 9.1%, 2009 = 7.8%). The following is an indicator of poverty risk, where the coefficient of variation is around 25%. The highest values of dispersion were found in severe indicators – in material deprivation, in the share of renewable energy sources, in gross final consumption, and energy

Table 3. Eigenvalues and variance percentages of the total newly arising factors for 2000, 2009

Order	2000		2009	
	Eigenvalue	% of total variance	Eigenvalue	% of total variance
1.	4,2	38,0	4,3	39,4
2.	2,4	22,1	2,1	19,0
3.	1,3	11,5	1,3	12,0
4.	1,1	9,5	1,3	11,6

Source: own processing outputs STATISTICA 9

Table 4. Factor loadings newly established factors for 2000, 2009

Variables	2000				2009			
	1.	2.	3.	4.	1.	2.	3.	4.
1)	-0,4	-0,3	-0,4	**0,5**	0,2	-0,4	**0,7**	-0,1
2)	-0,4	-0,5	-0,1	**0,6**	0,0	-0,5	**0,7**	-0,3
3)	**-0,8**	0,3	0,0	-0,1	**-0,8**	-0,4	-0,1	0,0
4)	0,2	-0,1	**-0,7**	0,5	0,0	0,2	**0,9**	0,2
5)	**0,9**	-0,1	0,0	-0,2	**0,6**	0,5	-0,2	0,4
6)	-0,2	**0,7**	0,0	-0,4	**-0,8**	0,3	-0,1	0,1
7)	-0,2	0,0	0,1	**0,9**	0,0	-0,2	0,4	**-0,7**
8)	**0,9**	0,3	0,1	-0,1	0,2	**0,9**	-0,2	0,1
9)	0,3	-0,1	**0,8**	0,3	0,0	0,0	-0,3	**-0,9**
10)	0,1	**0,9**	0,1	0,1	-0,2	**0,9**	0,0	0,0
11)	**0,9**	0,1	0,1	-0,2	0,4	**0,8**	-0,2	0,2

Source: own processing outputs STATISTICA 9

Explanatory notes are shown in Table 2.

intensive economy. The developed states can be identified according to the following statistical indicators:

(1) employment rate in the age group 20–64 years,

(2) gross domestic expenditure on research and development,

(3) greenhouse gas emissions,

(4) the share of energy from renewable sources in gross final energy consumption,

(5) the energy intensity of the economy,

(6) students dropping out of education and training,

(7) higher education people in the age group of 30–34 years,

(8) percentage of the population at risk of poverty and distress, according VUPSV risk of poverty rate,

(9) persons living in households with low labour intensity, according to the Research Institute of Labour and Social Affairs (VUPSV) proportion of people living in households without a staff person,

(10) people at risk of poverty in changing social transfers,

(11) severe material deprivation (the poorest people), according VUPSV material deprivation.

The above-specified variables were first calculated by using different methods of rotated factor analysis. Further they were also examined on the basis of the value of the Akaike information criterion. The rotated solution by using the Varimax method was selected. Varimax minimizes the number of variables that have a high load of common factor to each variable. It can be also called as a method of simplifying factors. This method tends not to create a general factor.

If the given values of the newly created variables (factors) are greater than 1, it is possible to consider their further classification (according to Kaiser‘s rule). The newly created variable in the year 2000 explains 38% of the variability of the original variables. In 2009, the value of the number rose to 4.3. This variable explains more variability in the original variables at a rate of 39.4%. The values and the percentage of the total variance are shown in Table 3. To determine the order of each member state, it is required to provide values of factor loads (Table 4).

The newly created factors for 2000

The first factor is called Ecology and Poverty. It is related to greenhouse gas emissions, energy-intensive economy and people who suffer the most.

The second factor is called Socially Vulnerable People – students dropping out of education and training, change in social transfers. The strongest correlation in the second factor is between the students dropping

Table 5. Ranking Member States 2000, 2009

State	Method A		Method B	
	2000	2009	2000	2009
Belgium	16	16	13	4
Bulgaria	27	27	27	27
Czech Republic	23	24	22	23
Denmark	1	5	8	16
Germany	13	15	9	5
Estonia	24	26	24	25
Ireland	2	2	11	14
Greece	15	10	18	12
Spain	7	3	17	18
France	12	13	7	6
Italy	4	7	14	13
Cyprus	14	4	19	17
Latvia	21	20	2	19
Lithuania	22	22	20	21
Luxembourg	10	11	12	11
Hungary	19	21	16	22
Malta	6	1	21	10
Netherlands	8	14	10	7
Austria	3	8	4	8
Poland	20	19	1	20
Portugal	9	6	23	9
Romania	26	25	25	26
Slovenia	18	18	15	2
Slovakia	25	23	26	24
Finland	17	17	5	1
Sweden	11	12	3	3
United Kingdom	5	9	6	15

out of education and training and people who are the most vulnerable to changes in social transfers and domestic expenditure on research and development.

The third factor most correlates with the share of renewable energy and people living in households without a staff personnel. It is called The Support for Socially Disadvantaged People.

The fourth factor is called the Educational Policy of State and Its Impact on Employment. The strongest correlation in the fourth factor is the employment rate, spending on research and development, the share of renewable energy and college-educated people.

The newly created factors for 2009

The first factor is called Ecology and Students Dropping out of Education and Training.

The second factor is called Poverty and Social Policy Changes. The strongest correlation in the second factor is the domestic expenditure on research and development, energy-intensive sectors, the level of risk of poverty and material deprivation

The third factor is the most correlated with the level of employment, support for science and research and a share of energy from renewable sources. It is called The Support for Employment and Science.

The fourth factor is called College Students and Entrepreneurs.

Commented were the factor loads of 0.5 or higher, depending on the newly created variables related to the specific year 2000, 2009. Factor loadings are shown in Table 4.

The order of the EU Member States

Newly created variables were always used to determine the order of the EU states. In the first case it was the procedure for establishing a mathematical

model. The procedure used linear combination of input variables and the factorial loads for the variables that explain the most variance of original variables (method A). In the second method (method B) the value of the number of the newly created variable was additionally used. The values of all four newly created variables were reflected in the order, see the method described by Svatošová et al. (2005). By using these procedures, very different results were achieved. Values of the order of the individual countries in 2000 and 2009 are shown in Table 5.

A procedure for 2000 and 2009 calculated for Belgium, Bulgaria, Ireland, Lithuania, and Finland are in the same order. According to the procedure, these states, comparing to other EU states, did not experienced any change in the order from 2000 till 2009. The greatest differences in the order for this process were calculated for countries: Denmark (1-5), Cyprus (14-4), Malta (6-1), Austria (3-8), and Great Britain (5-9). A wide range of factors that significantly influence the indicators, which were used in this article, may cause these differences. Procedure B for 2000 and 2009 calculated for Bulgaria (27-27) and Sweden (2-2) the same order. The largest differences in the order for this method B were calculated for the states: Belgium (13-4), Denmark (8-16), Germany (9-4), Greece (18-12), Lithuania (2-19), Hungary (16-22), Malta (21-10), Austria (4-8), Poland (1-20), Portugal (23-9), Finland (5-1), and the United Kingdom (6-15). The difference of the two selected methods is substantial. The difference is due to different calculation methods. The orders calculated according to procedures A and B are different. The first places, according to the method and appearing in 2000, for Denmark and Malta in 2009. For method B Poland was at first place in 2000 and in 2009 it was Finland. Yet the most prominent improvement was in Malta (approach A: 6-1 and B approach: 21-10). During the reporting period Malta increased by more than double the amount of spending on science and research, dramatically reduced the representation of energy-intensive economy, increased number of university educated people aged 30–34 years, and decreased the number of students dropping out of education and training. The last place ranking in both years of observation identically by both methods is Bulgaria (procedure A: 27-27, and procedure B: 27-27).

Of course we must not forget that an important factor, that affects the order of the factors, is also the choice of indicators. These indicators always have a major impact on the ranking of states.

The indicators are reflected in the national economy and their role in assessing the environment and ecology is very closely connected with agriculture. Therefore, specific indicators evaluating agriculture were analyzed.

Real income generated per worker increased by 5%. Between 2000 and 2009, employment in the agricultural sector in the EU27 decreased by 25%, i.e. by 3.7 million full-time jobs. It fell down by 17% in the EU15 and by 31% in the twelve Member States, which joined the EU in 2004 and 2007. In 2009, employment in the agricultural sector was equivalent to 11.2 million full-time jobs in the EU27, of which 5.4 million were in the EU15 and 5.8 million in the twelve Member States.

In 2009, the five Member States with the highest employment in the agricultural sector accounted for almost two thirds of the EU27 total: Poland (20% of EU27 employment in agricultural sector, the equivalent of 2.2 million full-time workers), Romania (19% and 2.1 million), Italy (10% and 1.2 million), Spain and France (both 8% and 0.9 million). Between 2000 and 2009, employment in the agricultural sector fell in all Member States. In general, the largest decreases were found among the twelve Member States: Estonia (–55%), Bulgaria (–48%), and Slovakia (–43%). The smallest decreases were registered in Greece (–3%) and Ireland (–4%). Among the five Member States with the highest employment in the agricultural sector, employment fell by 11% in Poland, 41% in Romania, 16% in Italy, and 17% in both Spain and France.

Between 2000 and 2009, real agricultural income per worker rose in seventeen Member States and fell in ten. The highest increases were found in Latvia (140%), Estonia (131%), Poland (107%), the United Kingdom (71%), and Lithuania (70%), and the largest decreases in Denmark (–46%), Italy and Luxembourg (both –36%), Ireland (–30%) and the Netherlands (–28%).

Between 2008 and 2009, real agricultural income per worker fell by 12% in the EU27. Real agricultural income per worker fell in 21 Member States, remained nearly unchanged in two and rose in four. The largest decreases were found in Hungary (–32%), Luxembourg (–25%), Ireland (–24%), Germany and Italy (both –21%), and the highest increases in Malta (8%) and Denmark (4%). Similar results were published in the article from Eurostat – news release (http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/5-07052010-AP/EN/5-07052010-AP-EN.PDF).

DISCUSSION AND CONCLUSION

Disparities of the EU Member States were evaluated on the basis of performed analyses. The largest benefit of statistical Multi-dimensional method is that it provides a comprehensive evaluation, i.e. evaluation of citation from several different points of view. It can also provide the comprehensive evaluation of all the used variables, and their mutual influences in the analysis. By using these properties, evaluation of the multidimensional statistical methods can be used as an appropriate option for the selected target. The article was focused on disparity between EU Member States evaluated on the basis of the Europe 2020 Agenda.

The results of the analysis showed interesting findings. In descriptive statistics, it was found that the average employment rate of 20–64 years is nearing the limit of 70%. However, in order to achieve the objective it must achieve a 75% employment rate for this age group which is most likely caused by the economic crisis in 2010. Influencing factors may be international companies, bankruptcy, indebtedness, etc. While comparing the average and median it is possible to put aside factors dividing most EU States into advanced and others. It is for example, the energy-intensive economy, the share of energy from renewable sources in gross final consumption of energy and material hardship. Factor analyses, which aim to reduce the number of variables and determine the relationship among the variables, were used for a comprehensive evaluation of the indicators. The results achieved by using different methods of factor analysis of rotated solution are showing interesting values. The value of the first newly established variable in 2000 explains 38% of the original variability of the variables. In 2009, the value of the own numbers increased from 4.2 to 4.3. This new variable explains more variation of the original variables, at a rate of 39.4%. Subsequently were found the load of factor, one of the factors is higher education of population aged 30–34 years. In this article, two different procedures were used. The difference is determined by computing procedure. The order calculated according to the procedures A and B is different to some extent, but the largest improvement in both the methods reached Malta (procedure and: 6-1 and the procedure (B): 21-10). Both methods agree on the last place of the order in both years of observation. On the last place is Bulgaria (procedure: 27-27, and procedure B: 27 and 27). According to above-mentioned method (A) on the first place is Denmark in 2000 and Malta in 2009. For method (B) Poland is in the first place in 2000, and Finland in 2009. The Czech Republic reached 23-24 by method (A) and 22-23 by approach (B), which is not a very positive outcome. But we can conclude that both methods give similar results for the Czech Republic, which is a slight change and minimum improvement for selected indicators, compared with the other Member States of the European Union. The Czech Republic is equally strong with other Member States only at one indicator — Market Share of Persons in the Population Living at Risk of Poverty and Social Exclusion (Hurdlíková, 2010).

The analysis enabled assessment based on multivariate statistical methods of disparity.

Hurdlíková in her study on "Europe 2020: The choice of method for determining the scales compilation of compound indicators" chose an objective method (equal weights), the method of principal components (factor analysis) and analysis of the Benefit of Doubt. By all these methods is in the first place Sweden, the Czech Republic being at 16th and/or 14th place. These methods have certain advantages and disadvantages. This study suggests that for better determination of the weights methods based on the attitudes of professionals and the general public should also be used. (Hudrlíková, 2011).

The paper "Assessment of Competitiveness of European Union Regions Chosen" is a comprehensive evaluation of selected EU regions at NUTS level 2. There have been selected multivariate statistical methods – factor analysis and cluster analysis. A similar procedure was used to detect differences among regions of the Czech Republic in this work. The difference is only in the use of rotated solutions (warimax normalized) for factor analysis (Odehnal, Michálek, 2009). The factor analysis achieved similar results, but without further calculation of the order.

Žižka et al. (2009) adopted a similar factor analysis. The conclusions are significantly different due to the use of different order of the EU Member States for calculation in this study. Compliance is only in the last place ranking.

When using cluster analysis, which, according to Navilas, Malakauskaite (2009) is the main tool for simulating the growth of regional economies, it is no longer possible to determine the exact order of the EU Member States, which was the main objective of this article. However, the use of multivariate statistical methods for complex evaluation of data is the same.

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Received for publication on February 16, 2012
Accepted for publication on December 19, 2012

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