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# Evaluation of Sustainable Development in the Member States of the European Union

# Ocena poziomu zrównoważenia rozwoju krajów Unii Europejskiej

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## Abstract

This study evaluates the level of sustainable development in 28 member states of the European Union in 2011-2013. Research was carried out based on the so-called Hellwig's development model method, which enabled the construction of a synthetic measure of sustainable development. It is based on indicators related to economic, social and environmental governance, as used in the European Union. The adopted method made it possible to evaluate the studied phenomenon as a whole, providing grounds for assigning the member states into four uniform groups characterised by a similar level of development. Group I, showing the highest level of sustainable development, comprised Sweden, Luxembourg, Slovenia, Denmark, Austria, and Finland. Conversely, Portugal, Bulgaria, Romania and Hungary were assigned to group IV.

**Key words:** the European Union, sustainable development, Hellwig development pattern

## Streszczenie

W opracowaniu dokonano oceny poziomu rozwoju zrównoważonego w 28 krajach członkowskich Unii Europejskiej w latach 2011-2013. Badania przeprowadzono w oparciu o metodę tzw. wzorca rozwoju Hellwiga, która umożliwiła skonstruowanie syntetycznego miernika rozwoju zrównoważonego. Bazuje on na stosowanych w Unii Europejskiej wskaźnikach, dotyczących ładu gospodarczego, społecznego oraz środowiskowego. Zastosowana metoda pozwoliła na kompleksową ocenę badanego zjawiska, dając podstawę do podziału krajów członkowskich na cztery jednorodne grupy charakteryzujące się podobnym poziomem rozwoju. Do grupy I, o najwyższym poziomie rozwoju zrównoważonego zaklasyfikowano Szwecję, Luksemburg, Słowenię, Danię, Austrię i Finlandię. W grupie IV znalazły się natomiast Portugalia, Bułgaria, Rumunia i Węgry.

**Słowa kluczowe:** Unia Europejska, rozwój zrównoważony, wzorzec rozwoju Hellwiga

### Introduction

In 1987 the United Nations World Commission on Environment and Development published *Our Common Future*, also known as the Brundtland Report (WCED, 1987) containing a catalogue of risks and challenges for the future desirable development of civilization (Mazur-Wierzbicka, 2005). According to a definition in the report: *sustainable development is development that meets the needs of the present*

*without compromising the ability of future generations to meet their own needs* (WCED, 1987).

In 1990 sustainable development became a political principle in the European Union. In 2001 in Gothenburg, the European Council established a sustainable development strategy (SDS) which was renewed in 2006 and aimed *to meet the needs of the present without compromising the ability of future generations to meet their needs*. This idea was also incorporated in the strategy *Europe 2020* proposed by the European Commission (2010). Apart from the above-mentioned strategies it is also present in many other Community documents and initiatives (Kryk, 2012).

This study aims at evaluating the level of sustainable development in the member states of the European Union. It was assumed, according to the definition of sustainable development, that improvement in the life quality and wellbeing of the present and future generations can be attained by an integrated approach to economic development, environmental protection and social justice. The starting point for the studies was the indicators covered by EU's methodology grouped into ten thematic areas.

## Materials and method of research

The level of sustainable development of 28 member states of the European Union was determined by means of one of the most popular taxonomic methods – Hellwig's taxonomic model. The study material was data from the Eurostat database. At the first stage of the study procedure, the indicators were initially selected based on literature research (Borys, 2005; Wskaźniki…, 2011; Bal-Domańska, Wilk, 2011; Sustainable…, 2013; Getting…, 2013). 52 diagnostic variables were selected and verified against compliance with formal criteria. Out of this group 46 variables eligible with the indicated criteria were classified for further investigation. At the next stage statistical criteria were taken into account and quasi-constants for which the coefficient of variation was lower than 10% were eliminated from the set of variables. Thus, the indicators removed from the set of indicators included, for instance: life expectancy in absolute value at birth – females (V=2,60%), life expectancy in absolute value at birth – males (V=4,80%)), healthy life years at birth in percentage of the total life expectancy – males (V=5,60%), healthy life years at birth in percentage of the total life expectancy – females (V=6,90%), Net national income at market prices – % GDP (V=8,10%), duration of working life (V=8,40%), employment rate (20 to 64 years), employment rate by age and highest level of education attained (%) – 20-64 years (V=9,50%).

Afterwards, based on the statistical criteria, excessively correlated variables were eliminated from the set according to Pearson's correlation coefficients matrix. They were not included in further investigation since they carried identical informational value. Ultimately 23 diagnostic variables were selected for the analysis evaluating the level of sustainable development in the member states of the EU. The variables were included in the following thematic groups:

**1. *Socioeconomic development*:**

$x_1$ - *GDP aggregates per capita (Euro*),
$x_2$ - *Real Effective Exchange Rate (deflator: unit labour costs in the total economy - 37 trading partners*),

**2. *Sustainable consumption and production*:**

$x_3$ - *Waste generated - kg per capita*,
$x_4$ - *Passenger cars per 1 000 inhabitants*,
$x_5$ - *Share of total organic crop area out of total Utilised Agricultural Area* (%)

**3. *Social inclusion*:**

$x_6$ - *Income quintile share ratio (in %*),
$x_7$ - *Long-term unemployment in % of active population*,
$x_8$ - *Gender pay gap in unadjusted form (in %)*,
$x_9$ - *Early leavers from education and training - 18-24 years*,
$x_{10}$ - *Participation rate in education and training (last 4 weeks) - 25-64 years (in %)*,
$x_{11}$ - *Expenditure on education as % of GDP (2011*).

**4. *Demographic changes*:**

$x_{12}$ - *Employment rate of older workers (55 to 64 years)* (*in %)*,
$x_{13}$ - *Fertility indicators - total fertility rate* ( *in %)*,
$x_{14}$ - *At-risk-of-poverty rate by poverty threshold, 65 years or older - % of total population* (*in %)*,
$x_{15}$ - *Government consolidated gross debt ( % of GDP)*.

**5. *Public health*:**

$x_{16}$ - *Death rate due to chronic diseases - per 100000 persons*,
$x_{17}$ - *Self-reported unmet needs for medical examination* (*%*).

**6. *Climate change & Energy, Natural resources, Sustainable transport*:**

$x_{18}$ - *Greenhouse Gas Emissions (CO2 equivalent - thousand tones)*,
$x_{19}$ - *Air pollution (Tonnes*),
$x_{20}$ - *Protected areas for biodiversity: Habitats Directive - Area - km$^2$ (2013*),
$x_{21}$ - *Share of renewable energy in transport (in %)*,
$x_{22}$ - *Share of renewable energy in electricity* (*in %*),
$x_{23}$ - *Share of renewable energy in heating and cooling* (*in %).*

Among the selected variables features such as $x_3$, $x_6$, $x_7$, $x_8$, $x_9$, $x_{14}$, $x_{15}$, $x_{16}$, $x_{17}$, $x_{18}$, $x_{19}$, $x_{20}$ were considered to be smaller-the-better (STB) characteri-

Table 1. Statistical characteristics of diagnostic variables for EU member states, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| Variable | Mean | Minimum | Maksimum | Standard deviation | Coefficient of variation [%] |
|---|---|---|---|---|---|
| $x_1$ | 25054 | 5600 (Bulgaria) | 82400 (Luxembourg) | 16533 | 65,99 |
| $x_2$ | 104,82 | 86,75 (United Kingdom) | 141,11 (Bulgaria) | 12,70 | 12,12 |
| $x_3$ | 469,39 | 271 (Romania) | 668 (Denmark) | 119,21 | 25,40 |
| $x_4$ | 463,93 | 224 (Romania) | 665 (Luxembourg) | 101,18 | 21,81 |
| $x_5$ | 6,56 | 0,3 (Malta) | 18,6 (Austria) | 4,80 | 73,21 |
| $x_6$ | 4,78 | 3,4 (Slovenia) | 6,6 (Greece) | 1,01 | 21,15 |
| $x_7$ | 5,10 | 1,1 (Austria) | 14,5 (Greece) | 3,40 | 66,59 |
| $x_8$ | 14,9 | 2,5 (Slovenia) | 30 (Estonia) | 6,54 | 43,87 |
| $x_9$ | 10,99 | 4,2 (Croatia) | 24,7 (Spain) | 5,18 | 47,10 |
| $x_{10}$ | 10,03 | 1,4 (Romania) | 31,6 (Denmark) | 7,63 | 76,09 |
| $x_{11}$ | 5,76 | 3,07 (Romania) | 14,09 (Greece) | 2,13 | 36,98 |
| $x_{12}$ | 47,50 | 32,9 (Slovenia) | 73 (Sweden) | 9,95 | 20,94 |
| $x_{13}$ | 1,58 | 1,28 (Portugal) | 2,01 (Spain) | 0,23 | 14,59 |
| $x_{14}$ | 15,5 | 5,5 (Netherlands) | 29,3 (Cyprus) | 6,11 | 39,41 |
| $x_{15}$ | 68,36 | 9,7 (Estonia) | 156,9 (Greece) | 35,10 | 51,35 |
| $x_{16}$ | 132,05 | 79,2 (Sweden) | 257,3 (Hungary) | 49,95 | 37,83 |
| $x_{17}$ | 4,94 | 0,1 (Slovenia, United Kingdom) | 23,5 (Latvia) | 5,98 | 121,11 |
| $x_{18}$ | 162294 | 3140 (Malta) | 939083 (Germany) | 222703 | 137,22 |
| $x_{19}$ | 192018 | 2066 (Luxembourg) | 1082838 (Spain) | 273556 | 142,46 |
| $x_{20}$ | 155241 | 316 (Malta) | 549192 (France) | 159506 | 102,75 |
| $x_{21}$ | 3,84 | 0 (Cyprus) | 12,9 (Sweden) | 2,96 | 77,04 |
| $x_{22}$ | 23,52 | 1 (Malta) | 66,5 (Austria) | 16,79 | 71,39 |
| $x_{23}$ | 22,66 | 2,3 (United Kingdom) | 65,7 (Sweden) | 15,57 | 68,71 |

stics[1]. Among the selected variables features such as $x_3$, $x_6$, $x_7$, $x_8$, $x_9$, $x_{14}$, $x_{15}$, $x_{16}$, $x_{17}$, $x_{18}$, $x_{19}$, $x_{20}$ were considered to be smaller-the-better (STB) characteristics reducing the synthetic measure of sustainability, whereas the rest were regarded as larger-the-better (LTB) characteristics having a positive influence on the said measure.

For the selected features statistical characteristics were determined as illustrated in Table 1. The table presents a disparity regarding respective variables between different member states of the European Union, expressed as the minimum values, mean value and coefficient of variation. The coefficient of variation for the indicators used in the analysis ranged from 12% to more than 142%. The highest variation was recorded for factors characterising environmental aspects, e.g. air pollution (V=142.46%) and greenhouse gas emissions (V=137.22%). On the other hand, the variable describing the actual exchange rate where the coefficient of variation was 12.12% showed the least variation.

## Determination of the level of sustainable development in the member states of the EU by means of Hellwig's development model method

In the course of investigation 28 EU member states were classified according to the level of sustainable development. The classification was based on Hellwig's development model method[2] with regard to the fact that it synthesises factors of various nature (deriving from different sources) and assigns them a single synthetic aggregate measure (Mika, 1995). This method is also referred to as *guided recognition* (Kisielińska, 2008). Used in the performed analyses it allowed a comparison between all member states

[1] Smaller-the-better characteristic are variables for which low values are desirable from the point of view of a given phenomenon, whereas higher values are undesirable. By contrast, larger-the-better characteristics are variables for which low values are undesirable from the point of view of a given phenomenon, whereas higher values are desirable.

[2] It is a model formula of aggregation of variables based on the constructed model object, the so-called development model created on the grounds of the optimum variables (the most favourable in the entire population).

of the European Union providing grounds for classifying them into uniform groups characterised by a similar level of sustainable development.

Prior to constructing the synthetic variables, the smaller-the-better characteristics were transformed into larger-the-better characteristics according to the following formula (Ostasiewicz, 1999):

$x_{ij} = \frac{1}{x_{ij}}$ and then the features were standardised (Bąk, 2007) according to the formula:

$z_{ij} = \frac{x_{ij} - \bar{x}_{ij}}{s_j}$, where: $i$ – object number, $j$ – feature number.

Such transformed features were subjected to the development model method which assumes the existence of a model (reference) object with reference to which the taxonomic distances between the investigated objects are determined.

This study determines the distance of each object from the set model by means of the taxicab metric,

where: $d_i = \sum_{j=1}^{m} \left| zij - z0j \right|$,

The resulting $d_i$ values were used for computing Hellwig's synthetic measure of development:

The $z_i$ indicator assumes values within the range <0;1>, whereas values closer to one are closer to the model and so are associated with a high level of the investigated object. Next, $z_i$ values were arranged in a linear manner in descending order and based on this arrangement typological unit classes were identified with four disjoint subsets of similar objects as follows (Mika, 1995):

Group I: $z_i \geq \bar{z} + s_z$,

group II: $\bar{z} \leq z_i < \bar{z} + s_z$,

group III: $\bar{z} - s_z \leq z_i < \bar{z}$,

group IV: $z_i < \bar{z} - s_z$

where: $\bar{z}$ - arithmetic mean, $s_z$ - standard deviation of the taxonomic measure of development.

According to the values of the $z_i$ indicator the member states were assigned to one of the four groups with regard to their level of sustainable development. Group I consisted of member states with the highest while group IV was with the lowest level of sustainable development.

The level of sustainable development in the EU member states was evaluated based on all 23 variables, and the outcomes of the analysis were recorded in Table 2. The highest synthetic evaluation of the level of sustainability was awarded to 6 member states assigned to group I – Sweden, Luxembourg, Slovenia, Denmark, Austria and Finland. Group II consisted of 4 member states representing an outstanding level of sustainable development, i.e. Malta, Estonia, the Netherlands and the Czech Republic. Group III, displaying an average level of sustainable development, was at the same time the most numerous one as it consisted of 14 member states: Latvia, the United Kingdom, France, Slovakia, Germany, Belgium, Lithuania, Cyprus, Ireland, Poland, Croatia, Spain and Greece. Group IV, characterised by the lowest level of sustainable development among the member states of the European Union, consisted of 4 countries, i.e. Portugal, Bulgaria, Romania and Hungary.

Table 2. Classification of EU member states according to the value of the synthetic measure describing the level of sustainable development, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| Group number | The number of countries in the group | The level of measurement | The member states of the European Union |
|---|---|---|---|
| I | 6 | above 0,34274 | Sweden, Luxembourg, Slovenia, Denmark, Austria, Finland |
| II | 4 | from 0,257055 to 0,342739 | Malta, Estonia, Netherlands, Czech Republic |
| III | 14 | from 0,17137 to 0,257054 | Latvia, United Kingdom, France, Slovakia, Germany, Belgium, Lithuania, Italy, Cyprus, Ireland, Poland, Croatia, Spain, Greece |
| IV | 4 | below 0,171369 | Portugal, Bulgaria, Romania, Hungary |

Table 3. Mean values of variables describing the level of sustainable development in terms of social and economic governance, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Socioeconomic development | |
|---|---|---|
| | $x_1$ | $x_2$ |
| I group | 43967 | 106,03 |
| II group | 21000 | 114,07 |
| III group | 22529 | 101,43 |
| IV group | 9575 | 105,59 |

Considering indicators which characterise social and economic governance in the area of the GDP per capita ($x_1$) diagnostic variable, a significant inequality was observed between group I for which the mean value exceeded 43 967 euro, and groups II and III with income reaching the level of about 22 thousand euro. The lowest GDP per capita was recorded in the member states representing group IV characterised by the lowest level of sustainable development with

the grand mean[3] being 9575 euro per person only. It is worth emphasising that, according to economists, GDP is an unquestionable measure of the level of development of a country (Kaczyńska, 2001). On the other hand, sustainable development and an increase in welfare are not conflicting ideas but rather the first one emphasizes the necessity to optimise management in terms of reducing the consumption of raw materials, energy and water and minimising the negative impact of business activity on the environment and building up the spiritual dimension in the realm of human life (Kubiczek, 2014). Thus, a more than 4-fold difference in the mean value of the discussed measure between the two extreme typological groups points to a strong inequality in the sustainability of respective member states of the EU with respect to social and economic development.

No significant inequalities between respective groups were recorded for the actual exchange rate ($x_2$) indicator facilitating the evaluation of whether a specific country is cost competitive in comparison to others. However, it is worth noting that the lowest total mean value (101.43) of that indicator was recorded in group III, while the highest (114.07) in group II. Groups I and IV both showed similar values – about 106.

Table 4. Mean values of variables describing the level of sustainable development in terms of sustainable production and consumption, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Sustainable production and consumption | | |
|---|---|---|---|
| | $x_3$ | $x_4$ | $x_5$ |
| I group | 535,33 | 533,83 | 10,07 |
| II group | 432,00 | 491,50 | 7,73 |
| III group | 472,64 | 464,64 | 5,78 |
| IV group | 396,50 | 329,00 | 2,85 |

According to the Eurostat methodology another group of indicators evaluating the level of sustainable development includes variables illustrating sustainable production and consumption (Table 4). The results of the investigation indicate that the increasing volume of production waste ($x_3$) and the increasing number of passenger cars per 1000 citizens ($x_4$) are accompanied by an increase in the level of sustainable development. A similar relationship is observed in case of the share of ecological crops in the overall cropland ($x_5$) where an increase in such a share is connected with an increase in the level of sustainable development. At the same time it is worth noting that inequality in this area between group I and IV is nearly 350%.

In turn, the level of social integration fostering sustainable development was determined by means of 6 indicators (Table 5). The first indicator is the quintile share ($x_6$), which, for the purposes of this study, is a smaller-the-better characteristic with regard to the fact that it characterises unequal distribution of income within the population. According to the research conducted the level of sustainable development of a specific member state is higher when the inequality of the citizens' income is lower. This means that reduction in related inequalities fosters sustainable development. A similar relationship was noted for a variable describing long-term unemployment in the economically active population ($x_7$). This indicator reached the lowest value (2.03%) for citizens of member states from group I, often presenting the highest level of economic development, and its highest value (5.63%) was noted in group IV characterised by the lowest level of sustainable development. The problem of social inequality in the EU, including the disparity in the distribution of income, was raised in the document published by the European Commission (2010) entitled *Europe 2020: A strategy for smart, sustainable and inclusive growth*. The document sets three general priorities for the European Union: smart, sustainable and inclusive growth. This problem was also undertaken by I. Bal (2012) who claimed in her studies that there is a relationship between the level of income inequality and the share of citizens at risk of poverty in the population. The above-named author suggests that the largest internal variations in the level of income are observed in Portugal, Lithuania and Latvia.

Table 5. Mean values of variables describing the level of sustainable development in terms of social inclusion Source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Social inclusion | | | | | |
|---|---|---|---|---|---|---|
| | $x_6$ | $x_7$ | $x_8$ | $x_9$ | $x_{10}$ | $x_{11}$ |
| I group | 3,93 | 2,03 | 14,43 | 7,60 | 20,77 | 6,16 |
| II group | 4,10 | 3,35 | 18,90 | 11,43 | 11,73 | 5,89 |
| III group | 5,11 | 6,77 | 13,98 | 11,04 | 6,66 | 5,98 |
| IV group | 5,55 | 5,63 | 14,83 | 15,48 | 4,05 | 4,22 |

The level of social integration is also expressed as the gender pay gap ($x_8$). The results of investigation show that this feature had no strong influence on the distribution of the EU member states in terms of the synthetic measure of sustainable development. The highest (18.9%) pay inequalities were noted in group II, with the lowest in group III (13.98%).

Another feature determining the level of sustainable development with the highest mean value in group IV (15.48) is the share of early school leavers ($x_9$). At the same time it must be emphasised that the lowest value (7.60%) was recorded for that indicator in

[3] The grand mean is computed based on the mean for 28 EU member states.

member states from group I. Related guidelines are included in the strategy Europe 2020 assuming a reduction in the number of early school leavers to 10%. Participation in education ($x_{10}$) and share of expenditure on education expressed as a % GDP ($x_{11}$) are subsequent variables in the social inclusion area. The studies under discussion found that a positive correlation exists between those variables and the synthetic measurement of the level of sustainable development. Higher expenditure on education and a wider range of participation of citizens in various forms of education positively translates into sustainable growth.

Table 6 presents four variables describing demographic changes which have a significant impact on the level of sustainable development: rate of unemployment among elderly people ($x_{12}$), fertility rate ($x_{13}$), at-risk-of-poverty rate ($x_{14}$) and general government gross debt ($x_{15}$).

Table 6. Mean values of variables describing the level of sustainable development in terms of demographic changes Source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Demographic changes | | | |
|---|---|---|---|---|
| | $x_{12}$ | $x_{13}$ | $x_{14}$ | $x_{15}$ |
| I group | 51,50 | 1,67 | 15,17 | 48,58 |
| II group | 50,78 | 1,54 | 11,50 | 47,40 |
| III group | 46,25 | 1,60 | 16,43 | 83,89 |
| IV group | 42,63 | 1,41 | 16,75 | 64,65 |

Across typological groups an increase in the rate of economic activity of elderly people ($x_{12}$) is observed. Another feature describing demographic changes is the rate of fertility ($x_{13}$) reaching the highest value (1.67) in group I and the lowest (1.41) in group IV. This can be explained by the fact that an increase in development is also accompanied by an increase in the level of social welfare oriented at helping families and promoting safe maternity which fosters an increase in the rate of fertility within the specific community. Taking the at-risk-of-poverty rate ($x_{14}$) into account, it is difficult to identify a clear relationship between this feature and the level of sustainable development. The lowest value of the discussed indicator (11.5%) was noted in group II and the highest in group IV (16.75%).

The last feature describing the demographic aspect is public expenditure on state-funded pensions which increases public debt ($x_{15}$). The results of the investigation indicate that the above-mentioned indicator had no significant influence on the distribution of the member states across the identified typological groups. However, it is worth noting that in group I and II it is relatively low (ca. 48%), while in group III it was higher than 83%.

Variables describing the relationship between the evaluation of the level of sustainable development against the level of quality and access to health care services are presented in Table 7. According to the analysis carried out, a downward trend in death rate due to chronic diseases ($x_{16}$) is associated with an increase in the evaluation of the level of sustainable development and classification of the specific member state to a higher group. An identical relationship was noted for reported but not satisfied medical requirements ($x_{17}$).

Table 7. Mean values of variables describing the level of sustainable development in terms of quality and access to health care services, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Public health | |
|---|---|---|
| | $x_{16}$ | $x_{17}$ |
| I group | 102,52 | 0,90 |
| II group | 121,63 | 1,28 |
| III group | 130,56 | 6,19 |
| IV group | 192 | 10,25 |

The last area characterising sustainable development comprised features describing climate change, natural resources and sustainable transport (Table 8). Due to the lack of many current figures allowing a description of sustainability characteristics for respective categories, the indicators were included in one group.

Table 8. Mean values of variables identifying the level of sustainable development in terms of climate change, natural resources and sustainable transport, source: own elaboration based on data from Eurostat pertaining to 2011-2013.

| The level of sustainable development | Climate change & Energy, Natural resources, Sustainable transport | | | | | |
|---|---|---|---|---|---|---|
| | $x_{18}$ | $x_{19}$ | $x_{20}$ | $x_{21}$ | $x_{22}$ | $x_{23}$ |
| I group | 46836 | 26365 | 150472 | 5,28 | 38,45 | 35,87 |
| II group | 86366 | 71389 | 41484 | 3,50 | 9,73 | 19,33 |
| III group | 257657 | 302747 | 195975 | 3,76 | 20,42 | 17,24 |
| IV group | 77636 | 173575 | 133580 | 2,33 | 25,78 | 25,15 |

These authors' own studies have shown that the highest greenhouse gas emissions (257557 thousand tonnes) ($x_{18}$) were recorded in member states from group III, while the lowest emissions (46836 thousand tonnes) were found in member states from group I. Analogous relationships were noted in terms of air pollution ($x_{19}$).

In turn, the distribution of the feature describing the size of areas protected for biodiversity conservation ($x_{20}$) in respective typological groups is varied and does not allow stating a clear relationship between its level and the level of sustainable development. With reference to the share of renewable energy in transport ($x_{21}$) it was observed that the share of RES in transport has a positive influence on a higher rating of sustainable development of the specific member state. Analysing the latter two variables, i.e. share of renewable energy in electricity generation

($x_{22}$) and share of renewable energy in heating and cooling ($x_{23}$), the highest level of these indicators was recorded in member states representing group I. This means that these member states are the fastest in reducing their dependency on fossil fuels, at the same time meeting the associated regulations of the European Commission.

## Conclusions

The investigation carried out made it possible to determine the level of sustainable development in 28 member states of the EU in 2011-2013. Three reasons must be indicated for which these studies make a significant contribution to literature concerning sustainable development. First, partial indicators used for the purposes of this study comprise a wide selection of variables describing social, economic and environmental aspects of sustainability. These variables are consistent with the Eurostat methodology used to evaluate the level of sustainable development. Secondly, the construction of a synthetic measure enabled a simultaneous evaluation of the level of sustainability of respective member states in all the main areas related to human life and activity. The third significant characteristic of these studies is their wide subjective range comprising 28 member states of the European Union.

The use of the taxonomic method (Hellwig's development model) allowed the classification of respective member states into one of four groups identified based on their sustainable development level. Group I representing the highest level of sustainable development consists of 6 EU member states, i.e. Sweden, Luxembourg, Slovenia, Denmark, Austria and Finland. Group II consisted of Malta, Estonia, the Netherlands and the Czech Republic. Group III was the most numerous as it consisted of 14 member states (Latvia, the United Kingdom, France, Slovakia, Germany, Belgium, Lithuania, Italy, Cyprus, Ireland, Poland, Croatia, Spain and Greece). In group IV, representing the lowest level of sustainable development, consisted of Portugal, Bulgaria, Romania and Hungary.

Analysing the mean values of respective factors in the member states representing the highest level of sustainable development, for 18 out all 23 investigated variables they are the most favourable (the highest for the larger-the-better characteristics and the lowest for the smaller-the-better characteristics) compared to the grand mean.

The country characterised by the highest level of sustainable development is Sweden, which had the most favourable values for 4 out of all 23 features: rate of employment of elderly people – 72%, minimum values of death rate due to chronic diseases – per 100000 persons – only 79, maximum values of the share of renewable energy in transport (12.9%) and the share of renewable energy in heating and cooling (65.7%).

In group IV, representing the lowest level of sustainable development, 12 out of 23 investigated features had very unfavourable values compared to the grand mean. A country with the lowest evaluation of the level of sustainable development among all the investigated member states was Hungary for which $z_i$ indicator amounted to 0.01373 only. That country recorded the highest (257.3%) rate of death due to chronic diseases.

The method applied revealed a significant disparity between sustainable development in the investigated member states of the EU. The results obtained support the usefulness of synthetic measures for evaluating the level of sustainable development. Nevertheless, limitations to their interpretation must be taken into account. The proposed approach to the evaluation of sustainable development must be considered as one of the many alternative methods of analysing the investigated issue which can add to a wide selection of instruments used so far. In addition, when analysing the presented results the specific characteristics of respective member states and their internal variation (territorial cohesion) must also be taken into consideration.

## References

1. BAL I., 2012, Marginalizacja i wykluczenie społeczne jako bariera rozwoju regionalnego, in: *Nierówności Społeczne a Wzrost Gospodarczy*, no 28, p. 252-262.
2. BAL-DOMAŃSKA B., WILK J., 2011, Gospodarcze aspekty zrównoważonego rozwoju województw – wielowymiarowa analiza porównawcza, in: *Przegląd Statystyczny*, vol. LVIII, no 3-4, p. 300-322.
3. BĄK I., 2007, Atrakcyjność regionów turystycznych w Polsce ze szczególnym uwzględnieniem warunków ekologicznych, in: *Statystyka w praktyce społeczno-gospodarczej*, ed. Ostasiewicz W., AE we Wrocławiu, Wrocław, p. 41-51.
4. BORYS T. (ed.), 2005, *Wskaźniki zrównoważonego rozwoju*, Ekonomia i Środowisko, Warszawa-Białystok.
5. EUROPEAN COMMISION, 2010, Europe 2020, *A European Strategy for Smart and Inclusive Growth*, Brussels.
6. EUROSTAT, *Getting messages across using indicators. A handbook based on experiences from assessing Sustainable Development Indicators*, http://ec. europa.eu/eurostat/documents 3859598/5936409/KS-GQ-12-001-EN.PDF (20.03.2015).
7. EUROSTAT, *Sustainable development in the European Union. 2013 monitoring report of the EU sustainable development strategy*, http://ec.europa.eu/eurostat/web/products-statistical-books/-/KS-02-13-237 (15.03.2015).

8. GUS, *Wskaźniki zrównoważonego rozwoju Polski*, Główny Urząd Statystyczny, Katowice 2011.
9. KACZYŃSKA B., 2001, Pomiar i monitoring w polityce społecznej, in: *Polityka Społeczna,* no 5-6, p. 30-38.
10. KISIELIŃSKA J., 2008, *Modele klasyfikacyjne prognozowania sytuacji finansowej gospodarstw rolniczych*, SGGW, Warszawa.
11. KRYK B. (ed.), 2012, *Gospodarowanie i zarządzanie środowiskiem*, Uniwersytet Szczeciński, Szczecin.
12. KUBICZEK A., 2014, Jak mierzyć dziś rozwój społeczno-gospodarczy krajów?, in: *Nierówności Społeczne a Wzrost Gospodarczy*, no 38, p. 40-56.
13. MAZUR-WIERZBICKA E., 2005, Koncepcja zrównoważonego rozwoju jako podstawa gospodarowania środowiskiem przyrodniczym, in: *Funkcjonowanie gospodarki polskiej w warunkach integracji i globalizacji*, ed. Kopycińska D., Katedra Mikroekonomii Uniwersytetu Szczecińskiego, Szczecin, p.33-43.
14. MIKA J., 1995, *Analiza statystyczna pozycji Polski na tle krajów Unii Europejskiej*, Spółka z o.o. „Śląsk", Katowice.
15. OSTASIEWICZ W., 1999, *Statystyczne metody analizy danych*, AE we Wrocławiu, Wrocław.
16. WCED (WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT), 1987, *Our Common Future*, Oxford University Press, New York.