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Assessment of Socio-Economic Sustainability in New European Union Members States in the years 2004-2012

Michał Bernard Pietrzak[1], Adam P. Balcerzak[2]

Abstract

Implementation of a concept of sustainable development is currently considered as a dominant paradigm for plans and programs of economic policy at regional, national and international levels. It can be seen in the case of most significant documents that are used as the guidelines for strategic planning in the European Union such as a Europe 2020 plan. This implies the need for constant monitoring of the progress achieved in this area by the European Union countries with application of quantitative tools. The main objective of the research is to assess the progress achieved by the new member states in the field of implementing the concept of sustainability. The analysis is focused on the socio-economic sphere at a macroeconomic level in the years 2004, 2008 and 2012. In the analysis Eurostat data is used. Sustainable development should be treated as a multi-dimensional phenomena. As a result, a concept of taxonomic measure of development was applied here. This method, proposed by Zdzisław Hellwig, is a useful tool for economic research. The main value of the Hellwig's proposals relates to its cognitive values in explaining economic reality, methodological simplicity and flexibility in its application. The tool can be used to analyze most of economic complex phenomena.

Keywords: *Hellwig's method, pattern of development, multivariate analysis, taxonomy, Socio-Economic Sustainable Development*

JEL Classification: *Q01, C38*

1. Introduction

The concepts of sustainability and sustainable development commonly form the core of long term growth strategies in developed countries. Its realization should help to build foundations for growth that additionally improves many social dimensions such as social inclusion or labour market situation (Müller-Frączek & Pietrzak, 2011; Wilk *et al*., 2013, Pietrzak & Balcerzak, 2016a). Effective long term application of the concept can be crucial for diminishing the negative consequences of globalization, domination of financial markets or macroeconomic budget constraints (Pietrzak & Łapińska 2015; Balcerzak *et al*. 2016; Pietrzak & Balcerzak, 2016b; Zinecker *et al*., 2016). Improving the conditions for sustainable development is one of the major issues in the case of European Union long-term strategic planning. It was pointed as the second priority of Europe 2020 plan (European Commission,

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2010; Balcerzak, 2015). As a result, implementation of the idea of sustainable development in the case of all European Union countries can be considered as an obligation, which is the subject of constant international monitoring. The problem is especially significant in the case of "new" member states that face the challenge of closing a development gap.

The main purpose of the article is to assess the progress achieved by ten Central European countries that joined the European Union after the year 2004 in the field of implementing the concept of sustainability. The research concentrates on the socio-economic sphere at a macroeconomic level. The study is based on the Eurostat data and is conducted for the years 2004, 2008 and 2012. The concept of sustainability is the subject of many controversies (Kopnina, 2016; Turečková, 2015; Bartniczak, 2014; Zielenkiewicz, 2014; Garriga & Mele 2004; Shrivastava, 1995). However, it is commonly accepted that this phenomenon must be analyzed from a multi-dimensional perspective. Thus, in order to conduct empirical international investigations, which can be useful at pointing best practices implemented by given countries, some tools of multiple-criteria analysis must be applied (Balcerzak, 2009, 2011, 2016, Balcerzak & Pietrzak 2016a, 2016b, 2016c). As a result, a concept of taxonomic measure of development proposed by Zdzisław Hellwig was used in the research.

2. The application of taxonomic measure of development in economic research

Taxonomic measure of development (TMD) is a tool commonly applied in spatial economic research that can be useful for describing variability of analyzed phenomena. In order to use this measure a given multivariate phenomenon is decomposed to some economic aspects, where each aspect describes a different part of the economic system. For each aspect a subset of potential diagnostic variables is selected. The variables enable to characterize the selected aspect and allow to describe it. Then, based on accepted diagnostic variables TMD is evaluated, which takes into account impact of all determinants of examined economic phenomenon. Thus, it allows a synthetic evaluation of its level. The application of the TMD in spatial economic research allows to assess current situation of the surveyed objects. The concept of TMD was proposed by Zdzisław Hellwig in 1968 (Hellwig, 1968). It should be stressed that the author have also disseminated the method in the world literature (Hellwig, 1972). Current development of the concept of TMD concentrates on taking into account spatial interdependence in the design of the measure, which can be found in the works of Antczak (2013), Pietrzak (2014) and Pietrzak *et al*. (2014).

The most important advantage of the Hellwig's concept relates to its cognitive values in explaining economic reality and flexibility in its application. The tool can be used to analyze

most of economic phenomena that have complex nature. There are two main limitations on the application of TMD in economic research. The first objective limitation is the availability of statistical data. The second one relates to researcher's knowledge and experience, which should allow to concretize properly an analyzed phenomenon and then to express its multi-dimensionality using single measurable economic aspects. In the case of the first problem cognitive values of the tool are not fully utilized or the tool cannot be applied. In the case of the second limitation the cognitive values of the tool are used improperly, which can lead to serious cognitive errors.

In the current research five diagnostic variables proposed by Eurostat relating to socio-economic sustainability were used. The variables are presented in table 1. The variable X_{3t} is a dis-stimulant as a result in the first stage it was transferred to stimulant. The remaining variables are stimulants. Then all the variables were standardized with classic standardization formula that is based on arithmetic mean and standard deviation.

Variable	Description of diagnostic variables
$\mathbf{X_{1t}}$	Socioeconomic development – real GDP per capita
$\mathbf{X_{2t}}$	Sustainable production and consumption – resource productivity (Euro per kilogram)
$\mathbf{X_{3t}}$	Social inclusion – people at risk of poverty or social exclusion (percentage of total population)
$\mathbf{X_{4t}}$	Sustainability under demographic changes – employment rate of workers aged 55-64 (percentage of total population)
$\mathbf{X_{5t}}$	Public Health – healthy life years and life expectancy at birth in years

Table 1 Diagnostic variables for sustainable development

In the next stage a TMD which is a distance of the measured objects form the pattern of economics development was estimated. In the research a constant pattern of economic development for all the years was used. It was given with the formula 1.

$$x_{0\,jt} = \max_{it} x_{ijt} \quad \text{for} \quad j \in S, \;\; i = 1, 2, ..., n; \;\; j = 1, 2, ..., p; \;\; t = 1, 2, ..., l, \tag{1}$$

where S relates to a set of standardized stimulants.

The distance from given pattern of economic development is estimated with the equation 2.

$$d_{i0t} = \sqrt{\sum_{j=1}^{p} (x_{ijt} - x_{0\,jt})^2} \quad i = 1, 2, ..., n; \;\; j = 1, 2, ..., p; \;\; t = 1, 2, ..., l. \tag{2}$$

TMD is given with formula 3.

$$d_{it} = 1 - \frac{d_{i0t}}{d_{0t}} \qquad i = 1, 2, ..., n;\ j = 1, 2, ..., p;\ t = 1, 2, ..., l, \tag{3}$$

where $d_{0t} = \bar{d}_{0t} + 2s_{dt}$, and $\bar{d}_{0t}$, s_{dt} are given with formula (4).

$$\overline{d_{0t}} = \frac{1}{n}\sum_{i=1}^{n} d_{i0t}, \quad s_{dt} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(d_{i0t} - \overline{d_{0t}})^2} \qquad i = 1, 2, ..., n;\ t = 1, 2, ..., l. \tag{4}$$

3. The results of measurement of sustainable development in Central European countries

According to the main purpose of the article TMD of sustainable development for 10 new European Union member states in the years 2004, 2008 and 2012 were calculated. The pattern of economic development was based on the maximum values of variables in the years 2004, 2008 and 2012, which ensures comparability of results. The countries were ordered starting with the once with the highest value of TMD to the once with its lowest value. Next, the economies were grouped to one of the two classes, where the classification criteria was the relation of the value of TMD for a given country to the value of median of TMD for whole set of countries. The first class grouped the economies with the value of TMD above median. Calculated values of TMD and the classes for the years 2004, 2008 and 2012 are presented in Table 2 and Figure 1.

2004				2008				2012			
Country	***TMD***	***Rank***	***Class***	**Country**	***TMD***	***Rank***	***Class***	**Country**	***TMD***	***Rank***	***Class***
Czech Republic	0,628	1	1	Czech Republic	0,679	1	1	Czech Republic	0,698	1	1
Slovenia	0,538	2	1	Slovenia	0,500	2	1	Lithuania	0,407	2	1
Estonia	0,369	3	1	Estonia	0,423	3	1	Estonia	0,382	3	1
Lithuania	0,321	4	1	Lithuania	0,393	4	1	Slovenia	0,332	4	1
Slovakia	0,295	5	1	Slovakia	0,294	5	1	Slovakia	0,321	5	1
Hungary	0,283	6	2	Hungary	0,270	6	2	Poland	0,315	6	2
Poland	0,249	7	2	Poland	0,253	7	2	Latvia	0,292	7	2
Latvia	0,234	8	2	Latvia	0,243	8	2	Hungary	0,289	8	2
Romania	0,182	9	2	Romania	0,145	9	2	Bulgaria	0,139	9	2
Bulgaria	0,094	10	2	Bulgaria	0,141	10	2	Romania	0,093	10	2

Table 2 Taxonomic measure of development for socio-economic sustainability for new European Union member states in the years 2004, 2008 and 2012.

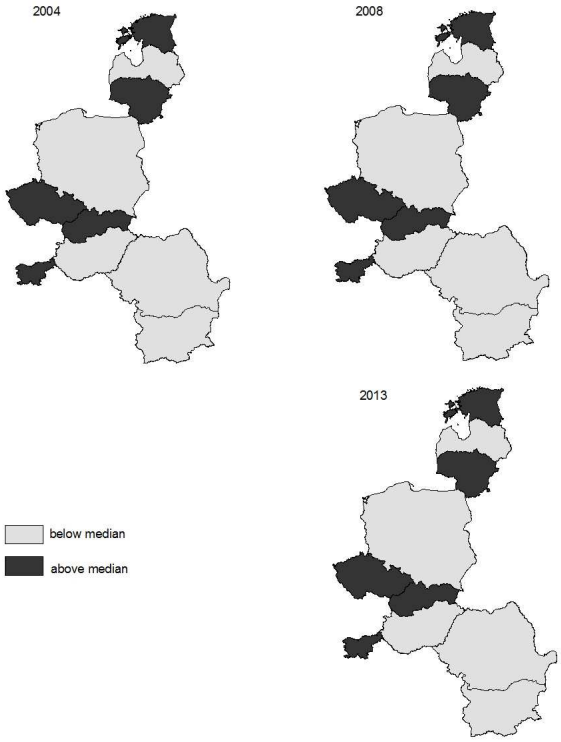

Fig. 1. Grouping of the countries based on the level of sustainable development.

2004-2008				2008-2012				2004-2012			
Country	*Percentage difference*	*Rank*	*Direc ton*	Country	*Percentage difference*	*Rank*	*Direc ton*	Country	*Percentage difference*	*Rank*	*Direc ton*
Bulgaria	50,42%	1	positi ve	Poland	24,35%	1	positi ve	Bulgaria	47,49%	1	positi ve
Lithuania	22,27%	2	positi ve	Latvia	20,08%	2	positi ve	Lithuania	26,79%	2	positi ve
Estonia	14,64%	3	positi ve	Slovakia	9,22%	3	positi ve	Poland	26,56%	3	positi ve
Czech Republic	8,10%	4	positi ve	Hungary	6,82%	4	positi ve	Latvia	24,85%	4	positi ve
Latvia	3,97%	5	positi ve	Lithuania	3,70%	5	positi ve	Czech Republic	11,16%	5	positi ve
Poland	1,78%	6	positi ve	Czech Republic	2,82%	6	positi ve	Slovakia	8,99%	6	positi ve
Slovakia	-0,21%	7	negat ive	Bulgaria	-1,95%	7	negat ive	Estonia	3,68%	7	positi ve
Hungary	-4,51%	8	negat ive	Estonia	-9,56%	8	negat ive	Hungary	2,00%	8	positi ve
Slovenia	-7,07%	9	negat ive	Slovenia	-33,47%	9	negat ive	Slovenia	-38,18%	9	negat ive
Romania	-20,52%	10	negat ive	Romania	-35,82%	10	negat ive	Romania	-48,99%	10	negat ive

Table 3 Changes of values of taxonomic measure of development in the years 2004, 2008 and 2012

Then, the percentage changes in the periods 2004-2008, 2008-2013 and 2004-2013 of the obtained values of TMD for all the countries were calculated. Also in that case the ranking of countries was done. Then the countries were grouped to two classed: a) set of countries that

were characterized with positive change of value of TMD; b) a set of countries with the negative change of value of TMD in the analyzed period. The results are presented in table 3 and figure 2.

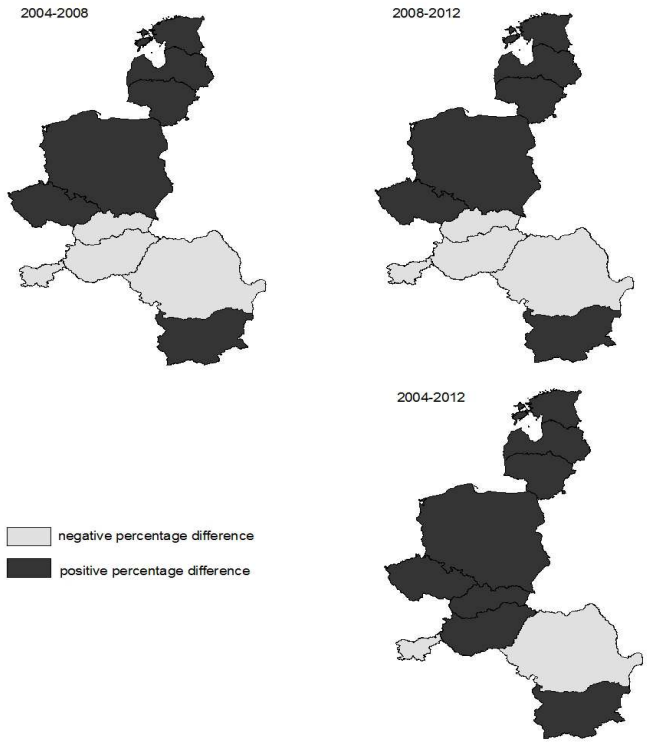

Fig. 2. Grouping of the countries based on the changes of level of sustainable development.

The conducted research confirms high stability of the relative results obtained by the analyzed countries in the years 2004-2012. In the whole period the values of TMD above median were obtained by Czech Republic (the leader of the ranking during the whole period), Slovakia, Estonia, Lithuania and Slovenia.

However, an interesting results can be found in the case of changes of the value of TMD in the analyzed years. The high positive changes of the values of TMD were mainly reached by the countries characterized with relatively weak results in the beginning of the analyzed period such as Bulgaria. This result can be considered as quite natural due to the "convergence process" in the field of implementing the European policy guidelines for supporting sustainable development. On the other hand, one can find relatively good results obtained by the leaders such as Czech Republic or Lithuania. In spite of the fact that these two countries were ranked in the first and second position from the perspective of the obtained TMD in the year 2004, in the years 2004-2012 they were able to improve the obtained values of TMD by 11,16% and 26,79% respectively.

Returning to the countries with the worst results in the year 2004 one can find mentioned Bulgaria, which in the whole analyzed period improved the values of obtained TMD by 47,49%. On the other hand, there is Romania that was the last one in the ranking in the year 2004, but in contrast to Bulgaria the value of TMD for this country decreased by 48,99% in the years 2004-2012.

4. Conclusions

The article concentrates on the multivariate phenomenon of sustainability in the "new" European Union member states. In order to evaluate the level of sustainable development in ten Central European countries taxonomic measure of development proposed by Zdzisław Hellwig was applied.

Very good results obtained in the whole period by the countries that were leaders in the first year of the research and the divergence between Bulgaria and Romania confirm that improvement in the field of implementing sustainability concept is not only a matter of "convergence process" easily and naturally reached by underdeveloped countries. It can be influenced by policy factors and many external and internal determinants that should be the subject of specific and detailed research.

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