DIMENSIONS OF SUSTAINABLE DEVELOPMENT IN ROMANIA - A DATA ENVELOPMENT ANALYSIS

Authors*:

Camelia BURJA, Vasile BURJA

***A**bstract. The efficiency registered by a country in the economic, social and ecological areas determines the growth pattern to achieve sustainable development. The contribution of each system component of sustainable development can be appreciated by various indicators. The main goal of this work is to present a possibility to evaluate the performance of new EU Member States related on the three important directions of sustainable development, using information from international databases. The paper used a Data Envelopment Analysis method for investigating the efficiency levels of sustainable development in the selected group of countries. These efficiency levels depend on each country's specific conditions in resources management. The application of the method led to obtaining an efficiency frontier, and the possibility of ranking the countries in accordance with their relative scores of sustainable performance. The results obtained highlight that Romania did not register enough efficiency in using its economic, social and ecological resources, since consistent possibilities to improve the sustainable performance existed. Some measures are identified for reducing the gaps between the Romanian economy and the other EU countries, which could lead to a better harmonization of the three sustainable development components and could increase their favourable effects.*

Keywords: *sustainable development, sustainable performance, DEA model, assessment*

JEL Classification: *O1; O47; Q2.*

* "1 Decembrie 1918" University of Alba Iulia, 13 Nicolae Iorga Street, 510009 Alba Iulia, Romania, *cameliaburja@yahoo.com*

Aims and background

Sustainable development is an ongoing process of mankind's evolution through balanced economic, social and ecological development [1]. This alternative economic growth model has replaced in many regions of the world the consumption-driven economic model. The objectives concerning the sustainable development are the core element of the future growth of the European Union, and were included in its strategy until 2020 for a smart, sustainable and inclusive growth [2]. These objectives have also been stated within the National Sustainable Development Strategy of Romania [3].

The economic component of sustainable development is still the main factor of progress, as it consists in processes of value creation. The new business model is grounded on efficiency and sustainable practices applied to the economic environment, such as: limitation of the mineral resources used, energy and water saving, diminution of the polluting emissions, waste management, extending the environmental management systems, increases in corporate social responsibility [4].

More and more the social and ecological dimensions have become important objectives in the management of the economic processes [5]. For this reason, good monitoring is necessary for both the connection and the balance between the three components of the sustainable development, and the short and long-term effects on society. The monitoring is achieved by means of some indicators and methods for sustainability appreciation: EU sustainable development indicators, OECD environmental indicators, synthesis indexes, methodology of the World Economic Forum, etc. [6, 7, 2, 5].

The evaluation of the sustainable development tendencies in the EU countries is usually made using the sustainable development indicators established by the European Commission. They provide a picture of the stage of achieving the EU Sustainable Development Strategy objectives in areas such as: socio-economic development, sustainable consumption and production, social inclusion, demographic changes, public health, climate change and energy, sustainable transport, natural resources, global partnership and good governance [8].

There is also a World Economic Forum methodology for appreciation of the national competitiveness at the global level. It is substantiated by the numerous indexes and sub-indexes which describe the national economies and are used in calculating the Global Competitiveness Index (GCI). The analysis of the GCI and its components reveals the countries' capacity to generate economic benefits using some drivers such as: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods

market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation [5].

In 2011, the World Economic Forum highlighted the importance of correlating the economic competitiveness with social and ecological sustainability. That is why, it proposed that the country's performance expressed by GCI to be adjusted for the two areas of sustainability – social and environmental. The indicators for environmental dimension refer to the environmental policy, use of renewable resources and degradation of the environment. The indicators for social sustainability assess some aspects concerning the access to basic necessities, vulnerability to shocks and social cohesion. At present, besides the traditional GCI, a Global Competitiveness Index-adjusted by indicators for social sustainability and environmental sustainability is determined for each country. The GCIs-adjusted can facilitate the identification of the sustainable competitiveness for countries, but they do not provide an absolute mark, whether countries are sustainable or not. Moreover, they do not include some of the elements related to sustainable development due to the lack of some relevant information [5].

This paper presents a concrete pathway to assess the global sustainability of a country in comparison with others considered as a benchmark system. The synthetic indicators from various international databases are used to measure the sustainability levels of the three dimensions of the sustainable development. This work intends to address the questions: Has Romania engaged in the process of sustainable development? What is its position in the EU from the economy sustainability point of view?

In order to answer the questions, the study aims to assess the stage of sustainable development in Romania, taking the sustainability features of countries that joined later the EU as reference. The countries having some economic characteristics similar to Romania are: Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovak Republic.

The method used to achieve the proposed objectives is Data Envelopment Analysis (DEA). The overall performance score obtained by Romania is an expression of its sustainable competitiveness compared to the other countries in the EU, which DEA identified as having the highest efficiency in the sustainable use of resources.

Assessment of the sustainable development performance

In order to assess the economic, social and environmental sustainability of the selected countries we used the synthetic indicators "Global Competitiveness

Index", "Human Development Index" and "Environmental Performance Index". The indicators are calculated by international organizations and have high information values due to the generalized significance, given by the aggregation level.

The dimension of sustainable economic development assessed by the "Global Competitiveness Index" includes data on certain aspects of competitiveness: institutional environment which facilitates the actions of value creation, infrastructure which determines the economic activities and their efficiency, macroeconomic environment, quality of the health and primary education, quality of higher education, goods market efficiency, the efficiency of the labour market, financial market development, technological readiness, the size of the market, sophisticated business practices and innovative activity. The GCIs are calculated annually by the World Economic Forum for all countries to characterize the national competitiveness using more than 100 indicators on 1 to 7 (best) scale [9].

The *Human Development Index* (HDI) is a composite indicator used to measure the social sustainability dimension of a country. The HDI is expressed as a value between 0 and 1. It measures the achievements in areas such as: a long and healthy life (life expectancy at birth), knowledge (mean years and expected years of schooling) and a decent standard of living (gross national income per capita). The indicator was introduced in 1990 by the United Nations to express national development dependent not only on economic growth but also especially on people development and their capabilities [10].

For assessing the ecological component, the *Environmental Performance Index* (EPI) calculated by the Yale Centre of Ecological Legislation and Policy was selected. This indicator summarizes the performance of the countries concerning two overarching environmental objectives: reducing environmental stress to human health and promoting ecosystem vitality. EPI is calculated by means of 22 performance indicators for the following policy categories: environmental health, air pollution, water and its effects on human health and on the ecosystem, biodiversity and habitat, condition of the forests, fisheries, agriculture and climate change. The information content of the indicator "facilitates country comparisons and provides a way to assess the global community's performance over time with respect to established environmental policy goals" [11].

Table 1 illustrates the performance of each dimension of sustainable development determined by means of a synthesis indicator in the selected countries. The indicators presented refer to two years which have a special significance: 2008 which marks the beginning of the economic crisis in Europe and 2012 considered the year that consolidated the recovery of the economic

growth in the majority of the European countries. The indicators illustrated in the table took on higher values in 2012 in comparison with 2008, except EPI, which demonstrates that the analyzed countries have overcome the crisis and became more competitive. The lower levels of EPI indicators in 2012 are related to the calculus methodology.

Table 1. Indicators of sustainable development in the new EU Member States, 2008-2012

Country	GDP per capita, euro PPS [1]		Global Competitiveness Index (1-7) [2]		Human Development Index (0-1)[3]		Environmental performance index (0-100)[4]	
	2008	2012	2008	2012	2008	2012	2008	2012
Bulgaria	10900	12100	3.93	4.27	0.773	0.782	78.5	56.28
Czech R.	20200	20300	4.58	4.51	0.873	0.873	76.8	64.79
Estonia	17200	18000	4.74	4.64	0.842	0.846	85.2	56.09
Latvia	14600	14700*	4.41	4.35	0.812	0.814	88.8	70.37
Lithuania	16100	17900	4.49	4.41	0.813	0.818	86.2	65.5
Hungary	16000	16700	4.35	4.30	0.828	0.831	84.2	57.12
Poland	14100	16800	4.28	4.46	0.811	0.821	80.5	63.47
Romania	11700	12600	3.97	4.07	0.784	0.786	71.9	48.34
Slovenia	22700	20900	4.48	4.34	0.892	0.892	86.3	62.25
Slovakia	18100	19100	4.45	4.14	0.833	0.840	86.0	66.62

Source: [1]Eurostat; [2]WEF; [3]http://hdr.undp.org/en/statistics/hdi; [4]http://epi.yale.edu/epi2012/rankings, http://epi.yale.edu/sites/default/files/downloads/2008EPI_Text.pdf.
*2011

The analysis correlation between the variables presented highlights a strong relationship between GDP per capita and HDI (coefficient correlation r=0.95), and GDP per capita and GCI (r=0.65). The correlation between GDP per capita and EPI (r=0.74 in 2012) suggests a relationship between the environmental challenges and level of development. The environmental problems can be associated with the impact of pollution in the case of developed countries due to industrialization and with poverty and underinvestment in basic environmental amenities for developing nations [11].

We observe the disparities related to the GDP per capita, Slovenia having a level two times higher than Romania and Bulgaria, which shows different economic performance of the countries analyzed.

In the domain of global competitiveness, Estonia distinguishes itself, followed by the Czech Republic, the less competitive being Romania and Bulgaria. According to the country profile made by the World Economic Forum (2012), in the last years Romania did not make remarkable progress in the general competitiveness of its economy. It is still in the efficiency-driven stage of development, i.e. its economic evolution is based mostly on the traditional sources that improve the productivity and less on innovation and sophisticated business practices.

The *Human Development Index* placed Romania on the last but one place concerning the capacity to achieve social performance, the group's leader being Slovenia. In the last decade Romania has made some important progress in the human development area; the growth of the average HDI in 2000-2011 period was 0.95%, Romania being classified as a country with high human development. But except Bulgaria, all the other new EU countries have very high human development. Studying the HDI components showed that the principal cause of a lower social performance in Romania was the low level of income [10]. So, compared with the European countries, Romania has a smaller capacity to ensure an adequate level of life for its population.

A top performer in 2012 EPI ranking was Latvia, due to its efficient policies in the air policy category, environmental health, biodiversity and habitat [12]. The last position of Romania in this ranking highlights that it is confronted with major problems related to the environmental quality and protection. The utilisation of the natural resources required by the economic activities was accompanied by pollution and degradation of the environment. As a consequence, the biologic capacity of the natural capital was surpassed by the demands of the socio-economic system [3].

These preliminary analyses suggest a modest position of Romania compared to the analyzed countries in each dimension of the sustainable development. But it is necessary to evaluate its competitiveness depending on all elements, because together they have to ensure sustainable development.

In order to investigate the overall situation of Romania's sustainable development we used the Data Envelopment Analysis technique. DEA is a method useful for measuring performance and substantiating the decisions of resource allocation based on the efficiency criteria for a set of similar decisional units. It does not require knowing a certain form of functional relationship between the phenomena studied, this being an important aspect if it is hard to detect. Also, the inputs and outputs can be very diverse, the method being robust to the high correlations

between variables [13]. The variables of the model were selected in accordance to the present approaches to the impact of each component of sustainable development on the progress of a country.

The DEA method is based on the classic linear programming model which contains *k* decisional units with *n* inputs and *m* outputs [14]:

$$\max \sum_{j=1}^{m} v_j y_{kj} \text{ s.t. } \sum_{i=1}^{n} u_i x_{ki} = 1 \quad \sum_{j=1}^{m} v_j y_{kj} - \sum_{i=1}^{n} u_i x_{ki} \leq 0 \tag{1}$$

$$\forall u_i, v_j \geq 0$$

where: u_i represent the weights of inputs (x);

v_j - the weights of outputs (y).

The DEA method was applied for a selection of the new EU Member States in the variant of the CRS output-oriented model. The output component that was introduced in the model is "GDP per capita" and inputs components were GCI, HDI and EPI (Table 1). The results show an efficiency frontier where which the most performing countries are placed. The others, which are not on frontier, are considered to be inefficient. Their relative efficiency scores are established compared to the group leaders and they allow for the ranking of the countries. The adjustments are also indicated for outputs or inputs in order to improve the efficiency of each economy in sustainable development terms.

Results and discussions

The results obtained using Data Envelopment Analysis for assessing the global sustainable performance, are presented in Table 2.

We see that in 2008 Slovenia and the Czech Republic were on the maximum efficiency frontier, becoming the benchmark for the other countries. In 2012 only Slovenia registered a maximum efficiency (score 1), closely followed by the Czech Republic. There is a general increase in 2012 of the efficiency scores, which shows a tendency of the countries to approximate the benchmark (Figure 1).

Table 2. Global sustainable performance of the EU's selected countries, 2008- 2012

Țări	2008		2012		2012 Output targets, GDP (PPS/capita)
	Efficiency score	Rank	Efficiency score	Rank	
Bulgaria	0.555	9	0.661	10	18316.854
Czech R.	1.000	1	0.994	2	20430.337
Estonia	0.803	3	0.956	4	18831.823
Latvia	0.707	6	0.773	9	19021.348
Lithuania	0.779	4	0.930	5	19256.180
Hungary	0.756	5	0.871	7	19177.639
Poland	0.682	7	0.872	6	19256.180
Romania	0.619	8	0.776	8	16229.815
Slovenia	1.000	1	1.000	1	20900.000
Slovakia	0.855	2	0.968	3	19725.843

Source: DEA software.

Figure1. The efficiency frontier
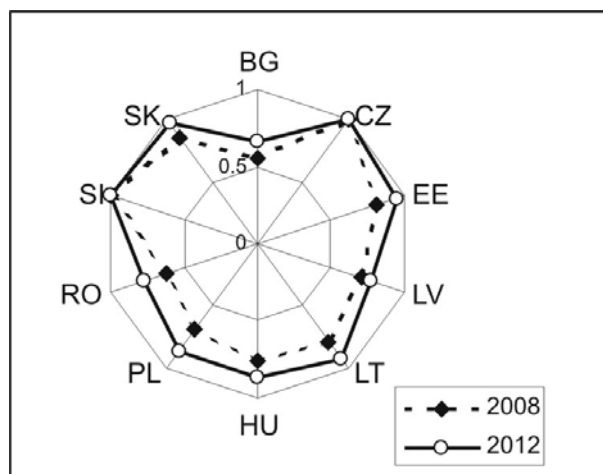
In 2012, Romania has a total score of sustainable development of 0.776, 25.4% higher compared to 2008. However, the sustainable competitiveness level of its economy is 22.4% smaller than that of Slovenia, so it still occupies the position 8 in the ranking performed.

According to the results of the DEA model, in order to be placed on the efficiency frontier Romania has some possibilities. A first possibility consists in a scenario of sustainable development in which the present level of utilisation of the economic-social resources and of the natural resources is maintained, but in which the GDP has to increase 29% to the level of 16230 PPS per inhabitant. Achieving this target requires a strong increase in the productivity of all factors implied in the processes of value added creation in accordance to the features of the knowledge-based economy: increase in the rates of participation in secondary an tertiary education; increase in the number of the graduates in math and science, extending the staff training; stimulating the competition on the domestic and foreign market; increase in the flexibility of the labour force and an adequate reward for the productive and quality labour; increase in the efficiency of the financial services and products; stimulating the technology transfer, especially of the new products or concepts; extending the use of ICT; develop the innovation capacity.

Another variant of development aims to reduce the disparities related to the sustainable development components compared to the group leaders (Slovenia). In this case, considering the characteristics of the efficient functioning of Slovenia (Table 1), Romania should also increase the level of the economic component (GCI) by over 6.6%, the social component (HDI) by at least 13.8% and the ecological component by over 28.8%, resulting a general improvement of the macroeconomic indicators.

The change of the economic growth pattern and sustainability development requires converging efforts to be made by economic organisations, research-development-innovation environment, educational system and legislative institutions [15].

Conclusions

The global assessment of sustainable development was made for a selection of new EU Member States in a DEA-environment approach. In the estimated model, GDP was used as an output variable and indexes GCI, HDI and EPI as input variables. As a novelty, the model proposed in this study allows for an evaluation of sustainable development using a procedure in which some synthetic indicators are considered in order to capture the whole complexity of economic, social and environmental phenomena. It highlights that the economic performance of a country is closely related to social and ecological sustainability. At the same time, due to its features, the model corresponds to the concept of sustainable competitiveness [9].

The analysis revealed that although Romania has made substantial progress it has a relative modest position in the international assessments concerning the economic competitiveness, social development or environmental performance. Compared to the country identified with the best practices of sustainable development in the 2008-2012 period (Slovenia), Romania belongs to the group of countries with low efficiency, and unsustainable development.

In Romania, an important problem is the need to increase the economic competitiveness and, on this basis, to stimulate the transition to a higher stage of development. In this line, the actions of some factors have to be intensified and improved, such as: quality of education, efficiency of goods markets, functioning of the labour and financial markets, technological readiness, and research-innovation potential. At the same time, the new pattern of economic growth has to be not only more efficient but also socially and ecologically sustainable; therefore a set of adequate measures are necessary to improve the social conditions and to reduce the pressures on the environment.

References

UN, Report of the United Nations Conference on Sustainable Development, Rio de Janeiro, June, 2012.

Communication from the Commission, Europe 2020 A strategy for smart, sustainable and inclusive growth, European Commission, Brussels, 2010.

Government of Romania, *National Sustainable Development Strategy of Romania 2013-2020-2030,* Bucharest, 2008, Available at: http://strategia.ncsd.ro

RICOH GROUP, *Sustainability Report (Environment) 2010*, http://www.ricoh.com/ environment/report/index2010.html.

B. Bilbao-Osorio, J. Blanke, R. Crotti, M.D. Hanouz, B. Fidanza, T. Geiger, C. Ko, C. Serin, *Assessing the Sustainable Competitiveness of Nations, The Global Competitiveness Report 2012-2013*, World Economic Forum, Geneva, 49-68, 2012.

OECD Organization for Economic Co-Operation and Development, "Towards Sustainable Development: Environmental Indicators", *SAGE publication*, Paris, 14-22, 1998.

M.Z. Zgurovsky, "Sustainable development global simulation: opportunities and treats to the planet", *Russian Journal of Earth Sciences*, 9 (2007).

EUROSTAT, "Sustainable Development in the European Union 2011- Monitoring report of the EU sustainable development strategy", *Publications Office of the European Union*, Luxembourg, 2011.

World Economic Forum, *The Global Competitiveness Report 2012-2013* (Ed. Schwab K..) Geneva, 302-303, 2012.

UNDP, Human Development Report 2011 Sustainability and equity: A better future for all, 2011.

YCLP Yale Centre for Environmental Law&Policy, EPI 2012 Environmental Performance Index and Pilot Trend Environmental Performance Index, Yale University, 2012.

H.E.E. Sprudzs, *Statements for Latvia, United Nations Conference on Sustainable Development,* 2012, www.uncsd2012.org/content/documents/1004latvia.pdf.

Nataraja N.R., Johnson A.L., "Guidelines for using variable selection techniques in data envelopment analysis", *European Journal of Operational Research*, 215(3), 662-669 (2011).

A. Charnes, W. Cooper, E. Rhodes, "Measuring the efficiency of decision-making units", *European Journal of Operational Research*, 2, 429–444 (1978).

Ch. A. Tsekos, "Contribution of environmental education to the achievement of sustainable development", *Journal of Environmental Protection and Ecology*, 13 (.3), 1474-1479 (2012).