New Trends and Issues Proceedings on Humanities and Social Sciences

Issue 4 (2017) 07-15

ISSN 2421-8030
www.prosoc.eu

Selected paper of 5th World Conference on Business, Economics and Management (BEM-2016) , 12 – 14 May 2016, Istanbul Limak Limra Hotel & Resort, Convention Center Kemer, Antalya-Turkey

The Evaluation of Green Growth in Selected OECD Countries

Armand Kasztelan [a] *, University of Life Sciences, Department of Economics and Agribusiness, Akademicka 13, 20-950 Lublin, Poland

Suggested Citation:
Kasztelan, A. (2017). The evaluation of green growth in selected OECD countries. *New Trends and Issues Proceedings on Humanities and Social Sciences.* [Online]. 04, pp 07-15. Available from: www.prosoc.eu

Selection and peer review under responsibility of Zehra Ozcinar, Ataturk Teacher Training Academy.

Abstract

Green growth is a relatively new concept, which has appeared in the international discussion in response to the increasing environmental threats and also as a potentially effective means to deal with the outcomes of the financial crisis of 2008. According to the OECD (2011a), green growth means taking measures conducive to growth and economic development, while ensuring that natural assets continue to provide the resources and environmental services that contribute to the country's prosperity. The purpose of this article is to analyze the level of green growth in selected OECD countries. Research was carried out based on Hellwig's method, which enabled the construction of a synthetic measure of "greening" of the growth. The adopted method made it possible to evaluate the studied phenomenon as a whole, providing grounds for assigning the selected countries into four groups, characterized by similar levels of green growth. In Group I, showing the highest level, there is only one country—Denmark. Conversely, 12 of the 21 countries analyzed were assigned to Group IV.

Keywords: green growth; sustainable development; environmental protection; OECD; taxonomic methods; Hellwig's method;

* ADDRESS FOR CORRESPONDENCE: **Armand, Kasztelan** University of Life Sciences, Department of Economics and Agribusiness, Akademicka 13, 20-950 Lublin, Poland
E-mail address: armand.kasztelan@up.lublin.pl / Tel.: +48814610061

1. Introduction

Over the past decades, striving to improve the living standards has opened up the possibility of unprecedented economic growth. The pace of economic development and population growth in the world has proved to be significantly faster than the progress in reducing environmental degradation. Environmental threats come to solve together with the effects of the economic crisis. EU member states have great difficulty in maintaining a mutually agreed principle of economic cooperation; what's more, the functioning of the common currency became a subject of public debate. Governments of each member state are under pressure to present a credible plan for overcoming the crisis and to avoid stagnation and increasing public debt. In this situation, the need for a new paradigm of economic growth and development is emphasized, a paradigm which clearly states that—in the process of building a prosperous world economy—"environment" and "growth" can no longer be regarded as contradictory goals (Huhtanen, 2010; OECD, 2009).

Considering the above circumstances, it is not surprising that in recent years, the concept of green growth burst with a vengeance into the international public debate. This term was first promoted in 2005 by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) with an effort to search for opportunities to introduce a new low-carbon sustainable development model for the rapidly developing Asian countries (Satbyul, Ho & Yeora, 2014; ESCAP, 2005). In the wake of the financial crisis of 2008, green growth has gained wider attention of politicians and representatives of science. The term, rarely heard before 2008, currently occupies a prominent place in the discussions of various international institutions. The World Bank, along with five other multilateral development banks, committed to the implementation of the concept of green growth (The World Bank, 2012; OECD, 2012). In turn, the Organization for Economic Cooperation and Development (OECD) has developed assumptions of the Green Growth Strategy (Strategy), which is a package of four documents. The strategy pays special attention to the value of natural capital and its participation in the processes of economic development, articulated in many papers (Ekins et al., 2003; Kasztelan, 2010, 2013, 2015; Kijek, 2013; Malovics, 2007; OECD, 2011). It focuses on cost-effective ways of reducing pressure on the environment, allowing for the transition to the new models of development.

Green growth is a proposal of a new global compromise, which has a potential for uniting different fractions around the main goal, that is, sustainable development. Green growth is not a substitute for sustainable development but should be seen as a means to achieve it. It has a narrower range and it is associated with operational objectives, which are to lead to measurable progress at the interface between the economy and the environment. According to the assumptions, green growth strategies developed at the national level are to encourage businesses and consumers for environmentally friendly behaviors, to improve the optimal reallocation of jobs, capital, and technology toward greener activities, and to provide motivation for the development of eco-innovation (OECD, 2011; Kijek & Kasztelan, 2013; Budzynska, 2010).

At this stage, one of the main challenges is to develop an effective system for monitoring progress toward green growth. To this end, the OECD proposed a set of indicators for defining and tracking changes. In 2011, the first OECD report was published, showing the conceptual framework, the initial proposal of a set of 30 key indicators of green growth and the results for selected indicators from the OECD database. Green growth indicators focus primarily on the mutual relations of the economy and the environment, and more specifically their main task is to characterize the level of "greening" of economic activity (OECD, 2011b).

Experiences and results of individual states (Federal Statistical Office, 2013; Havranek & Sidorov, 2011; Hook et al., 2014; Statistics Korea, 2012; Statistics Netherlands, 2011 & 2013), over the national sets of green growth indicators became the basis for the development of the second version of the OECD report (2014). A new report proposes 41 core indicators grouped around four main objectives: establishing a low carbon, resource-efficient economy; maintaining the natural asset base; improving people's quality of life; and implementing appropriate policy measures and realizing the economic opportunities that green growth provides. In addition, in order to facilitate communication with decision makers, media, and the society, it was decided to develop a representative set of six key indicators. They will allow to monitor several key elements of the concept of green growth, that is, carbon and material productivity, environmentally adjusted multifactor productivity, a natural resource index, changes in land use and cover, and population exposure to air pollution (OECD, 2014).

Table 1. Indicators of Green Growth

Indicators group	Indicators sub-group	Indicator symbol	Indicator name
Environmental and Resource Productivity	CO_2 productivity	x_1	Production-based CO_2 productivity, GDP per unit of energy-related CO_2 emissions (US dollars per kilogram, 2005)
		x_2	Production-based CO_2 intensity, energy-related CO_2 per capita (Tonnes)
		x_3	Production-based CO_2 emissions, index 1990=100
	Energy productivity	x_4	Energy productivity, GDP per unit of TPES (US Dollar, 2005)
		x_5	Renewable energy supply, % TPES (Percentage)
	Non-energy material productivity	x_6	Non-energy material productivity, GDP per unit of DMC
Natural Asset Base	Land resources	x_7	Arable and cropland, % total land area (Percentage)
		x_8	Pastures and meadows, % total land area (Percentage)
		x_9	Forest, % total land area (Percentage)
		x_{10}	Other land, % total land area (Percentage)
	Wildlife resources	x_{11}	Threatened mammal species, % total known species (Percentage)
		x_{12}	Threatened bird species, % total known species (Percentage)
Economic Opportunities and Policy Responses	Technology and innovation: R&D	x_{13}	Environmentally related government R&D budget, % total government R&D (Percentage)
		x_{14}	Renewable energy public RD&D budget, % total energy public RD&D (Percentage)
		x_{15}	Energy public RD&D budget, % GDP
	Technology and innovation: Patents	x_{16}	Development of environment-related technologies, % inventions worldwide
		x_{17}	Development of environment-related technologies, inventions per capita
		x_{18}	International collaboration in development of environment-related technologies, % collaboration in all technologies
		x_{19}	Development of renewable energy technologies, inventions per unit of public RD&D
		x_{20}	Diffusion of environment-related technologies, % all technologies
	International financial flows: Official Development Assistance	x_{21}	ODA - environment sector, % total allocable ODA
		x_{22}	ODA - renewable energy sector, % total allocable ODA
		x_{23}	ODA - water supply and sanitation sector, % total allocable ODA
		x_{24}	ODA - all sectors - biodiversity, % total allocable ODA
		x_{25}	ODA - all sectors - climate change mitigation, % total allocable ODA
		x_{26}	ODA - all sectors - desertification, % total allocable ODA
		x_{27}	Total allocable ODA, % GNI
	Environmental taxes and transfers	x_{28}	Environmentally related taxes, % GDP
		x_{29}	Energy related tax revenue, % total environmental tax revenue
Socio-Economic Context		x_{30}	Real GDP, Index 1990=100
		x_{31}	Real GDP per capita
		x_{32}	Population density, inhabitants per km^2
		x_{33}	Labor tax revenue, % GDP

Source: own elaboration based on OECD database.

It is worth noting that the concept of green growth is in line with the objectives of the Europe 2020 strategy (European Commission, 2010), which is based on three main pillars: smart, sustainable, and inclusive growth. Europe needs to strengthen the synergy between smart and green growth, to address climate change, environmental, and energy challenges, as well as the increasing shortages of resources.

Green growth of selected countries can be assessed based on both simple and more complex statistic methods. The main goal of this paper is to evaluate the green growth of the selected OECD countries, based on the set OECD indicators and Hellwig's method. This type of analysis provides answer to the following question: At what stage are the individual countries placed in terms of implementing the green growth assumptions, thus reaching the ultimate goal, which is the entrance to the path of sustainable development? Identification of critical points of assessment should direct the appropriate corrective action in the critical areas. On the other hand, in the case of countries with a relatively high synthetic variable of green growth, the analysis of this kind can also create the basis for specialization processes of countries with regard to the environmental factors.

Green growth of a given country can be measured but expressing it with one universal meter requires application of a proper method. This amounts to the formation of aggregate indicator, also called synthetic variable, which is the basis for structuring examined objects by the level of multi-feature phenomena. For the first time, this measurement was introduced by Z. Hellwig (1968), who constructed the so-called synthetic measure of development for the typological division of countries, according to the development level, resources, and structure of qualified staff.

For the purposes of implementing the main research objective, the article utilizes the literature method, comparative method, and deductive reasoning. The article concludes with a summary identifying the areas for further research.

2. Problem Formulation and Methodology

The level of green growth of selected 21 OECD member countries was determined by means of one of the most popular taxonomic methods—Hellwig's pattern model. The reference years 2010–2014 were chosen due to data availability. Diagnostic variables defining the level of green growth for particular countries were adjusted in an attempt to meet three criteria: substantive, formal, and statistical (Strahl, 2006).

Substantive indicators selection was based on literature studies, first of all strategic documents of the OECD (2011 b, c, d; 2014) and review of OECD databases. On this basis, 34 countries (OECD members) and 53 diagnostic variables were chosen. The next step was to check if they meet formal criteria, that is, whether they are measurable, complete, and ensure comparability. It turned out that only 41 variables met these requirements. At this stage, due to data incompleteness. The last step was to check whether acknowledged variables met statistic criteria. Based on the analysis of the coefficients of variation, it was found that all the variables have exceeded the required threshold, that is V = 10%. Afterwards, eight excessively correlated variables were eliminated from the set according to Pearson's correlation coefficients matrix. They were not included in further investigation, because they carried identical informational value (Bujanowicz-Haras, Janulewicz, Nowak &Krukowski, 2015).

Ultimately, 21 countries and 33 diagnostic variables were selected for the green growth analysis (Table 1). Among the selected variables, six were considered to be smaller-the-better (STB) reducing the synthetic measure of green competitiveness, whereas the rest were regarded as larger-the-better (LTB) characteristics having a positive influence on the measure.

The procedure chosen for evaluating the green growth provided multidimensional comparative analysis, allowing comparison of multi-featured objects. Taxonomic meters were applied, which replaced research description using a set of diagnostic features with one aggregate volume that is synthetic variable. In typological research, Hellwig's pattern method was applied (Adamowicz and Janulewicz, 2012; Hellwig, 1968). It allowed a comparison between selected member states of the EU providing grounds for classifying them into uniform groups characterized by similar levels of green growth.

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

$$x_{ij} = \frac{1}{x_{ij}} \tag{1}$$

Afterwards, the features were standardized according to the formula:

$$z_{ij} = \frac{x_{ij} - \overline{x_{ij}}}{s_j} \tag{2}$$

where: *i* – object number, *j* – feature number, *s* - standard deviation.

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:

$$d_i = \sum_{j=1}^{m} | z_{ij} - z_{0j} | \tag{3}$$

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

$$z_i = 1 - \frac{d_i}{d_0} \tag{4}$$

where:

$$d_0 = \overline{d} + 3s_d \tag{5}$$

$$\overline{d} = \frac{1}{n}\sum_{i=1}^{n} d_i \tag{6}$$

$$s_d = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(d_i - \overline{d})^2} \tag{7}$$

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:

Group I: $$z_i \geq \bar{z} + s_z \tag{8}$$

Group II: $$\bar{z} \leq z_i < \bar{z} + s_z \tag{9}$$

Group III: $$\bar{z} - s_z \leq z_i < \bar{z} \tag{10}$$

Group IV: $$z_i < \bar{z} - s_z \tag{11}$$

Where: $\bar{z}$ - arithmetic mean, s_z - standard deviation of the taxonomic measure of development (Bujanowicz-Haras et al., 2015; Adamowicz, Janulewicz, 2012).

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

3. Problem Solution

Table 2 presents a disparity regarding respective variables between different countries of the OECD, expressed as the minimum values, mean value, and coefficient of variation. The coefficient of variation for the indicators used in the analysis ranged from 13.5% to 213.9%. The highest variation was recorded for the population density indicator and the lowest for the variable describing energy-related tax revenues.

The level of green growth in the selected 21 OECD countries was evaluated based on 33 variables, and the outcomes of the analysis were presented in Table 3. The highest synthetic evaluation was awarded to only one country—Denmark (z_i = 0.4385), assigned to Group I. Group II consisted of two member states representing an outstanding level of green growth, that is Germany and Sweden. Group III, displaying an average level of green growth, consisted of six countries: France, Spain, Japan, Italy, the Netherlands, and Austria. Group IV, characterized by the lowest level of green growth among the countries, was at the same time the most numerous one as it consisted of 12 countries. The lowest evaluation of the studied phenomenon among the entire 21 member states was the United States for which z_i indicator amounted to a mere 0.1171. It is worth noting that over 85% of the surveyed countries (18) were in Groups III or IV of the evaluation, with the lowest value of the synthetic metric observed in almost 60% of the countries.

Table 2. Statistical Characteristics of Diagnostic Variables for the OECD Countries.

Variable	Mean	Minimum	Maximum	Standard deviation	Coefficient of variation [%]
x_1	4,14	2,30	9,27	1,60	38,7
x_2	0,1371	0,0595	0,2564	0,0536	39,1
x_3	0,0104	0,0040	0,0169	0,0029	27,5
x_4	8691,47	5096,72	15018,14	2343,60	27,0
x_5	13,97	1,06	34,38	9,64	69,0

x_6	2,64	1,06	5,88	1,34	50,6
x_7	24,48	5,57	56,89	13,25	54,1
x_8	16,50	0,10	48,82	13,48	81,7
x_9	36,69	10,78	73,11	18,04	49,2
x_{10}	22,47	5,89	54,65	10,05	44,7
x_{11}	0,0806	0,0291	0,5714	0,1111	137,8
x_{12}	0,0595	0,0191	0,1332	0,0283	47,6
x_{13}	2,42	0,41	5,86	1,27	52,5
x_{14}	29,13	10,06	61,87	14,71	50,5
x_{15}	0,03	0,00	0,12	0,03	75,7
x_{16}	4,02	0,02	22,31	6,74	167,5
x_{17}	11,62	0,46	35,67	11,52	99,1
x_{18}	10,22	4,43	19,47	3,05	29,8
x_{19}	1,13	0,02	3,21	0,95	83,7
x_{20}	11,95	6,46	22,18	3,53	29,5
x_{21}	3,61	0,51	11,45	2,85	78,9
x_{22}	2,46	0,00	11,69	2,99	121,6
x_{23}	6,42	0,14	17,44	5,12	79,8
x_{24}	7,92	0,71	18,67	5,39	68,0
x_{25}	13,34	3,33	35,02	7,71	57,8
x_{26}	12,64	0,50	33,09	7,94	62,9
x_{27}	0,16	0,01	0,40	0,12	77,4
x_{28}	2,23	0,76	3,94	0,69	31,1
x_{29}	71,18	53,93	85,82	9,64	13,5
x_{30}	173,08	116,20	340,04	55,45	32,0
x_{31}	31915,87	19465,97	46042,98	7347,63	23,0
x_{32}	0,0396	0,0019	0,3322	0,0847	213,9
x_{33}	0,1651	0,0546	0,8929	0,2128	128,9

Source: author's calculation based on OECD database.

Table 3. Classification of 21 OECD Member States according to the Value of the Synthetic Measure Describing the Level of Green Growth

Group number	The number of countries in the group	The level of green growth	OECD countries
I	1	above 0,37912	Denmark
II	2	from 0,30330 to 0,37911	Germany, Sweden,
III	6	from 0,22747 to 0,30329	France, Spain, Japan, Italy, the Netherlands, Austria,
IV	12	below 0,22746	Ireland, Finland, South Korea, Poland, Australia, Portugal, Belgium, Canada, Greece, Slovak Republic, Czech Republic, United States

Source: author's calculation.

4. Conclusion

Green growth strategy presented at the OECD in 2011 initiated the design and implementation of green growth programs within the framework of national policies. Green growth, even though it is a separate category, does not stand in opposition to sustainable development. It is seen as an effective tool for achieving sustainable development in the long term; therefore, an important direction of research and analysis is to develop a universal method of monitoring the progress of each country in the implementation of green growth assumptions.

The results of the research presented in this article are based on 33 selected green growth indicators based on the methodologies and database of the OECD. The use of Hellwig's method in the research, which belongs to the group of multidimensional taxonomic methods, allowed the classification of the selected OECD countries into one of four groups identified based on their green growth level. Based on the results obtained, we can conclude that the level of "greening" of growth in the OECD countries is still insufficient. In Group I, characterized by the highest level of green growth, only Denmark was classified. In comparison, Group IV represents the countries with the lowest level of evaluation; 12 countries were classified (nearly 60% of the survey sample).

The results obtained support the usefulness of synthetic measures for evaluating the level of green growth. Note that Hellwig's pattern method is one of many tools used to assess the level of territorial units' development. It appears advisable to continue research using other analytical methods, for example pattern-less method or Ward's clustering method, which would allow comparing results. Moreover, due to better data availability, it would also be possible to expand a set of indicators for the analysis, as well as the number of countries which in turn would lead to more comprehensive evaluation of green growth.

References

Adamowicz, M. & Janulewicz, P. (2012). The use of multidimensional methods in defining the competitive position of the community on the example of Lubelskie Voivodeship (in Polish). *Metody Ilosciowe w Badaniach Ekonomicznych*, XIII/1, 17-28.

Budzynska, K. (2010). Logistics in sustainable development. World Experience (in Polish) in A. Pabian (Ed) Creativity and Innovation in the Management of Organizations, Częstochowa: Wydawnictwo Wydziału Zarządzania Politechniki Częstochowskiej.

Bujanowicz-Haraś, B., Janulewicz, P., Nowak, A. & Krukowski, A. (2015). Evaluation of sustainable development in the member states of the European Union. *Problemy Ekorozwoju-Problems of Sustainable Development*, 10, 2, 71-78.

Ekins, P., Simon, S., Deutsch, L., Folke, C. & De Groot, R. (2003). A framework for the practical application of the concepts of critical natural capital and strong sustainability. *Ecological Economics* 44, 2-3, 165-185.

ESCAP (2005). *State of Environment Asia and the Pacific 2005*. Bangkok.

European Commission (2010). *Europe 2020. A strategy for smart, sustainable and inclusive growth* [online]. [cit.2016-04-15]. Available:

http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf.

Federal Statistical Office (2013). *Test of the OECD set of green growth indicators in Germany 2012.* Wiesbaden.

Hak, T., Sidorov, E. & Hajek, M. (2014). *Green growth in the Czech Republic. Selected indicators 2013*. Prague: Czech Statistical Office.

Havranek, M. & Sidorov, E. (2011). *Green growth in the Czech Republic. Selected indicators*. Prague: Czech Statistical Office.

Hellwig, Z. (1968). Application of the taxonomic method to the countries typology according to their level of development and the structure of resources and qualified Staff (in Polish). *Przegląd Statystyczny* 4: 307–326.

Huhtanen, T. (2010). Europe and green growth: The key to recovery? In State of the Union 2010*.* Schuman Report on Europe. Paris: Springer-Verlag France.

Kasztelan, A. (2010). Environmental competitiveness of regions – Attempt of conceptualization (in Polish). *Problemy Ekorozwoju-Problems of Sustainable Development*, 5, 2: 77-86.

Kasztelan, A. (2013). A comparative analysis of the environmental competitiveness of Lubelskie and Zachodniopomorskie Voivodships. *Rocznik Ochrona Środowiska - Annual Set The Environment Protection*, 1: 637-648.

Kasztelan, A. (2013) Regional development based on environmental competitive advantages – A comparative analysis of Polish Voivodships*. Comparative Economic Research 16* (2): 105-122.

Kasztelan, A. (2015) Natural capital as a factor in regional competitiveness. *Miscellanea Geographica – Regional Studies on Development*, 19, 3: 63-69, DOI: 10.1515/mgrsd-2015-0010.

Kijek, T. (2013a). External conditions influencing the implementation of eco-innovations in European Enterprises. *Rocznik Ochrona Środowiska - Annual Set The Environment Protection*, No. 1: 659-670.

Kijek, T. (2013b). Innovation capital as a driver of eco-innovations: A case of European Enterprises. In Proceedings of *the 8th European Conference on Innovation and Entrepreneurship* (ECIE 2013), 1. Book Series: Proceedings of the European Conference on Entrepreneurship and Innovation, Brussels: Hogeschool Univ Brussel, 363-369.

Kijek, T. & Kasztelan, A. (2013). Eco-innovation as a factor of sustainable development. *Problemy Ekorozwoju-Problems of Sustainable Development*, 8, 2, 103-111.

Malovics, G. (2007). *The role of natural capital in regional development*. 2nd Central European Conference in Regional Science. 10 –13.10.2007. Nový Smokovec, [CD-ROM], 648-655.

OECD (2009). *OECD and green growth*. Paris: OECD.

OECD (2011). *Towards green growth*. Paris: OECD.

OECD (2011). *Towards green growth: Monitoring progress - OECD Indicators*. Paris: OECD.

OECD (2011). *Tools for delivering on green growth*. Paris: OECD.

OECD (2011). *Towards green growth. A summary for policy makers*. Paris: OECD.

OECD (2012). *Inclusive green growth: For the future we want*. Paris: OECD.

OECD (2014). *Green growth indicators 2014*, OECD Green growth studies. Paris: OECD.

Satbyul, K.E., Ho, K. & Yeora, C. (2014). A new approach to measuring green growth: Application to the OECD and Korea. *Futures,* 63: 37–48.

Statistics Korea (2012). *Korea's green growth (based on OECD green growth indicators).* Daejeon: Statistics Korea.

Statistics Netherlands (2011). *Green growth in the Netherlands*. Hague: Statistics Netherlands.

Statistics Netherlands (2013). *Green growth in the Netherlands 2012.* Hague: Statistics Netherlands.

Strahl, D. (2006). *The methods of the regional development evaluation* (in Polish). Wrocław: Wydawnictwo AE.

The World Bank (2012*). MDBs: Delivering on the promise of sustainable development.* The World Bank, Washington D.C. [online]. [cit.2016-04-15]. Available:

http://www.worldbank.org/en/news/feature/2012/06/19/mdbs-delivering-promise-sustainable-development.