ENVIRONMENTAL GOVERNANCE AS AN ELEMENT OF SUSTAINABLE DEVELOPMENT IN THE EUROPEAN UNION COUNTRIES

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ABSTRACT

Environmental governance is one of the dimensions of sustainable development. It is very important to know what factors particularly strongly affect environmental governance to be able to consciously shape it. A key issue considered in this publication is the impact of groups of variables that define social, economic and institutional-political governances on environmental governance. Data for the study described in this article were obtained from the website of Eurostat. Variables were assigned to environmental, social, economic and institutional-political governances and divided into stimulants, nominants and destimulants based on the description of the variables provided by Eurostat. These data were used to determine Hellwig's synthetic measure of environmental governance and to select those groups of variables assigned to the three remaining governances that have a significant impact on the environmental dimension of sustainable development. Total values for groups of variables relating to individual governances were determined for 28 selected European countries based on the values of the variables observed over successive ten years. These results were then subjected to the procedure of panel data modelling. A fixed effects model was then selected as the most appropriate model. The econometric model determined in the study describes environmental governance based on six groups of variables selected from among 17 groups characterizing social, economic and institutional-political governances.
Keywords: *environmental governance, sustainable development, synthetic measure*

1. INTRODUCTION

Over the past two decades, eco-efficiency has been considered to be the most appropriate way to realize progress in a sustainable way. Eco-efficiency combines a concern for the economic rationality of projects with the environmental determinants of development. The need to combine economic efficiency with environmental efficiency is indisputable, because it leads to the selection of the most promising solutions from the point of view of the creation of environmental governance and economic governance (Angelis-Dimakis, Alexandratou, Balzarini, 2016). The use of appropriate tax-system instruments is a good example of motivators designed to enhance care for the environmental aspects of sustainable development. These instruments are meant to encourage entrepreneurs to introduce environmentally-friendly solutions, such as green sources of power (Andrei et al, 2016). More and more attention is paid every year to environmental factors due to the ongoing climate change. The range and speed of climate change make us realize that the present economic patterns should no longer be maintained and that it is necessary to develop new, completely different patterns, particularly

in the area of power supply and consumption (Lima et al, 2016). It is necessary to optimize the chain of biomass supply to power plants, among other things. Efforts taken in this direction should contribute to sustainable environmental and economic development (Zhao, Li, 2016). It should be emphasized in this context that measures taken to strengthen environmental governance have a positive impact on many social aspects, often greatly enhancing the quality of life for all. For example, the results of analyses indicate a positive relationship between environmental governance and social governance resulting from the use of recycling. Importantly, the benefits of recycling are manifold. Not only does it improve the quality of citizens' life, but it also entails more rational management, which accelerates economic growth (Horst, Freitas, 2016). Sustainable development is a very complex issue. It includes dimensions such as environmental, social, economic and institutional-political governances. Thus, only certain selected aspects are usually the subjects of literature about sustainable development. For example, authors often discuss the sustainable development of tourism (Ioncica, Ioncica, Petrescu, 2016). The problems of social inequality and universal access to healthcare are also frequently touched upon in the context of sustainable development (Paredes, 2016). These considerations also include areas such as sustainable energy development (Romano et al, 2016) and the impact of human activities on irreversible climate changes (Ouml, 2016). The purpose of this article has been determined by the complexity of the issues discussed. Namely, its purpose is to determine the strength and the direction of the impact of factors affecting social, economic and institutional-political governances on environmental governance, expressed by means of a synthetic measure. This paper presents a completely new approach, which is different from approaches previously adopted by researchers dealing with sustainable development. The author believes that the analytical solutions proposed in this paper will significantly contribute to the development of methodology allowing for a quantified description of the multi-dimensionality of environmental governance.

2. METHODOLOGY

Data for the study were obtained from the website of Eurostat. The analysis included 28 selected European countries, which were examined from 2004-2013. Variables were assigned to individual governances and divided into stimulants, nominants and destimulants based on the description of the variables available in the Eurostat database (Tables 1-4).

Table following on the next page

Table 1: Groups of variables describing environmental governance

No.	Specification	Type of variable
1.	**Climate changes**	
1.1.	- greenhouse gas emissions in CO_2 equivalent	destimulant
1.2.	- greenhouse gas emissions per unit of energy consumed	destimulant
2.	**Energy**	
2.1.	- share of energy from renewable sources in gross final energy consumption	stimulant
2.2.	- share of energy from renewable sources in the consumption of transport fuels	stimulant
2.3.	- energy intensity of the economy; GDP at constant prices in 2000 (kgoe/1,000 euros)	destimulant
3.	**Air protection**	
3.1.	- air pollutants emitted by road vehicles per $100 \, km^2$ – carbon monoxide	destimulant
3.2.	- air pollutants emitted by road vehicles per $100 \, km^2$ – non-methane volatile organic compounds	destimulant
3.3.	- air pollutants emitted by road vehicles per $100 \, km^2$ – nitrogen oxides	destimulant
3.4.	- air pollutants emitted by road vehicles per $100 \, km^2$ – particulate matter	destimulant
3.5.	- average CO_2 emissions from new cars per 1 km	destimulant
3.6.	- emissions of acidifying pollutants per $1 \, km^2$ – sulphur oxides	destimulant
3.7.	- emissions of acidifying pollutants per $1 \, km^2$ – nitrogen oxides	destimulant
3.8.	- emissions of acidifying pollutants per $1 \, km^2$ – ammonia	destimulant
4.	**Marine ecosystems**	
4.1.	- the size of the fishing fleet	destimulant
5.	**Fresh water resources**	
5.1.	- the percentage of population using at least grade II wastewater treatment plants	stimulant
5.2.	- water consumption per capita	destimulant
6.	**Land use**	
6.1.	- woodiness	stimulant
7.	**Biodiversity**	
7.1.	- stands damaged by defoliation	destimulant
8.	**Waste management**	
8.1.	- non-mineral waste generated per capita	destimulant
8.2.	- municipal waste generated per capita	destimulant
8.3.	- municipal waste disposed of by dumping per capita	destimulant
8.4.	- recycling of packaging waste	stimulant

Source: http://wskaznikizrp.stat.gov.pl/ [accessed on 21 December 2016]

Table following on the next page

Table 2: Groups of variables describing social governance

No.	Specification	Type of variable
1.	**Demographic changes**	
1.1.	- fertility rate	stimulant
1.2.	- the rate of international migration	stimulant
1.3.	- the rate of actual population growth/decline	stimulant
2.	**Public health**	
2.1.	- life expectancy at age 65 years in good health	stimulant
2.2.	- standardized mortality rates from cardiovascular disease	destimulant
2.3.	- standardized mortality rates from malignant neoplasms	destimulant
2.4.	- standardized mortality rates from chronic diseases of the lower respiratory tract	destimulant
2.5.	- standardized mortality rates due to diabetes	destimulant
2.6.	- Euro Health Consumer Index EHCI	stimulant
2.7.	- urban population exposure to excessive PM10 levels	destimulant
2.8.	- urban population exposure to air pollution by ozone	destimulant
3.	**Poverty and living conditions**	
3.1.	- the risk of persistent poverty	destimulant
3.2.	- the risk of poverty or social exclusion	destimulant
3.3	- inequality of income distribution	destimulant
4.	**Education**	
4.1.	- adults participating in education and training (%)	stimulant
4.2.	- public expenditure on education in relation to GDP	stimulant
4.3.	- young people not in further education	destimulant
4.4.	- the percentage of people aged 25-64 with at most lower secondary education	destimulant
5.	**Access to the labour market**	
5.1.	- the percentage of people in households without working people aged 0-17 years	destimulant
5.2.	- the percentage of people in households without working people aged 18-59 years	destimulant
5.3.	- the rate of long-term unemployment	destimulant
5.4.	- the unemployment rate according to LFS	destimulant
5.5.	- gender-based wage differentials	destimulant
6.	**Public safety**	
6.1.	- victims of fatal accidents per 1 million population	destimulant
7.	**Consumption patterns**	
7.1.	- electricity consumption in households per capita 1	destimulant

Source: http://wskaznikizrp.stat.gov.pl/ [accessed on 21 December 2016]

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Table 3: Groups of variables describing economic governance

No.	Specification	Type of variable
1.	**Economic development**	
1.1.	- gross domestic product growth per capita	stimulant
1.2.	- investment rate	stimulant
1.3.	- regional GDP per capita in purchasing power parity (PPP) at NUTS 3 level	destimulant
1.4.	- general government debt-to-GDP ratio	destimulant
1.5.	- the result (surplus/deficit) of the general government debt-to-GDP ratio	nominant
1.6.	- the energy consumption of transport and GDP – railway transport	destimulant
1.7.	- the energy consumption of transport and GDP – car transport	destimulant
1.8.	- the ratio between the energy consumption of transport and GDP	destimulant
1.9.	- GDP per capita in purchasing power parity (PPP)	stimulant
2.	**Employment**	
2.1.	- the employment rate for people aged 20-64 years	stimulant
2.2.	- duration of working life	stimulant
2.3.	- the economic and social inactivity rate for young people aged 15-24 years	destimulant
2.4.	- the economic and social inactivity rate for young people aged 20-24 years	destimulant
2.5.	- economic activity rate	stimulant
3.	**Innovativeness**	
3.1.	- the share of net revenues from sales of innovative products in net revenues from sales	stimulant
3.2.	- human resources for science and technology	stimulant
3.3.	- work productivity	stimulant
3.4.	- R & D expenditure relative to GDP	stimulant
3.5.	- the number of patent applications filed by residents to the European Patent Office per one million inhabitants	stimulant
4.	**Transport**	
4.1.	- freight transport – rail transport	stimulant
4.2.	- freight transport – inland waterway transport	stimulant
4.3.	- passenger transport – trains	stimulant
5.	**Production patterns**	
5.1.	- resource efficiency	stimulant
5.2.	- the share of organic farms in the total agricultural area	stimulant
5.3.	- organizations registered in the Eco-Management and Audit Scheme (EMAS)	stimulant

Source: http://wskaznikizrp.stat.gov.pl/ [accessed on 21 December 2016]

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Table 4: Groups of variables describing institutional-political governance

No.	Specification	Type of variable
1.	**Financing sustainable development**	
1.1	- Official Development Assistance (ODA) to developing countries	stimulant
2.	**The globalization of trade**	
2.1.	- imports from developing countries – countries that are on the list of recipients of development aid according to OECD DAC	stimulant
3.	**Cohesion and efficiency policy**	
3.1.	- the level of trust in public institutions – government	stimulant
3.2.	- the level of trust in public institutions –national parliament	stimulant
3.3.	- the level of trust in public institutions – the judiciary and legal system	stimulant
3.4.	- the level of trust in public institutions – police	stimulant
3.5.	- the level of trust in public institutions – political parties	stimulant
3.6.	- the level of trust in public institutions – European Parliament	stimulant
3.7.	- the level of trust in public institutions – European Commission	stimulant
3.8.	- the level of trust in public institutions – Council of the European Union	stimulant
3.9.	- corruption perception index	stimulant
4.	**Civil society – openness, participation and active citizenship**	
4.1.	- turnout in elections to the national parliament	stimulant
4.2.	- turnout in elections to the European Parliament	stimulant
4.3.	- the percentage of households with broadband Internet access at home	stimulant
4.4.	- the percentage of people using the Internet in contacts with public administration	stimulant
4.5.	- confidence index	stimulant
5.	**Equal rights in management**	
5.1.	- the share of women in management positions in the total number of employees in managerial positions	stimulant
5.2.	- women's participation in public life – national parliaments in the fourth quarter: unicameral or lower houses of parliaments	stimulant
5.3.	- women's participation in public life – national parliaments in the fourth quarter, the upper houses of parliaments	stimulant
5.4.	- women's participation in public life – local authorities (councillors): total	stimulant
5.5.	- women's participation in public life – local authorities: mayors or other leaders in municipal councils	stimulant
5.6.	- women's participation in public life – local authorities: councillors	stimulant

Source: http://wskaznikizrp.stat.gov.pl/ [accessed on 21 December 2016]

The data collected in Tables 1-4 were used to determine the values of Hellwig's synthetic measure according to the procedure described in detail in the publication (Zyzewski, Polcyn, 2016). Total values were then calculated as a basis to carry out further stages of the study. Total values obtained for groups of variables describing individual governances, which were determined for each of the 28 countries covered by the analysis based on observation conducted over ten consecutive years, were tested statistically in order to select the optimal version of the model and method of its estimation. The testing proceeded in the following steps:

1. Choosing between the classical least-squares (CLS) model and the panel data model
   A Breusch-Pagan test was first performed. The result of the Breusch-Pagan test was 4.27286e-049. The low value of this statistic suggests that the CLS model should be rejected. Therefore, individual effects should be introduced.

Since an individual effect was present in the model covered by the analysis, a fixed effects estimator or a random effects estimator should be selected. The estimators are selected by analysing Hausman test results.

2. A panel-data estimator
   2.1. A random effects estimator: individual effects are treated as random variables.
   The p-value from the Hausman test for random effects is 3.99785e-007. This value suggests that a random effects estimator should not be used in the analysis (Hausman, 1978; Hausman, Taylor, 1978).
   2.2. A fixed effects estimator is used to estimate the parameters of individual effects models.

The p-value from the Hausman test for random effects is 3.99785e-007. The value of $p < 0.05$ for the Hausman test indicates that a fixed effects estimator should be used in the analysis (Hausman, 1978; Hausman, Taylor, 1978).
Modelling was performed using software Gretl 2016d.

3. RESULTS AND DISCUSSION
Table 5 shows the successive steps in which the panel data model was improved by estimating fixed effects. The logarithm of likelihood was adopted as a criterion indicating the improvement of the model's explanatory properties and it was assumed that lower values of this measure pointed to more favourable explanatory properties of the model sought. The logarithm of likelihood in the model thus obtained was 105.8. This model had the lowest value and so was considered most preferred. Furthermore, the decreasing values of the Bayesian, Akaike and Hannan-Quinn information criteria indicate improvement of the explanatory properties of the model. Therefore, model (5) is the most appropriate model - Table 5 (Schwarz, 1978; Akaike, 1973; Hannan, Quinn, 1979).

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Table 5: The results of the estimation of panel data for the dependent variable 'environmental governance' and fixed effects

Independent variables	Models describing the formation of the dependent variable				
	(1)	(2)	(3)	(4)	(5)
const	2.498** (0.5419)	2.868** (0.3456)	3.031** (0.3097)	3.026** (0.3092)	3.073** (0.3072)
Poverty and living conditions	0.4399** (0.1514)	0.4585** (0.1341)	0.4671** (0.1330)	0.4597** (0.1233)	0.4566** (0.1234)
Transport	-1.298** (0.4947)	-1.400** (0.4785)	-1.445** (0.4732)	-1.374** (0.4689)	-1.403** (0.4688)
Equal rights in management	-0.4963** (0.2294)	-0.4700** (0.2163)	-0.4858** (0.2144)	-0.5017** (0.2136)	-0.5058** (0.2138)
Demographic changes	0.4570** (0.2228)	0.4368** (0.2177)	0.4970** (0.2088)	0.5226** (0.2033)	0.5457** (0.2027)
Financing sustainable development	1.027** (0.5128)	0.9628** (0.4856)	0.9161* (0.4830)	0.9894** (0.4772)	1.008** (0.4775)
Employment	-0.6039 (0.4291)	-0.5761 (0.3767)	-0.5136 (0.3665)	-0.6639** (0.3017)	-0.6481** (0.3018)
Public safety	0.1237 (0.1327)	0.1298 (0.1248)	0.1342 (0.1242)	0.1525 (0.1230)	
Access to the labour market	-0.1709 (0.1988)	-0.1703 (0.1888)	-0.1828 (0.1861)		
Cohesion policy	0.1397 (0.1660)	0.1482 (0.1633)	0.1415 (0.1501)		
Public health	0.1480 (0.2037)	0.1340 (0.1935)			
Economic development	0.1504 (0.2170)	0.1812 (0.2047)			
Production patterns	0.2017 (0.3043)				
The globalization of trade	0.7542 (1.319)				
Consumption patterns	0.3427 (0.6831)				
Innovativeness	-0.0778 (0.1915)				
Civil society	0.0450 (0.1380)				
Education	0.05876 (0.2316)				

Additional criteria of model fit

LSDV R^2	0.817	0.816	0.816	0.815	0.814
Within R^2	0.207	0.203	0.201	0.199	0.194
The logarithm of likelihood	-103.42	-104.18	-104.64	-104.94	-105.80
The Bayesian criterion	460.41	428.12	423.40	418.36	408.82
The Akaike criterion	296.84	286.37	285.28	283.87	281.60
The Hannan-Quinn criterion	362.45	343.23	340.68	337.82	332.63
The Durbin–Watson statistic	1.5668	1.5438	1.5286	1.5350	1.5275
Autocorrelation of residuals – rho1	0.0762	0.0879	0.0969	0.0940	0.9655

Source: own study based on modelling software Gretl 2016d

The value of LSDV R^2 in model (5) indicates that the model explains about 81% of variation. It is worth noting that the size of this indicator underwent minor changes in all models taken into consideration (Table 5). The within-group variance is 0.194. The within-group variance depends on differences within a group - in this case, differentiation within the time series studied (Turczak, Zwiech, 2016). The variable 'poverty and living conditions' is most statistically significant in this model: p = 0.0003. An increase in the synthetic measure of poverty by one unit increases the synthetic measure of environmental governance by 0.4566. This correlation in combination with the measures of the variables discussed (Tables 1-2) may indicate that the problem of social inequality is deepening or that goods adversely affecting environmental governance are used to a lesser extent. The structure of the synthetic measure of environmental governance indicates that this measure increases with the reduced impact of adverse factors on environmental governance. Thus, an increase in the value of environmental governance may indicate a lower use of goods having adverse effects on environmental governance and the correlated higher levels of poverty. The second scenario assumes the presence of high-tech goods on the market and their low adverse impact on the environment, and also a simultaneous increase in poverty levels, which may indicate an increase in social inequalities. Poverty can be alleviated through the development of tourism, but the development of this branch of the economy may disturb environmental governance if the principles of sustainable development are not applied (Medina-Munoz, Gutierrez-Ferez, 2016). Poverty can be prevented by providing jobs to those at risk of poverty through an increased involvement of entrepreneurs in the idea of corporate social responsibility (Kao et al, 2016). It is indicated that two major obstacles to worldwide development are poverty and environmental protection in the context of sustainable development. The two problems are related to each other and are also associated with the use of the rule of law (Anjinappa, 2015). An increase in the measure of transport by one unit reduces the synthetic measure of environmental governance by 1.403. This figure indicates the well-known adverse effects of transport on environmental governance. An increase in the synthetic measure describing a group of measures relating to equal rights in management indicates a decline in the measure of environmental governance by 0.5058. The high value of this measure certainly requires in-depth research that will confirm or deny this regularity. An increase in the synthetic measure of demographic changes by one unit increases the synthetic measure of environmental governance by 0.5457. The analysis of the variables making up the demographic measure shows that these variables may also indicate the environment-based quality of life (Table 2). Financing sustainable development can also favourably affect environmental governance. An increase in the synthetic measure of financial resources for sustainable development by one unit increases the synthetic measure of environmental governance by 1.008. The positive direction of this variable's impact on the synthetic measure of environmental governance indicates that budgetary resources for sustainable development are properly allocated; in the present case, these resources were targeted to so-called developing countries. According to the model presented, this funding brought good results through the introduction of technology enhancing the growth of the synthetic measure of environmental governance (Table 5). An increase in the synthetic measure of employment adversely affects the development of the synthetic measure of environmental governance. An increase in the synthetic measure of employment by one unit in this model decreases the synthetic measure of environmental governance by 0.6481. This may be due to the regularity indicating an increase in the level of unfavourable factors for environmental governance resulting from the improvement of the economic situation of society: the higher the employment rate, the higher the purchasing power of consumer goods is. This is in contrast to the previously discussed role of poverty factors in shaping environmental governance.

4. CONCLUSIONS

This study made it possible to determine the econometric model describing environmental governance based on the values of six groups of variables selected from among 17 groups characterizing social, economic and institutional-political governances. Of course, this does not mean that the other 11 groups of variables have no effect on the environmental dimension of sustainable development. However, the model specified in this article indicates correlations with the greatest impact. The knowledge of these correlations makes it possible to identify the areas on which efforts should be focused to improve environmental governance. Particular attention should be paid to the problem of poverty, which may be due to the presence of social inequality or a lower use of material goods. This is manifested by favourable impacts on environmental governance, but is not desirable for the economy. This direction of changes in society should not be supported. We should certainly strive to increase consumption among all strata of society while maintaining the principles of sustainable development in the area of environmental governance. The level of employment has a direct correlation with the level of poverty. This analysis confirms that an increase in the level of employment increases the purchasing power of consumer goods. The regularity indicating the adverse impact of the level of employment leads to the conclusion that an increased consumption of goods should be associated with marketing consumer goods that have low adverse impacts on environmental governance. This study has confirmed that budgetary spending on sustainable development has a positive effect on environmental governance. This indicates that the financial support for countries that are in unfavourable economic situation is justified in terms of the synthetic measure of environmental governance. The model presented in this paper shows that transport has an adverse impact on environmental governance. Therefore, the efficiency of transport should be improved through logistics activities and technological reduction of the harmful effects exerted by transport on environmental governance. The regularities presented in this article require further in-depth research on mutual interactions between individual domains of sustainable development. The aim of such research should be to identify new correlations, the knowledge of which will facilitate effective stimulation of sustainable development.

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