

Ghiță, Simona Ioana; Gogonea, Rodica Manuela; Săseanu, Andreea Simona

Article

Manifestations of the European ecological footprint from the perspective of social responsibility codes

Amfiteatru Economic Journal

Provided in Cooperation with:

The Bucharest University of Economic Studies

Suggested Citation: Ghiță, Simona Ioana; Gogonea, Rodica Manuela; Săseanu, Andreea Simona (2019) : Manifestations of the European ecological footprint from the perspective of social responsibility codes, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 21, Iss. 52, pp. 554-571, <https://doi.org/10.24818/EA/2019/52/554>

This Version is available at:

<https://hdl.handle.net/10419/281460>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

**MANIFESTATIONS OF THE EUROPEAN ECOLOGICAL FOOTPRINT
FROM THE PERSPECTIVE OF SOCIAL RESPONSIBILITY CODES**

Simona Ioana Ghiță^{1*}, Rodica Manuela Gogonea²
and Andreea Simona Săseanu³

¹⁾²⁾³⁾ Bucharest University of Economic Studies, Romania.

Please cite this article as:

Ghiță, S.I., Gogonea, R.M. and Săseanu, S.A., 2019. Manifestations of the European Ecological Footprint from the Perspective of Social Responsibility Codes. *Amfiteatru Economic*, 21(52), pp. 554-571.

DOI: [10.24818/EA/2019/52/554](https://doi.org/10.24818/EA/2019/52/554)

Article History

Received: 30 March 2019

Revised: 16 May 2019

Accepted: 15 July 2019

Abstract

The process of converting the economy to more sustainable production forms is the essence of bio-economy, currently becoming more and more important in all the European countries. Sustainability is a complex concept that can be quantified through an entire system of indicators. A “marker” of corporate environmental responsibility, of the extent and manner in which the companies apply social responsibility codes is the ecological footprint. The present study identifies, using a cumulative ordinal logistic regression model with proportional odds, the factors with significant impact on the behavioral changes of the ecological footprint of the production, for finding ways of increasing the sustainability in the business environment, through a better application of social responsibility codes. At the same time, the variables included in the model were selected in accordance with the principles of the European Corporate Social Responsibility Strategy, serving as criteria for the hierarchy and clustering of European countries, for identifying patterns and predicting the behavior of ecological footprint of production, as a prerequisite for optimizing social environmental responsibility and applying social responsibility codes in the business environment.

The analysis results indicate that the educational level of labor force, the degree of economic freedom and the use of renewable energy sources have a significant positive influence on the ecological footprint behavior, while the social exclusion has a significant negative effect, with a major impact on the prospects of sustainable growth, specific to bio-economy.

Keywords: ecological footprint, corporate social responsibility, social responsibility codes, bioeconomy, ordinal logistic regression model.

JEL Classification: C5, M14, O13, Q5.

* Corresponding author, **Simona Ioana Ghiță** – simo_ghita@yahoo.com

Introduction

In the current decade, customers assess the quality of the products and the business practices of the companies. Thus, the greening of production and consumption processes determines both an increase in the quality of life and a change in the population consumption behavior (Luca et al., 2019). In this context, considering how people live their lives and their desire to survive in a less polluted and stressed environment, an increasing number of consumers wish to contribute as much as possible to supporting a sustainable development of society as an integral part of bio-economy.

The development of bio-economy in Europe presents the following advantages: the ability to maintain and generate both economic growth and employment in rural, coastal and industrial areas, the possibility of reducing dependence on fossil fuels, and the growth of the economic and ecological sustainability process of primary production, as well as the manufacturing industries. (European Commission, 2018)

The above context justifies the need to elaborate the present paper on European ecological footprint, taking into account the social responsibility codes and the conjuncture of a sustainable economic growth, thus characterizing the transition process to bio-economy. Social and environmental responsibility is one of the keys to sustainable growth and is essential for long-term business development. It represents a dynamic and continuous process through which the groups' concerns are balanced and harmonized in relation to the principle of regenerating resources for the future generations. At the same time, social and environmental responsibility highlights the level of human dimension of the business and the interdependence between the company, the community and the society in terms of sustainability. The primary factors that catalyse the changes in the relationship between companies, consumers and society form a pyramid of responsibilities, based on the economic level, followed by the legal, the ethical and ending with the philanthropic level on the top.

Designed and developed on the background of sustainable development, 9 principles of social and environmental responsibility are emerging: ethics, governance, transparency, business relationships, capital distribution, company involvement in economic development, product or service values, employment protection, environment protection. The instrument through which social and environmental responsibility is integrated in a company is represented by social responsibility codes, based on the above principles.

On this background, the present paper aims at analyzing the impact of social responsibility codes on the perspectives of the ecological footprint. The process of modelling the behavior of the ecological footprint is based on numerous factors, including socio-educational ones, the development sustainability and the degree of economic freedom that explains the level of economy openness. The study has analyzed, for 33 European countries, the association between the production component of the ecological footprint and four factors that belong to three pillars: socio-educational, sustainability and economic freedom.

The purpose of this paper is to reflect how the application of social responsibility codes relates to the level of ecological footprint, acting in the direction of sustainable economic development, as an integral part of the bio-economy, paving the way for a more competitive, innovative and efficient society through the sustainable use of renewable resources. Thus, the work is structured in four sections. The introduction is followed by a review of the different points of view and ways of addressing the issue of the ecological footprint and the corporate social responsibility, in the context of innovation and

globalization by various specialists in the field and other interested persons. The next section includes the research methodology developed to identify the prospects for the evolution of the ecological footprint of production. The *Results and discussion* section – based on the research results – is followed by the conclusions reflecting the role of the social responsibility codes for the evolution of the ecological footprint, in the context of sustainable development and implicitly the need to correlate the bio-economy policies existing at national level with the EU policy.

1. Review of scientific literature

The effect of Social Responsibility on the corporate environment, on consumer behavior, on the role of governments and even on democracy itself is still the subject of many debates (Murphy-Bokern, Ehrendorf and Kleemann, 2014).

By the official statement 347/2002, the European Commission defines Corporate Social Responsibility as a contribution of enterprises to sustainable development as a beneficial factor for the sustainability of the whole Europe. It has also established the principles of the European Corporate Social Responsibility Strategy, recommending the integration of these principles into social responsibility codes, so that companies, by their business network, do not jeopardize the planet's ability to restore natural balance, to regenerate the consumed resources, and thus contributing to the reduction of ecological footprint. (Barbuta et al., 2014). Ecological footprint represents a tool for measuring and monitoring sustainability, taking into account that it is the sum of all footprints for all types of resources used and generated waste in a geographic area. It is an integral part of the bio-economy, considering its composition: the production of renewable biological resources, the conversion of these resources and waste streams into value-added products, namely food, animal feed, bioproducts or bioenergy.

By applying and enforcing social responsibility codes, companies assume certain responsibilities and obligations towards the community. The main responsibilities towards society are: the contribution to economic, social and environmental development, by promoting the sustainable development principles; support and encourage the environment protection; minimizing the impact of activities on the environment and natural resources; respecting the human rights; encouraging the development of local communities; applying fair management principles and practices to win the trust of the society in which the companies operate (Barbuta et al., 2014). Dobson (2003) believes this community is based on ecological footprint as a way of quantifying the impact of a firm or company on the limited natural resources. Some companies use resources to a greater extent than others, producing higher ecological footprints, and corporate social responsibility codes must also set higher obligations towards the community for these companies (Bondy and Matten, 2011).

Numerous studies have analyzed the effect of globalization on corporate social responsibility, pointing out some contradictory effects. Thus, Scherer and Palazzo (2008) consider that globalization leads to the intensification, flexibility and efficiency of economic cooperation relations between different regions, maximizing the profit of multinational companies, leading at the same time to an income and welfare polarization. That is why responsible and sustainable companies are preferred, because they ensure long-term profitability. Teegen, Doh, and Vachani (2004) and Scherer and Palazzo (2008) render that the challenge of Corporate Social Responsibility is to engage in a political process

which defines standards and global business regulations. This way, the Corporate Social Responsibility gives corporations greater power and provides them stronger relationships with decision factors. The effects of globalization on the environment are also analyzed in Rudolph and Figge's (2015) study, through the ecological footprint and a multidimensional globalization index. The investigation of the complex relationship between the economic, social and political variables has shown that social globalization is significantly and negatively correlated with the ecological pressure of production and consumption, and positively correlated with imports and exports.

Another addressed issue is the effectiveness of social responsibility codes in environmental protection and in the optimization of ecological footprint, in an attempt to conciliate the need of maximizing profit with the need of reducing the pollution, the pressures on the environment and the level of ecological footprint. Thus, Murphy-Bokern, Ehrendorf and Kleemann, (2014) studied various corporate social responsibility strategies applied in agriculture and in the food sector, which have a great relevance on climate protection by reducing greenhouse gas emissions and the ecological footprint. Almost all the surveyed companies have introduced social responsibility elements over the past decade, which they have also applied during the global financial crisis in 2007-2010. The authors identified two main drivers underlying the social responsibility in the food sector: reducing internal costs and increasing brand quality. The awareness of social and environmental responsibility must be promoted in and through the education system. Thus, Moon and Matten (2005) conducted a study on social responsibility-oriented education in business schools in Europe. The conclusion of the study – which included the answers from a quarter of the higher business education institutions across Europe – shows that – although not all business schools are promoting initiatives in the area of social and environmental responsibility – a high percentage of respondents indicated the awareness of the urgent need to promote social and environmental responsibility. Two-thirds of respondents also admit to promoting some education in corporate responsibility. According to the results of the study, the main promoters, initiators of corporate responsibility are the individual members of the faculties, a greater involvement of the institutions in such actions being needed. Almost all the respondents declared their interest in cooperating with the business community, towards a higher responsibility of their activities.

Another category of studies has analyzed the relationship between energy consumption (renewable and non-renewable) and the sustainability of economic growth, though with contradictory conclusions. Thus, Narayan and Doytch (2017) showed that in all countries, regardless the income level, economic growth has an unsustainable component, as it attracts the growth of non-renewable energy consumption. At the same time, economic growth has a significant positive effect on the use of non-renewable energy, but only for countries with low or below average income. These countries can apply environmental preservation policies without affecting their economic growth. For countries with high or above average income there was no evidence of a significant correlation between renewable energy consumption and economic growth. The studies of Işık, Dogru and Sirakaya-Turk (2018) reveal a bidirectional or unidirectional causal relationship between renewable energy consumption and economic growth in countries such as Italy, Spain or China, but such a relationship has not been confirmed for France. Armeanu, Vintila and Gherghina (2017) analyze the influence and causality between renewable energy and sustainable economic growth in the EU28 for the period 2003-2014. The results of the analysis indicate there is a

significant positive influence of the renewable energy consumption (totally and individually) on economic growth, thus highlighting its sustainable character.

Other studies focus on the premise that social inclusion should be used to reduce the ecological footprint of individuals and society. (Boechat and Faria, 2012). Analyzing social inequality and superconsumption with a high ecological footprint, Alsamawi et al. (2014) concluded that inequality of ecological footprint for developed countries is higher than inequality within them, as developed countries import goods and services from multiple economies with unequal ecological footprint. Thus, poverty is polarizing the ecological footprint even more. Inequality of ecological footprint and income should be addressed through social and environmental responsibility policies.

2. Research methodology

The aim of the research is to analyze the ecological footprint of production in European countries and the way in which the codes of social and environmental responsibility can support it, following the spectrum of sustainability of economic development, as a priority direction in transforming the bio-economy into a national field of intelligent specialization. The starting point of the analysis is that Corporate Social Responsibility – implemented through established codes – is a contribution of enterprises to sustainable development, and that the ecological footprint is the statistical indicator that triggers signals and impulses towards increasing corporate environmental responsibility, the degree and manner in which corporations apply social and environmental responsibility codes.

The main objectives of the research are:

- to analyze the evolution concerning the ecological footprint of production in European countries and implications on corporate responsibility;
- to identify the factors with significant impact on the behavioral changes of the ecological footprint of production, in order to find ways to enhance the sustainability of business activities and increase corporate responsibility over the environment and society, by applying social and environmental responsibility codes (using four hypotheses formulated and tested);
- to model and to predict the behavior of the ecological footprint according to the changes in the level of identified influence factors for the European countries;
- to provide a multicriteria hierarchy of European countries, according to the chosen factors;
- to identify key profiles of European countries, in terms of their economic sustainability, social and environmental responsibility;
- to identify action pathways, in order to optimize the sustainability of economic activity and corporate empowerment for each country pattern.

The research focused on: the analysis of the evolution in the ecological footprint of production in the European countries and the implications on corporate responsibility; modelling the behavior of the ecological footprint according to social-educational factors, the development sustainability (the degree of renewable energy use) and the degree of economy opening; multi-

criteria hierarchy and clustering of European countries in terms of selected variables, forecasting the behavior of the ecological footprint of production, as a premise for optimizing social environmental responsibility and applying social responsibility codes in the business environment. The association between the ecological footprint production component – as a measure that can characterize the social and environmental responsibility of the corporate sector – and the factors that belong to four pillars: the educational pillar, social exclusion, sustainability and economic freedom was econometrically analyzed using a cumulative probability ordinal logistic regression model (based on proportional odds).

For the first pillar (The educational pillar) it was selected the variable: „*The share of employment with tertiary education*” (age group 20-64 years), while for the second pillar (The social exclusion pillar) – the variable „*The material deprivation rate*”. The third pillar (The sustainability pillar) was represented by the variable „*The share of renewable energy in gross final energy consumption*”, in order to reveal the energy consumption sustainability; for the fourth pillar (The globalization pillar), the variable „*Employment in foreign controlled enterprises*” was selected, as an indicator reflecting the economic freedom (the economy opening degree) (table no. 1). At the same time, the variables were identified according to the principles of the European Corporate Social Responsibility Strategy (Barbuta et al., 2014), as follows: The „Employment and social affairs” principle was illustrated by the variables „*The share of employment with tertiary education*” and „*The material deprivation rate*”; the „Environmental” principle was expressed through the variable „*The share of renewable energy in gross final energy consumption*”; The principle of „Foreign trade, foreign relations and development” was characterized by the variable „*Employment in foreign controlled enterprises*”. The data for the four independent variables were provided by EUROSTAT database (Eurostat, 2019), for a number of 33 European countries corresponding to 2014 (the most recent year for which the ecological footprint was calculated), while the data for the dependent variable (Ecological Footprint) were provided by the National Footprint Accounts Report, 2018 Edition (Global Footprint Network, 2018). A synthesis of the variables included in the model is shown in the table below (table no.1), (figure no.1).

Table no. 1: The variables included in the model

Name of the variable	Type of the variable	Symbol of the variable	Measurement scale	Content of the variable
Ecological footprint of production (global hectares per person)	Dependent variable	EF_P (score)	Ordinal variable	The ecological footprint of production is a measure of the extent to which nature can absorb waste generated and can provide new resources instead of used ones.
Employment with tertiary education (% of total employment, 20-64 years)	Independent variable	TERTIARY_ED	Continuous numerical variable	Share of the employment with tertiary education (ISCED 5-8) in the total employment of the same age group.

Name of the variable	Type of the variable	Symbol of the variable	Measurement scale	Content of the variable
Share of renewable energy in gross final energy consumption (%)	Independent variable	RENEW_EN	Continuous numerical variable	The extent to which renewable energy sources have replaced fossil and / or nuclear fuels, contributing to the decarbonisation of the European economy.
Employment in Foreign Controlled Enterprises (%)	Independent variable	FOREIGN_ENT	Continuous numerical variable	Share of the employment in foreign controlled enterprises in the total employment of the country.
Material deprivation rate (%)	Independent variable	DEPRIV_RATE	Continuous numerical variable	The share of the population unable to acquire the goods and services needed for a proper living.

Source: authors' contribution

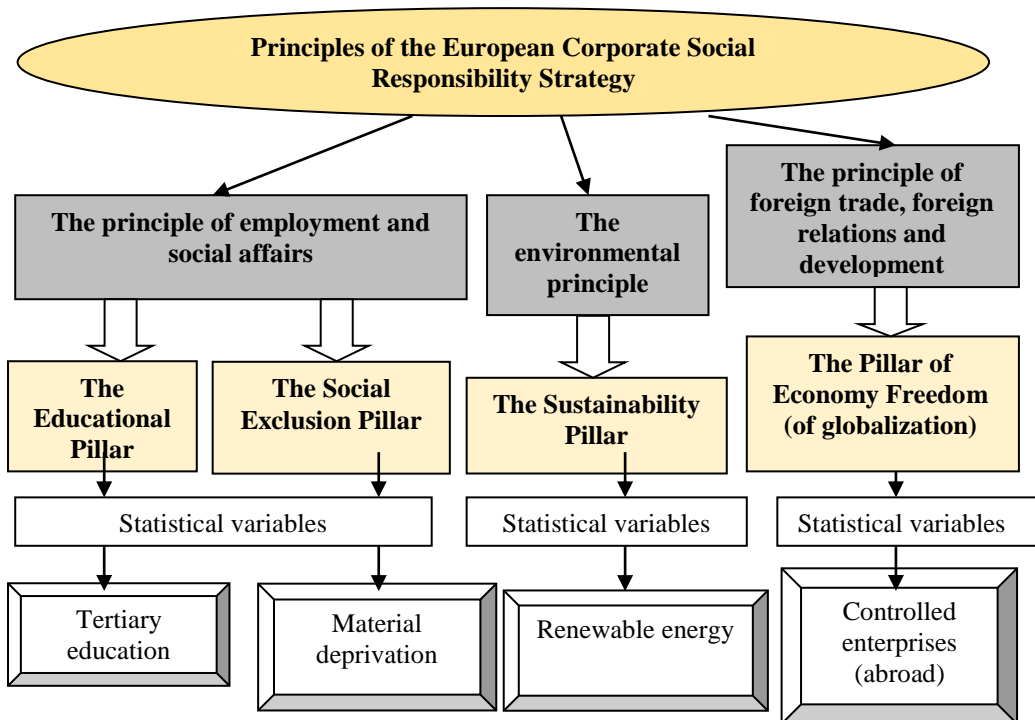


Figure no. 1: The ecological footprint of production and its factors

Source: made by the authors

In order to achieve the objective of identifying the factors with significant impact on the behavioral changes of the ecological footprint of production, the following hypotheses resulted:

- Hypothesis 1: The employment with higher education determines a significant differentiation in the level of ecological footprint of production and significantly influences the corporate environmental responsibility.
- Hypothesis 2: The share of employed population in foreign controlled enterprises leads to a significant differentiation of the ecological footprint of production, influencing social and environmental responsibility.
- Hypothesis 3: The degree of renewable energy use has a significant impact on the level of ecological footprint of production and corporate environmental responsibility.
- Hypothesis 4: The material deprivation rate has a significant impact on changes of the ecological footprint and social responsibility.

The values of the “Ecological Footprint of Production” variable have been recodified on an ordinal scale with 5 response variants: 1 (for values less than 3.5); 2 (for values between 3.5 and 4.9); 3 (for values between 5 and 6.4); 4 (for values between 6.5 and 7.9); 5 (for values at least equal to 8).

The relationship between the five variables is modeled using the multinomial ordinal logistic regression model with cumulative probabilities, based on proportional odds (through the SPSS Polytomous Universal Model PLUM procedure) (Denham, 2017; Liu, 2007; O’Connell, 2006)., data being processed using SPSS ver. 20 program. The logit type variable, corresponding to the ordinal dependent variable with 5 variants, presents the following form:

$$\Theta_j = \text{prob}(\text{score} \leq j) / \text{prob}(\text{score} > j) = \text{prob}(\text{score} \leq j) / (1 - \text{prob}(\text{score} \leq j)); j = \overline{1,4} \quad (1)$$

The ordinal logistic regression model that links the five variables is:

$$\ln(\Theta_j) = \alpha_j + \beta_1 \cdot \text{FOREIGN_ENT} + \beta_2 \cdot \text{TERTIARY_ED} + \beta_3 \cdot \text{RENEW_EN} + \beta_4 \cdot \text{DEPRIV_RATE} \quad (2)$$

where: Θ_j is the ordinal dependent variable

$$\alpha_j \text{ and } \beta_1 \text{ } \beta_4 \text{ are the model parameters. } (j = \overline{1,4}).$$

$$\ln\left(\frac{\text{prob}(\text{score} \leq j)}{1 - \text{prob}(\text{score} \leq j)}\right) = \alpha_j + \beta_1 \cdot \text{FOREIGN_ENT} + \beta_2 \cdot \text{TERTIARY_ED} + \beta_3 \cdot \text{RENEW_EN} + \beta_4 \cdot \text{DEPRIV_RATE} \quad (3)$$

After converting the logit type value into probabilities, the model becomes:

$$\text{Prob}(EF_P) = \frac{e^{\alpha_j + \beta_1 \cdot \text{FOREIGN_ENT} + \beta_2 \cdot \text{TERTIARY_ED} + \beta_3 \cdot \text{RENEW_EN} + \beta_4 \cdot \text{DEPRIV_RATE}}}{1 + e^{\alpha_j + \beta_1 \cdot \text{FOREIGN_ENT} + \beta_2 \cdot \text{TERTIARY_ED} + \beta_3 \cdot \text{RENEW_EN} + \beta_4 \cdot \text{DEPRIV_RATE}}} \quad (4)$$

In applying the cumulative logistic model with proportional odds, four assumptions were tested: the explained variable is measured on an ordinal scale; the explanatory variables are continuous, ordinal or categorical numeric variables; the absence of multicollinearity between the explanatory variables; the existence of proportional odds.

In order to analyze the territorial disparities and to provide a multi-criteria hierarchy of the European countries in terms of the variables included in the regression model previously determined, it was applied the method of *Relative distance to the maximum performance*. For each territorial unit i , ($i = \overline{1, n}$) and for each ranking criterion X_j ($j = \overline{1, m}$), it was determined the relative distance of a specific unit in comparison to the maximum performance unit. The previously determined relative distances were assembled in the form of a geometrical mean, resulting in an average relative distance of the respective unit, and average synthetic indices were obtained, on the basis of which the territorial units were ranked. As a result of clustering the European countries included in the study and the identification of four main country profiles, based on the previously determined regression model, the average probabilities of changing the level of the ecological footprint were estimated (namely the probabilities of moving from a lower category to a higher one), for each profile of the European countries, depending on the changes in the influence factors.

3. Results and discussions

The research results were focused on the following directions: analysis of the evolution of the ecological footprint in the European countries and the implications on the corporate responsibility; modeling the behavior of the ecological footprint depending on social-educational factors, sustainability and the degree of economic opening; multicriteria ranking and clustering of European countries; predicting the behavior of the ecological footprint of production as a prerequisite for optimizing social environmental responsibility.

After 2000, the global ecological footprint recorded a slight upward trend, thus indicating some problems in ensuring the sustainability of economic development. In a continental ranking, Europe ranks second, after North America, being characterized by a high level of ecological footprint (4 global hectares per person in the EU28, 2014). If 1.7 planets are needed worldwide to regenerate the resources that mankind consumes, Europe (EU28) needs 2.8 planets to do so. Looking at the dynamics, it is a positive fact that Europe's ecological footprint registered a slight downward trend, enrolling on a sustainable path (from 4.94 global hectares per person in 2000 to 4.69 global hectares per person in 2014). However, the indicator had two subperiods with contrasting developments: thus, up until 2008, the trend was predominantly upward, and then reversed, supported to a certain extent by the global financial crisis of that period.

Correlation analysis between the level of ecological footprint and GDP per capita in European countries indicates a strong direct relation between the two indicators, which means that the results of economic activity have not been decoupled from the resources use, to ensure the necessary economic development. Countries with a high ecological footprint are Finland and Norway, and those with a low ecological footprint are divided into two categories: either the ex-socialist countries, with a lower economic development level (Albania, Montenegro, Macedonia), or developed countries that have succeeded in maintaining a sustainable economic activity and enforcing the principles of corporate responsibility in the business environment (Switzerland, Italy, Portugal, UK).

The unfavorable developments in European countries in sustainability domain can be mitigated by increasing the social and environmental responsibility of economic activity, a process that must start at microeconomic level. Thus, in Eastern European countries, where the corporate social responsibility concept is newer than in the developed countries, an

enlargement is necessary, especially in the context of the integration of these countries into the European Union and the influence of foreign investors. Multinational companies with headquarters in these countries, NGOs and the media can join governments in an effort to raise awareness, to impose a pressure on the business environment, in order to emphasize the necessity of implementing the social and environmental responsibility codes.

After testing the hypotheses of the regression model, the following results were obtained:

- the explanatory variables are poorly correlated, the correlation between them being statistically insignificant (the Variance Inflation Factor statistic is lower than 4, ranging between 1.006 and 1.326);

- the adequacy of the ordinal regression model with proportional odds is significant. Indeed, following the application of the "Test of parallel lines" and the Pearson and Deviance statistics, we can say that there is insufficient evidence to reject the null hypothesis, and therefore the regression model is appropriate, the *logit* type relationship between the five variables is valid (The Chi-Square Test value is 3.276, at a minimum significance level of 0.993);

- the intensity of the association between the explanatory variables and the explained variable, measured by the Cox and Snell, Nagelkerke and McFadden indicators shows that quite important proportions of the total variance of the dependent variable are explained by the changes in the independent variables, certifying the suitability degree of the *logit* model (the shares range between 63.9% and 68.2%);

- the application of the Chi Square test at 5% significance level led to the conclusion that the model parameters $\beta_1, \beta_2, \beta_3, \beta_4$ significantly differ from zero, therefore the model contains predictors (the calculated test value is 33.326 – higher than the critical test value).

The four assumptions being validated, the estimates of the model parameters were obtained (table no. 2)

Table no. 2: Estimates of model parameters
Parameter Estimates (Link function: Logit)

	Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval		
						Lower Bound	Upper Bound	
Thresh old	[EF_P_Code = 1]	7.335	2.651	7.654	1	.006	2.138	12.531
	[EF_P_Code = 2]	10.088	2.937	11.801	1	.001	4.332	15.843
	[EF_P_Code = 3]	11.476	3.150	13.269	1	.000	5.301	17.650
	[EF_P_Code = 4]	13.726	3.676	13.940	1	.000	6.521	20.931
Loc atio n	FOREIGN_ENT	.206	.062	11.003	1	.001	.084	.328
	TERTIARY_ED	.108	.052	4.384	1	.036	.007	.210
	RENEW_EN	.098	.032	9.185	1	.002	.035	.162
	DEPRIV_RATE	-.095	.048	3.928	1	.047	-.190	-.001

Source: Authors' results in SPSS, based on data provided by EUROSTAT and National Footprint Accounts 2018 Edition.

The logit regression model takes the following form:

$$\ln\left(\frac{\text{prob}(\text{score} \leq 1)}{1 - \text{prob}(\text{score} \leq 1)}\right) = 7.335 + 0.206 \cdot \text{FOREIGN}_{\text{ENT}} + 0.108 \cdot \text{TERTIARY}_{\text{ED}} + 0.098 \cdot \text{RENEW}_{\text{EN}} - 0.095 \cdot \text{DEPRIV}_{\text{RATE}} \quad (5)$$

$$\ln\left(\frac{\text{prob}(\text{score} \leq 2)}{1 - \text{prob}(\text{score} \leq 2)}\right) = 10.088 + 0.206 \cdot \text{FOREIGN}_{\text{ENT}} + 0.108 \cdot \text{TERTIARY}_{\text{ED}} + 0.098 \cdot \text{RENEW}_{\text{EN}} - 0.095 \cdot \text{DEPRIV}_{\text{RATE}} \quad (6)$$

$$\ln\left(\frac{\text{prob}(\text{score} \leq 3)}{1 - \text{prob}(\text{score} \leq 3)}\right) = 11.476 + 0.206 \cdot \text{FOREIGN}_{\text{ENT}} + 0.108 \cdot \text{TERTIARY}_{\text{ED}} + 0.098 \cdot \text{RENEW}_{\text{EN}} - 0.095 \cdot \text{DEPRIV}_{\text{RATE}} \quad (7)$$

$$\ln\left(\frac{\text{prob}(\text{score} \leq 4)}{1 - \text{prob}(\text{score} \leq 4)}\right) = 13.726 + 0.206 \cdot \text{FOREIGN}_{\text{ENT}} + 0.108 \cdot \text{TERTIARY}_{\text{ED}} + 0.098 \cdot \text{RENEW}_{\text{EN}} - 0.095 \cdot \text{DEPRIV}_{\text{RATE}} \quad (8)$$

Examining the results in the above table, it can be noticed that all the model parameters are statistically significant (Wald test values are higher than the critical value, and all significance levels are lower than 0.05). The four „Slope” parameters related to the four explanatory variables are statistically significant, the first three being positive and the last one – negative, indicating that the first three explanatory variables have significant direct effects on the variability in the dependent variable, while the last explanatory variable inversely influences the variability in the explained variable.

1% increase in the employment in foreign-controlled enterprises, is expected to lead to 0.206 average increase in the log-odds of the ecological footprint (if the level of the other explanatory variables remains constant). 1% increase in the employment share with higher education is expected to increase the log-odds of the ecological footprint by 0.108, on average, under the same conditions. At the same time, according to the regression results, 1% increase in the share of renewable energy will lead to 0.098 average increase of the logarithm of chances that the ecological footprint will move to a higher category, while 1% increase in the material deprivation rate is expected to lead to an average decrease in the chances that the ecological footprint will move to a higher value class of 0.095.

Following the determination of proportional odds ratios and their confidence intervals, at 95% confidence level, it can be argued that 1% increase in the share of the employed population in foreign-controlled enterprises, is expected to rise the odds of ecological footprint to move from a lower to a higher score 1.229 times (minimum 1.088 times and maximum 1.388 times), while the other explanatory variables do not change their level. At the same time, it can be estimated that 1% increase in the share of the employment with tertiary education will lead to an increase in the chances that the ecological footprint moves from a lower to a higher score category of 1.114 times (minimum 1.007 times and maximum 1.233 times) if the level of the other explanatory variables does not change (table no. 3). Regarding the effect of the share of renewable energy on the ecological footprint of production, a 1% increase in the share of renewable energy is expected to imply an average increase of 1.103 times in the odds of the ecological footprint to move from a lower to a higher score (minimum 1.035 times and up to 1.176 times). A 1% increase in the material deprivation rate may lead to an expected average decrease of the odds that the ecological footprint moves to a higher score category by 9.1% (by at least 0.1% and by no more than 17.3%).

Table no. 3: Proportional Odds-Ratios

VAR	EXP_B	LOWER	UPPER
[EF_P_Code = 1]	1532.663	8.486	276807.454
[EF_P_Code = 2]	24049.383	76.117	7598441.050
[EF_P_Code = 3]	96357.954	200.590	46287709.453
[EF_P_Code = 4]	914343.315	678.995	1231266055.273
FOREIGN_ENT	1.229	1.088	1.388
TERTIARY_ED	1.114	1.007	1.233
RENEW_EN	1.103	1.035	1.176
DEPRIV_RATE	.909	.827	.999

Source: Authors' results, based on data provided by EUROSTAT and National Footprint Accounts 2018 Edition and SPSS.

As a result of demonstrating a significant impact of the four factors on the change of the ecological footprint of production level, the four hypotheses are validated.

In order to analyze the territorial disparities, the 33 European countries included in the study were ranked using as ranking criteria the five variables: the ecological footprint of the production, the share of the employed population in foreign controlled enterprises, the share of employment with tertiary education, the share of renewable energy and the material deprivation rate. The method used to achieve multi-criteria hierarchy was the relative distance method to the maximum performance unit. The final scores and the relative distances of each country, compared to the best performance country are shown in the following table and chart (table no. 4), (figure no. 2):

Table no. 4: Multicriteria ranking and clustering of European countries

Ranks	Countries	Relative distance to maximum performance (%)	Cluster	The average probability of changing the ecological footprint from one category to another (%)
1- 8	Switzerland, Sweden, Norway, Finland, Denmark, Austria, France, Spain	Maximum: 100.00 Minimum: 65.67 Average: 78.05	I	15.61
9- 20	Cyprus, Portugal, Italy, Germany, Croatia, Slovenia, Netherlands, Montenegro, Greece, Belgium, Lithuania, United Kingdom	Maximum: 65.05 Minimum: 51.11 Average: 57.80	II	24.28
21-26	Luxembourg, Latvia, Estonia, Ireland, Malta, Czech Republic	Maximum: 49.69 Minimum: 44.64 Average: 46.75	III	11.75

Ranks	Countries	Relative distance to maximum performance (%)	Cluster	The average probability of changing the ecological footprint from one category to another (%)
27-33	Bosnia and Herzegovina, Macedonia TFYR, Poland, Slovakia, Bulgaria, Romania, Hungary	Maximum: 44.08 Minimum: 38.56 Average: 41.81	IV	12.14

Source: Authors' results, based on data provided by EUROSTAT and National Footprint Accounts 2018 Edition

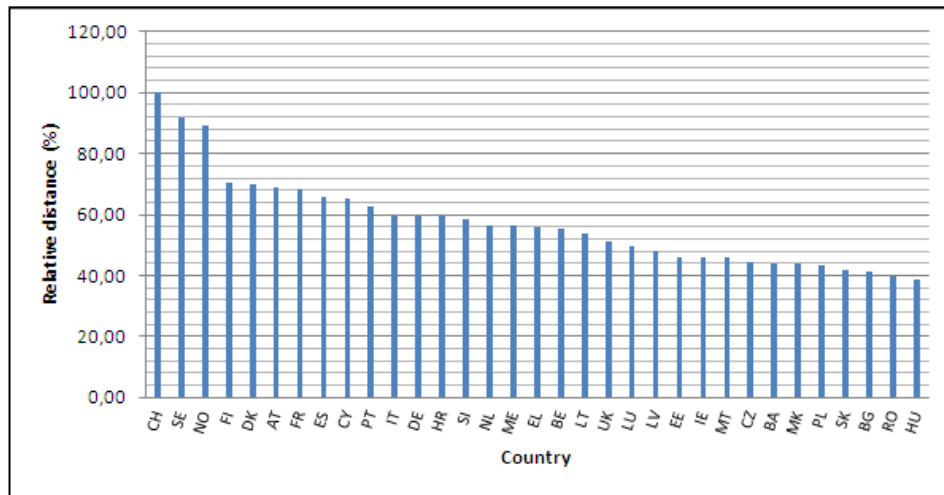


Figure no. 2: Relative distance of European countries to the maximum performance
Source: Authors' results, based on data provided by EUROSTAT and National Footprint Accounts 2018 Edition

Using the multinomial ordinal logistic regression model with cumulative probabilities, based on proportional odds, the average probabilities of changing the ecological footprint of production for the four profiles of European countries were calculated (table no. 9), (figure no. 3).

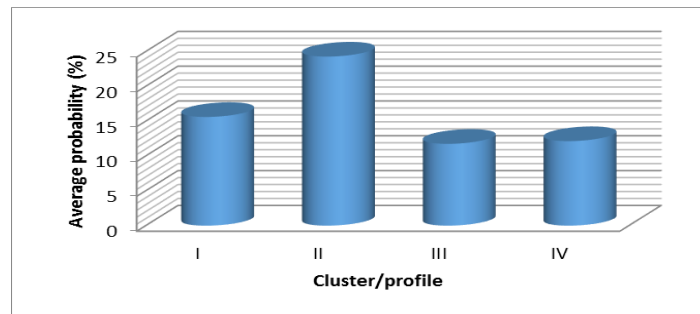


Figure no. 3: The average probability of passing the ecological footprint from a lower to a higher category, by European countries profiles (%)

Source: Authors' results, based on data provided by EUROSTAT and National Footprint Accounts 2018 Edition and SPSS.

The countries in the first cluster/profile are developed countries, that have achieved over 65% of the maximum performance, placed on the first eight ranking positions, most of them with a high variability in the ecological footprint (the group includes countries with the highest ecological footprint), but with favorable levels of factors: high degree of economic openness, high percentage of the population with higher education (above average), most with a high level of renewable energy use and with a low material deprivation rate. There are countries with significant chances and resources to improve corporate environmental responsibility through a large degree of highly qualified workforce and alternative energy resources use. The countries in the second cluster achieved between 50-65% of the maximum performance. There are countries with different development levels, with low ecological footprint, but with varied factor levels: lower economic openness, high variability in the share of employment with higher education, in the share of renewable energy use and in the material deprivation rate (below and above average). Developed countries in this group, such as Germany, the Netherlands, the United Kingdom or Italy are characterized by high corporate responsibility, while low developed countries (Montenegro, Croatia) must emphasize the focus of education on social and environmental responsibility. The countries in the third cluster achieved between 44-50% of the maximum performance. They have an above-average ecological footprint, with a high share of employed population in foreign controlled enterprises and a share of highly educated employment above 22%. Regarding renewable energy, there are very large variations within the cluster, from 4.5% (Luxembourg) to 38.7% (Latvia). The rate of material deprivation is low (below average). It is recommended that these countries reduce their ecological footprint of production and concentrate their increased share of tertiary educated laborforce to energy-efficient and environmental friendly production, to improve the use of renewable energy. In this way they can increase their social and environmental corporate responsibility. Countries in cluster four achieved at most 44% of the maximum performance. There are formerly socialist countries with a lower development level, a low ecological footprint on the background of a narrower national output, countries which have been focused on a wider economy freedom, countries with an above-average share of the employment in foreign-controlled enterprises, with a low share of the employed population with superior education, mostly with a low use of renewable energy and a high rate of material deprivation. Such countries are recommended to increase corporate environmental responsibility by expanding production under priority of renewable energy use, extending

the use of the labor force with higher education, and improving social exclusion through a reduction in poverty and material deprivation.

Conclusions

In the past decade, Europe is involved in building and implementing bio-economy oriented strategies, as the core of the smart and green growth process.

The research performed was focused on the analysis of the ecological footprint of production in European countries, taking into account the way in which the application of social and environmental responsibility codes can support it, given the sustainability of economic development as a tool of bio-economy. The first part of the paper has approached an analysis of the ecological footprint evolution in European countries and the implications for corporate responsibility. The results indicate the existence of a low ecological footprint in Eastern Europe, but also the need to raise the awareness of the implementation of social responsibility codes. Compared to this region, the high level of the ecological footprint for North and West Europe highlights the need for social and environmental empowerment of national and multinational companies in applying these codes. Unfortunately, due to the lack of more recent data from highly reliable sources – our analysis is based on the indicator level for 2014, published in the Global Footprint Network 2018 report.

Furthermore, the paper includes the modeling of the ecological footprint behavior depending on social-educational factors, on the sustainability of the economic development (the usage degree of renewable energy) and the openness degree of an economy. The results lead to the conclusion that an increase in the share of the employed population in foreign controlled enterprises, in the share of highly educated employment and in the increase of the renewable energy use will all lead to an increase in the level of the ecological footprint. Our results do not provide sufficient reasons to certify the beneficial action of the educational level of labor force on the reduction of the ecological footprint and on the increase of social environmental responsibility, which can be explained by the fact that a highly-educated workforce (better qualified) is more efficient, more productive, thus achieving a superior output. Nowadays, a large production is achieved with an excessive use of the planet's resources, resulting in an increase of the ecological footprint through a negative impact on the environment, and thus a decrease in corporate environmental responsibility. Another explanation is the insufficient focus on social and environmental educational responsibility in higher education business institutions. Countries with a higher degree of renewable energy use are also developed countries with a higher income, coming from an extended productive activity, associated with a high ecological footprint and, sometimes, with a deficient application of social and environmental responsibility codes. As the material deprivation rate increases, there is a decrease in the ecological footprint. Indeed, a high rate of material deprivation indicates a high level of population poverty and social exclusion, which are characteristics of low income countries, with less developed economic activity and a lower ecological footprint.

In the last part of the analysis, the multicriteria ranking and clustering of the European countries were carried out. In terms of selected variables, four clusters were formed. Regarding the prediction of the ecological footprint of production, as a prerequisite for the optimization of the social environmental responsibility and the application of the responsibility codes in the business environment, it can be mentioned that the average

probabilities for the European countries of moving from one category of the ecological footprint to another vary between 11.75% for the third cluster and 24.28% for the first one. The results also reveal that markets and enterprises are differently developed in Europe; an universally applicable method that attempts to impose a single model for corporate behavior is not relevant and will not lead to significant assumption of social and environmental responsibility by enterprises; moreover, emphasis should be placed on the development of civil society and, in particular, on consumer awareness of responsible production in order to promote corporate responsibility, which is a long-term and relevant commitment for the national and regional context. The authors intend to expand research by identifying other factors with significant impact on the behavior of the ecological footprint, as well as studying their impact using different types of models, in order to capture both temporal and spatial changes in the ecological footprint.

A responsible social and environmental behaviour of the companies can help both to increase the number of jobs and to improve working conditions, to ensure the employees' rights and to promote research and development of technological innovations; also, it supports the principle of responsible competitiveness as an integral part of the Commission's Program for Innovation and Competitiveness; it invites European companies to report on their contribution on achieving the goals set out in European strategies. On the other hand, most consumers are pursuing both companies with optimal results and companies with poor performance, thus social and ecological responsibility playing a key role at the level of each individual company. Therefore, companies that wish to move towards sustainable lifestyles should impose some essential measures all at the same time, such as: transparency in their business practices; to have an open and permanent dialogue with all consumers; to support sustainable transformation, creating socio-economic developed communities, supporting high-performance tools compared to previous ones. When consumers decide to buy products, they will choose companies that are responsible to help them make a personal contribution to the planet's sustainability, by offering opportunities to act or by translating how their purchases can create an individual impact. These aspects reflect the importance of sustainability for a company's reputation. Progress in bio-economy research and innovation will enable Europe to improve the management of its own renewable bio-resources and open up new and diversified markets for food and bio-products.

References

- Alsamawi, A., Murray, J., Lenzen, M., Moran, D. and Kanemoto, K., 2014. *The Inequality Footprints of Nations: A Novel Approach to Quantitative Accounting of Income Inequality*, [online] *PLOS ONE*. Available at: <<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0110881>> [Accessed 20 January 2019].
- Armeanu, D., Vintilă, G. and Gherghina, Ș., 2017. *Does Renewable Energy Drive Sustainable Economic Growth? Multivariate Panel Data Evidence for EU-28 Countries*. *Energies*, [online] Available at: <<https://www.mdpi.com/1996-1073/10/3/381/pdf>> [Accessed 20 January 2019].
- Barbuta, R., Hentea, M., Mesteru, S.D. and Cociorvei, D., 2014. *Rolul Consiliilor Economice si Sociale si al institutiilor similare din UE in promovarea conceptului de Responsabilitate Sociala a Companiilor, CES România*, [online] Available at:

- <<http://www.ces.ro/newlib/studii-ces/STUDIUL-Responsabilitate-Sociala-Companii.pdf>> [Accessed 22 January 2019].
- Boechat, C. and Faria, J., 2012. *Degree of Inclusiveness: A Tool for the Development of Inclusive Markets*, [online] Available at: <<https://books.google.ro/books?isbn=1351287834>> [Accessed 22 January 2019].
- Bondy, K. and Matten, D., 2011. *The relevance of the natural environment for corporate social responsibility research*, [online] Available at: <<https://www.dirkmatten.com/Chapters/AB/Bondy%20Matten%20for%20OUP%20HB%20Final%20Version.pdf>> [Accessed 25 January 2019].
- Denham, B.E., 2017. Ordinal Logistic Regression. In: John Wiley & Sons (eds) *Categorical Statistics for Communication Research*, pp. 171-197. New York: John Wiley & Sons.
- Dobson, A., 2003. *Citizenship and the environment*. Oxford: Oxford University Press. [online] Available at: <<https://ecpr.eu/Filestore/WorkshopOutline/6bbf065b-46cf-4751-9b06-ec8bec22e212.pdf>> [Accessed 30 January 2019].
- European Commission, 2018. *O bioeconomie durabilă pentru Europa: consolidarea legăturilor dintre economie, societate și mediu*, Bruxelles, [online] Available at: <http://www.cdep.ro/afaceri_europene/CE/2018/COM_2018_673_RO_ACTE_f.pdf> [Accessed 30 January 2019].
- Eurostat, 2019. *Eurostat database*. [online] Available at: <<https://ec.europa.eu/eurostat/data/database>> [Accessed 30 January 2019].
- Global Footprint Network, 2018. *Data and Method*. [online] Available at: <<https://www.footprintnetwork.org/resources/data/>> [Accessed on 10 January 2019].
- Işık, C., Dogru, T. and Sirakaya-Turk, E., 2018. A nexus of linear and non-linear relationships between tourism demand, renewable energy consumption, and economic growth: Theory and evidence. *International Journal of Tourism Research*, 20, pp.38-49.
- Liu, X., 2007. Ordinal regression analysis: Fitting the proportional odds model using Stata, SAS and SPSS. *Journal of modern applied statistical methods: JMASM*, 8(2), pp.632-642.
- Moon, J. and Matten, D., 2005. Corporate Social Responsibility Education in Europe. *Journal of Business Ethics*, 54(4), pp.323-337.
- Murphy-Bokern, D., Ehrendorf K., and Kleemann, L., 2014. *The role of corporate social responsibility in reducing greenhouse gas emissions from agriculture and food. Draft for public consultation*, [online] Available at: <http://www.murphy-bokern.com/images/IFPRI_CR_Report_July_2015.pdf> [Accessed 15 February 2019].
- Narayan, S. and Doytch, N., 2017. An investigation of renewable and non-renewable energy consumption and economic growth nexus using industrial and residential energy consumption. *Energy Economics, Elsevier*, 68(C), pp. 160-176.
- O'Connell, A.A., 2006. *Logistic regression models for ordinal response variables*. Thousand Oaks: SAGE.

- Rudolph, A. and Figge, L., 2015. *How does globalization affect ecological pressures? A robust empirical analysis using the Ecological Footprint*, Discussion Paper Series, No. 599. [pdf] University of Heidelberg, Department of Economics. Available at: <http://archiv.ub.uni-heidelberg.de/volltextserver/19204/1/rudolph_figge_2015_dp599.pdf> [Accessed 20 February 2019].
- Scherer, A.G. and Palazzo, G., 2008. *Globalization and Corporate Social Responsibility*. In: Crane, A., McWilliams, A., Matten, D., Moon, J., Siegel, D. (eds.) *The Oxford Handbook of Corporate Social Responsibility*, pp. 413-431.
- Teegen, H., Doh, J.P. and Vachani, S., 2004. The Importance of Nongovernmental Organization (NGOs) in Global Governance and Value Creation: An International Business Research Agenda. *International Business Studies*, 35(6), pp.463-483.