ECONOMIC GROWTH AND SUSTAINABLE DEVELOPMENT IN EUROPE. A CROSS-SECTIONAL STUDY

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Abstract

Social and economic changes and the technological progress in the past 30 years and a global propensity towards sustainable development are the challenges for the economic world. In this paper, we have identified the main factors that influence economic growth in the European Union countries, especially since in the past 15-20 years the European programs and strategies on sustainable development have become a priority. The aim of the paper is to analyse economic growth and sustainable development. The aim was achieved using statistical methods: descriptive statistics, exploratory analysis, correlation analysis and multiple regression. The findings indicate that GDP per capita in 2015 depends on GDP per capita in 2014, on Healthy life years, labour productivity, and improved sanitation facilities. We can remark that there is a strong connection among economic, social, and ecological aspects.

Key words: *economic growth, sustainability, cross-sectional study, regression analysis*

1. INTRODUCTION

Present day society and economic world is faced with an evolutionary challenge for at least two reasons: major social and economic changes on one hand and the technological progress in the past 30 years, along with an obvious global propensity towards a new development model, i.e. sustainable development, on the other. Starting from the observation that a significant part of these changes have appeared as a consequence of social, economic and technological progress, following international scientific debates, the conclusion was drawn that we are in actual fact witnessing some *reverse* effects of technological progress. A general observation is that resources, which act at as support to optimal development of social and economic activities, are in danger both quantitatively and qualitatively, and will no longer ensure continuous GDP growth. We thus find ourselves faced with new evolutionary tendencies in the social and economic environment, with an emphasis on the manner in which growth is achieved; economic growth should be oriented towards the main social and environment objectives.

To support the previous statements, in the present paper a set of reference indicators has been selected to analyse economic growth under the conditions of sustainable development: per capita GDP, Healthy life years in absolute value at birth – females, Real labour productivity per hour worked, Improved sanitation facilities (% of population with access), Unemployment rate, Research and Development Expenditures, Natural resources rents, Foreign Direct Investments, Municipal Waste, Land covered by artificial surfaces (%). By analysing these indicators we aim at identifying the factors on which economic growth depends. In other words, ensuring that a balance is preserved between social and environmental factors will have beneficial effects on economic growth. Thus, we advocate the idea that in an economy where the population does not benefit from balanced life conditions (health-care, education, life satisfaction, access to resources and information, etc.), while the environment is regarded only as resource to be exploited, economic growth will be affected or will be non-existent.

Since a part of economic research is mainly oriented towards the analysis of economic growth, while another part – especially in the past 20 years – supports balanced development, we have advanced several questions associated with the objectives of the present study: how can healthy economic growth be ensured to satisfy the requirements of sustainable development? Which are the most adequate indicators to measure economic growth to preserve social and environmental balance? Which are the connections between economic growth indicators and sustainable development indicators? Finding answers to these questions will allow us to make sense of the relation between GDP and sustainable development.

The impact of re-examining growth and economic development from the standpoint of sustainable development can be established in three distinct major domains, and points at various aspects and specific phenomena:

- the economic aspect: GDP growth, employment rate, investments, profit, etc.;
- the social aspect: demographic changes, social opportunities and inequalities, life quality, social progress, etc.;
- the environmental aspect: the use of resources, environmental factor conservation, decrease of pollution level, etc.

The threefold approach of sustainable development, also known as the *triple bottom line*, was suggested by the World Commission on Environment and Development (2007), which supports the content analysis of the three dimensions: economy, society, and environment. We consider that three more dimensions can be added: technological, informational, and institutional. Thus, development is described as sustainable if it generates a balance between the three dimensions or if it validates the balance of the 3E rule: economy, equality, and environment.

One modern and relevant way of classifying sustainable development at the macroeconomic level in terms of the coordinates used to identify it was proposed by Daniel Loucks (from the Cornell University, Ithaca - USA) in the form of the perspectives from which sustainable development can be analysed (Zaman and Gherasim 2007). The adequate analysis indicators from among the set presented above have been associated to it. Therefore, the perspectives on sustainable development, the aspects considered, and the selected analysis indicators are:

- *Economic*. The aspects considered are: efficiency, growth, equality: they are measured using the following indicators: per capita GDP, Real labour productivity per hour worked, Foreign Direct Investments.
- *Ecological*. The aspects considered are ecosystemic integrity, the capacity to support and diminish adverse global impacts; the analysis indicators are: Natural resources rents, Municipal Waste, Land covered by artificial surfaces (%).
- *Social and demographic*. The aspects considered are: public participation, social mobility, social cohesion, cultural identity, institutional development. The analysis indicators selected are: Healthy life years in absolute value at birth - females, Improved sanitation facilities (% of population with access), Unemployment rate.
- *Technological.* The aspects considered are: efficient use of energy and natural resources, minimization of losses, comprehensive economic and environmental evaluation by analysing the entire product life cycle; we have chosen to use Research and Development Expenditures as one of the reference indicators.

In this particular context, a new concept, increasingly present in the functionality of economic systems, can be used: circular economy, formally used in the economic model for the first time by Pearce & Turner (1990). In this model, the relation between economy and environment prevails and incorporates three basic functions of the environment: provider of resources, wastage management, a source of utilities. We consider that the key to sustainable development is the current and future management of natural resources, of energy, raw materials and informational resources, in relation to the objectives of economic growth and to increased life and environment quality (Zaman and Gherasim 2007). Besides, the issues related to rational resource management to increase efficiency are connected to the issues of sustainable development, given that each generation's resources are influenced by the previous generations' consumption (Georgescu-Roegen 1926, in Tiezzi and Marchettini 1999).

In the present paper we have aimed at identifying the main factors that influence economic growth in the EU countries, since sustainable development has been a priority in the European programs and strategies in the past years. The objectives of our paper are:

- To describe the variables that measure economic growth and the sustainable development;
- To measure the relationship between the GDP and the factors that influence economic growth and sustainable development by taking into account the economic, social and environmental objectives;
- To measure the dependency between GDP, on one hand, and the factors that influence economic growth, on the other hand.

In order to accomplish these objectives we used descriptive analysis, exploratory analysis, and regression analysis. The present paper is structured as follows: Introduction, Literature Review, Data and Methods, Results, and Conclusions.

2. LITERATURE REVIEW

Specialized literature dedicated to economic growth under circumstances in which sustainable development has become a priority indicate many authors' efforts towards elucidating the relation between the factors that ensure social progress and improved life quality on the one hand, and the factors that ensure environmental stability on the other. Specialized international literature in this area is extremely rich and, chronologically, it includes the first mention of the risk of natural resources depletion as early as 1970; this phenomenon would endanger both future economic growth and life quality. As early as 1933, Frederick Soddy remarks on the fact that any quantitative growth that results from the use of the productive system mechanisms must be accompanied by a decrease in resource over-consumption or by the elimination of irrational consumption (Soddy 1933). Later, Rachel Carson (1962) was the first to draw attention to the dangers of increased pollution levels and the lack of interest in protecting the environment; this warning is currently reflected in the numerous social, demographic, economic and environmental issues that derive from this aspect.

From the point of view of the present paper, social demographic are essential in preserving the balance characteristic of sustainable development. A considerable number of the aspects related to economic growth, major social and demographic phenomena and sustainable development are part and parcel of the problems of the 21st century: poverty, increased inequality, poor health, resource overconsumption etc. (Singh 2016). In fact, the problems to be solved are associated to investment issues, while investment in its turn rely on resources and technological progress.

Le (2014) identifies the way in which natural resources correlated with technological progress, can influence economic growth. Gerelmaa (2016) analysed data from 182 countries collected over two periods 1970-1989 and 1990-2010 and emphasized that along the time natural resources had various effects on economic growth.

The relation between foreign direct investment and economic growth was studied, among others, by Nistor (2014), Pegkas (2015), and Liu (2015).

Recent studies have indicated a strong correlation between healthy life years and economic growth. A high value for life expectancy indirectly supports economic growth as it determines increased labour force productivity (Bloom & Canning 2008; Ashraf, Lester & Weil 2014). Also, Hueltenschmidt et al. (2013) and Salomon et al. (2012) identified significant positive correlations between healthy life ears and economic growth.

According to Korkmaz S. & Korkmaz O. (2017), labour productivity is determined by three factors: the human capital (the level of education and the experience of the labour force), technological changes (new inventions and innovations) and scale economies that decrease production costs. In their studies, the cited authors showed that, at the level of the OECD countries, there is significant connection between labour productivity and economic growth; productivity represents one of the most important factors that determines growth. There are other numerous recent studies presenting the connection between the two concepts. Rudolf & Zurlinden (2010) published a study conducted in New Zealand for the period 1991-2005 in which it was shown that labour force input and capital have positively influenced economic growth. Authors Su & Heshmati (2011) reached the same conclusion

after studying the relation between labour productivity and economic growth in China between 2000-2009.

Haller et al. conducted a study in 2007 where they emphasized the main economic benefits of indoor sanitation: on the one hand there are direct economic benefits in avoiding health hazards; on the other there are indirect benefits consisting in decreased number of off days for medical reasons. Besides the already identified economic benefits, Hutton (2006) also identified the non-economic advantages of using indoor sanitation.

3. DATA AND METHOD

Data on selected economic, socio-demographic, ecological, and technological indicators for 28 European Union countries were recorded. The economic indicators taken into consideration in our analysis are: per capita GDP (GDP_CAP), Healthy life years in absolute value at birth – females (HLY_F), Real labour productivity per hour worked (L_P_H), Improved sanitation facilities (% of population with access) (SAL_ACC), Unemployment rate (R_UNEMP), Research and Development Expenditures (RD_EXP), Natural resources rents (NAT_RES), Foreign Direct Investments (FDI), Municipal Waste (MW), Land covered by artificial surfaces (%) (ART_LAND).

Labour productivity per hour worked refers to the quantity of goods and services per worked hour. It is calculated as real output per unit of labour input (European Commission 2017)

The socio-demographic variables are: Healthy life years in absolute value at birth (females), Improved sanitation facilities (% of population with access), and Unemployment rate. Healthy life years in absolute value at birth is an indicator used to monitor if the increase in life expectancy is also accompanied by an increase in healthy active life. Access to improved sanitation facilities refers to the percentage of the population benefiting from improved indoor sanitation (improved sanitation facilities).

The indicator Research and Development Expenditures was used to measure the technological aspects. Natural resources rents, Municipal Waste, and Percentage of Land covered by artificial surfaces were selected to measure the ecological aspects.

Various statistical methods adequate for the data analysed were applied. In order to describe the indicators under consideration Descriptive Statistics were used. The correlation matrix shows the correlations between sets of variables. Principal Components Analysis (PCA), which is an exploratory data analysis method, was used to discover the relationships among variables. In PCA a set of correlated variables is transformed to a smaller set of uncorrelated hypothetical constructs called principal components (Timm 2002).

We also have developed a regression analysis to examine whether any of the explanatory variables have a significant effect on the explained variable. The relationship between the explained variable, denoted with Y, and the explained variables, denoted with X, is Y = f(X). The multiple linear regression model is

$$Y = f(x_1, x_2, ..., x_k) + \varepsilon$$

where y is the explained variable and $x_1, x_2, ..., x_k$ are the explained variables. The term ε is a random disturbance.

Multiple regression was used to analyse how the indicators selected might influence GDP in 2015. The explained variable considered is the GDP per capita in 2015, and the explanatory variables initially considered in the model are: per capita GDP, Real labour productivity per hour worked, Foreign Direct Investments, Labour productivity per hour worked, Healthy life years in absolute value at birth (females), Improved sanitation facilities (% of population with access), Unemployment rate, Research and Development Expenditures, Natural resources rents, Municipal Waste, and Percentage of Land covered by artificial surfaces.

4. RESULTS

Table 1 summarizes the main indicators of the central tendency, dispersion and shape of distributions of the variables under analysis. We can see that the mean GDP per capita decreased in 2015 compared to 2014, but the dispersion is large (the coefficient of variation is greater than 50% in both years). Half of the EU countries' population have a healthy life longer than 61.65 years. 50 % of the countries under analysis have an unemployment rate higher than 8.72%, municipal waste greater than 449.5 kilograms per capita, the percentage of land covered by artificial surfaces greater than 3.95 %, and percentage of population with access to improved sanitation facilities greater than 99%.

Table 1. Descriptive Statistics

	Mean	Median	Std. Deviation	Variance	Coef. of variation
GDP_CAP_2015	30278.8444	22919.5109	20562.11149	422800428.850	67.90917
GDP_CAP_2014	34500.6133	26232.9897	23111.00494	534118549.277	66.98723
HLY_F	61.604	61.650	5.2584	27.651	8.535809
R_UNEMP	9.614643	8.722000	4.8781331	23.796	50.7365
L_P_H	107.436	104.900	7.7840	60.591	7.245244
RD_EXP	1.626429	1.355000	.8367097	.700	51.44459
NAT_RES_EXP	.391097	.275385	.4278950	.183	109.4089
FDI	8.136	1.800	17.1827	295.245	211.1935
MW	466.68	449.50	118.979	14155.930	25.49477
ART_LAND	5.3929	3.9500	4.55265	20.727	84.41933
SAL_ACC	96.79	99.00	5.116	26.175	5.28567

To see the degree of homogeneity of the distribution of each variable, we identified the coefficient of variation using the mean and dispersion. Results in Table 1 indicate that in the case of the variables GDP per capita in 2015, GDP per capita in 2014, unemployment rate, natural resources rents, foreign direct investments, and land covered by artificial surfaces the coefficient of variation is greater than 50%. These large values indicates a high level of heterogeneity of each of the variables considered. One cause of the heterogeneity is the existence of extreme values.

Thus, Netherlands has the extreme value for GDP per capita in 2015 and GDP per capita in 2014, Greece has the extreme value for the variable unemployment rate, Bulgaria has the extreme value for the variable natural resources rents, Ireland has the extreme value for the variable for foreign direct investments, and Malta has the extreme value for the variable in the case of the Artificial Land variable. In subsequent analyses, we have taken these extreme values into account in order not to distort the results of the analyses.

In order to identify the relations that exist among the variables taken into consideration PCA was applied. KMO' test value of 0.519 is greater than 0.5; this indicates that the solution obtained on applying PCA is good. The Bartlett sphericity test (sig < 0.05) shows that there are significant relationships between the variables. From Figure 1, we can see that there are significant direct correlations between artificial land and municipal waste, on one hand, and significant indirect correlations between these variables and natural resources rents, on the other hand.

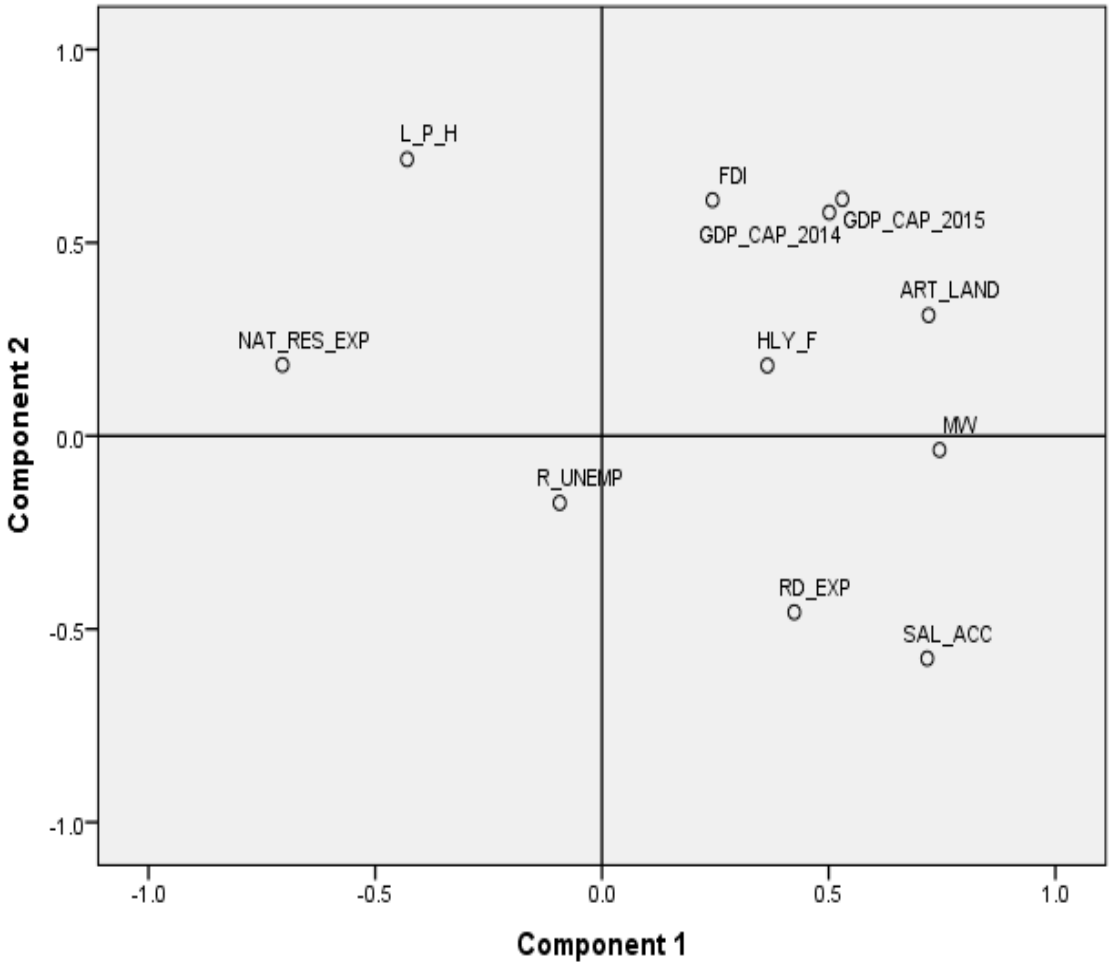


Figure 1. PCA plot for variables

The correlation matrix also indicates that there are significant relationships between GDP per capita in 2015 and the percentage of land covered by artificial surfaces with a coefficient of correlation of 0.439 and sig = 0.010 (less than $\alpha = 0.05$). This significant correlation indicates that economic growth involves an orientation towards investments in an anthropic land development, namely increased areas covered by buildings, industrial units, residential areas, infrastructure etc. In other words, when the financial growth of an economy is more significant, investment tendencies are directed towards the same aim, which implies the use and exploitation of new grounds and natural areas which will be used to implement investment projects.

At the same time, such investments, managed at a faster pace, will result in producing a greater amount of wastage. From the point of view of sustainable development, which supports the balance between economic and environmental objectives, it follows that higher economic growth implying investment activities, as well as the expansion of built up areas, is also accompanied by a decrease in existing natural areas as well as in increased amounts of wastage resulting mainly from construction activities. Moreover, natural resources are more intensely exploited, which will, in turn, produce further income; however, given the limited nature of both land and natural resources, economic growth can prove to be viable only in the short term.

On the second axis (Figure 1), we can see significant direct correlations between GDP per capita in 2015, GDP per capita in 2014, labour productivity and foreign direct investments, on one hand, and significant indirect correlations between these variables and improved sanitation, on the other hand.

We can identify a connection that is characteristic of sustainable development, which involves a balance between economic, social and environmental objectives. In other words, economic growth (measured by GDP per capita) is considered healthy only when it is accompanied by social progress and increased life quality, and by ecological stability respectively. Thus, the present analysis model indicates that increased Labour Productivity per Hour worked and Foreign Direct Investments determine economic growth, however, in terms of the social protection of the population, more precisely an orientation towards the social objectives of sustainable development, a balance is not struck, meaning that the population does not benefit by better living conditions and improved life quality through access to utilities and infrastructure which normally accompany improved living conditions.

Table 2. Regression coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-77502.904	20765.335		-3.732	.001		
GDP_CAP_2014	.892	.017	1.001	51.129	.000	.984	1.016
HLY_F	215.023	79.496	.054	2.705	.013	.956	1.046
L_P_H	348.375	101.536	.098	3.431	.002	.460	2.173
SAL_ACC	275.873	119.789	.067	2.303	.031	.451	2.218

a. Dependent Variable: GDP_CAP_2015

In order to study the dependency between GDP_CAP_2015 and the explanatory variables we used a multiple regression model. The independent variables initially included in the model are the variables significantly correlated with GDP_CAP_2015, as follows: GDP_CAP_2014, RD_EXP, HLY_F, L_P_H, MW și SAL_ACC. The assumptions of the linear regression model (linearity, exogeneity of the independent variables, homoscedasticity and no autocorrelation, and normality of the errors) were verified. The final regression model is:

$$\text{GDP_CAP_2015} = -77502{,}904 + 0{,}982 * \text{GDP_CAP_2014} + 215{,}023 * \text{HLY_F} + 348{,}275 * \text{L_P_H} + 275{,}873 * \text{SAL_ACC}$$

As expected there is a positive partial relationship between GDP per capita in 2015 and GDP per capita in 2014, healthy life years, labour productivity and access to sanitation.

The results suggest that an increase of 1$ of GDP_CAP_2014, holding all other independent variables fixed, determines an increase of GDP_CAP_2015, by 0.982 $ on average (Table 2), which implies that investment in one year is an element of support for the investments in the following years, which means that economic growth is progressive and supported, and, consequently, achieving economic growth proves to be an important economic objective for sustainable development.

It can also be seen that the increase of the variable Healthy life years at birth - females (HLY_F) by one year determines the increase of GDP_CAP_2015 by 215.023 $ on average, which shows that increased Healthy life years - another objective of sustainable development (it is essential that the population not just increases in number, but it also be healthy) - determines increased GDP, as it

secures the population's increased capability to work. This connection is also related to the Labour Productivity per Hour worked indicator, meaning that an increase of the variable Labour Productivity per Hour worked by one unit determines the increase of GDP_CAP_2015 by 348.275 $ on average, holding all other independent variables fixed. In other words, increased productivity determined by healthy life years determines in turn increased economic growth shown in increased GDP.

From the point of view of the social objectives specific to sustainable development, it can be seen that sustainable development is involved in a circular system, in the sense that improved life conditions for the population make it healthier and more apt to work, which is conducive to increased GDP. Thus, the increase of the variable Improved Sanitation Facilities (% of population with Access) by 1% determines an increase of GDP_CAP_2015 by 275.873 $ on average, holding all other independent variables fixed.

After the previous model was identified, the model parameters were *tested and validated*. All model parameters are statistically significant. Given that both the hypotheses regarding the model parameters and those regarding the modelling errors are validated, we can draw the conclusion that the regression model estimated between GDP_CAP_2015 and the variables correlated with it is statistically valid.

5. CONCLUSIONS

An imbalance in economic growth creates dysfunctionalities in both society and in the environment. Currently, an increased interest is shown in adopting steps, solutions and strategies aiming mainly at a more efficient management of those resources that support economic growth and development, as well as at greater care for the social environment and human resources, for the environment and the protection of environmental factors respectively. Thus, a balanced or sustainable development implies a non-accelerated economic growth that takes into account the population's objective needs, the preservation of a social and demographic balance, increased quality of life quality and improved life conditions, the necessity of protecting environmental factors etc.

Our findings suggest that there is a close connection between economic, social and environmental aspects. Progressive economic growth must be associated with improved life conditions and life quality, as well as with decreased levels of pollution, wastage, and increased activity in protecting natural resources. Our findings are consistent with the idea that sustainable development is a form of multilateral balanced development. To sum up, sustainable development is that evolution that is equally favourable to economy, society and the environment; such an evolution is circumscribed to a broader range of aspects regarding: resource management, production orientation, a productive purpose, human resources, life quality, technological innovations, access to information, etc. One of the distinct aspects of sustainable development is a multidisciplinary temporal approach to the concept, which brings together environmental, social and economic issues of interest for both the present and the future generations.

REFERENCES

Ashraf, Q. H., Lester, A., Weil, D. N. 2014, `When Does Improving Health Raise GDP?`, *National Bureau of Economic Research Working Paper Series*, No. 14449, viewed 15 May 2017, <http://www.nber.org/papers/w14449.pdf>.

Bloom, E.D., Canning, D. 2008, `Population Health and Economic Growth`, *Commission on Growth and Development Working Paper*, No. 24, pp. 12-15.

Carson, R. 1962, `Silent spring`, Fawcett Publications, INC., Greenwich, Conn. Member of American Book Publishers Council, INC., viewed 21 March 2017, <http://library.uniteddiversity.coop/More_Books_and_Reports/Silent_Spring-Rachel_Carson-1962.pdf>.

European Comission 2017, *Eurostat*, viewed 26 July 2017, <http://ec.europa.eu/eurostat/web/products-datasets/-/tsdec310>.

Gerelmaa, L., Kotani, K. 2016, `Further investigation of natural resources and economic growth: Do natural resources depress economic growth?`, *Resources Policy*, Vol 50, Elsevier, pp. 312-321.

Haller L, Hutton G, Bartram J. 2007, `Estimating the costs and health benefits of water and sanitation improvements at global level`, *Journal of Water and Health*, Vol. 5, Issue 4, pp. 467-480.

Hueltenschmidt, N., Olsen, T., Vishwanath, V. 2013, `Healthcare and Consumer Products Brief: Healthy living: Economic necessity and business opportunity`, viewed 4 May 2017, <http://www.bain.com/publications/articles/healthy-living-economic-necessity-and-business-opportunity.aspx>.

Hutton, G., Haller, L., Bertram, J. 2006, `Economic and health effects of increasing coverage of low cost water and sanitation interventions`, *Human Development Report Office Occasional Paper*, viewed 23 January 2017, <http://hdr.undp.org/en/media/economicandhealtheffects.pdf>.

Korkmaz, S., Korkmaz, O. 2017, `The Relationship between Labor Productivity and Economic Growth in OECD Countries`, *International Journal of Economics and Finance*, vol. 9, No. 5, 2017, pp. 71-76.

Latouche, S. 2016, *Mic tratat de decreștere senină*, Seneca Lucius Annaeus Publishing House.

Liu, W.H. 2015, `Intellectual Property Rights, FDI, R&D and Economic Growth: A Cross-country Empirical Analysis`, *The World Economy*, Vol 39, Issue 7, pp. 983-1004.

Nistor, P. 2014, `FDI and Economic Growth, the Case of Romania`, *Procedia Economics and Finance*, vol. 15, pp. 577-582.

Pegkas, P., Tsamadias, C. 2015, `Does formal education at all levels cause economic growth? Evidence from Greece`, *Review of Economic and Business Studies*, Vol 8, Issue 1, pp. 9-32.

Pearce, D.W. & Turner, R.K.. 1990, *Economics of Natural Resources and the Environment*, John Hopkins University Press, Great Britain.

Rudolf, B., Zurlinden, M. 2010, `Productivity and Economic Growth in Switzerland 1991-2006`, *Swiss Journal of Economic and Statistics*, 146(3), 577-600.

Salomon J.A. et al. 2013, `Healthy life expectancy for 187 countries, 1990-2010: a systematic analysis for the Global Burden Disease Study 2010`, *The Lancet*, 380(9859), 2144-62.

Singh, S. 2016, 'Sustainable Development: A Literature Review', *International Journal of Indian Psychology*, Volume 3, Issue 3, No. 6, DIP: 18.01.104/20160303, pp. 63-69.

Soddy, F. 1933 - *Whealth, virtual whealth and debt. The solution of the economic paradox*, 2nd Edition, 1933, London England Britons Publishing Company, viewed 4 April 2017, <www.fadedpage.com/link.php?file=20140873-a5.pdf>.

Su, B., Heshmati, A. 2011, `Development and Sources of Labor Productivity in Chinese Provinces`, *IZA Discussion Paper*, No. 6263, pp. 1-28.

Tiezzi, E., Marchettini, N.1999, *Che cosé lo sviluppo sostenibile? Le base scientifiche della sostenibilita e i guasti di un pensiero unico*, Donzelli Editore, Roma.

Timm, N. H. 2002, *Applied Multivariate Analysis*, Springer, pp. 445 – 514.

Zaman, Gh., Gherasim, Z., 2007, 'Criterii şi principii ale dezvoltării durabile din punctul de vedere al resurselor acesteia', *Buletinul AGIR*, No.1, pp. 136-142.