“Economic growth and environmental health: a dual interaction”

AUTHORS	Liudmyla Katan Olena Dobrovolska https://orcid.org/0000-0002-4159-8446 https://www.webofscience.com/wos/author/record/ABG-3563-2021 José Manuel Recio Espejo

ARTICLE INFO	Liudmyla Katan, Olena Dobrovolska and José Manuel Recio Espejo (2018). Economic growth and environmental health: a dual interaction. *Problems and Perspectives in Management*, *16*(3), 219-228. doi: 10.21511/ppm.16(3).2018.18
DOI	http://dx.doi.org/10.21511/ppm.16(3).2018.18
RELEASED ON	Thursday, 09 August 2018
RECEIVED ON	Friday, 15 June 2018
ACCEPTED ON	Thursday, 19 July 2018
LICENSE	This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License
JOURNAL	"Problems and Perspectives in Management"
ISSN PRINT	1727-7051
ISSN ONLINE	1810-5467
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
16	2	7

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10, Sumy,
40022, Ukraine

www.businessperspectives.org

Liudmyla Katan (Ukraine), **Olena Dobrovolska** (Ukraine),
José Manuel Recio Espejo (Spain)

ECONOMIC GROWTH AND ENVIRONMENTAL HEALTH: A DUAL INTERACTION

Abstract

In most countries of the world, realizing the sustainable development concept has caused a lively discussion in the scientific environment regarding the mutual influence of the economic growth and the environmental health. Is the economic growth even possible without environmental damage? The answer is still unknown. Research studies both confirm and refute this interaction. The U-shaped curve (Environmental Kuznets Curve) hypothesis is the most popular in this regard. Scientists from different countries analyze the impact of the economic climate on the environmental health taking the hypothesis into account. At the same time, these studies use gross national income as a base indicator, which reflects only the economic dimension of the research, but does not consider the depletion of natural capital on the path of economic growth. The purpose of this study is to identify the factors that have the most significant impact on the adjusted net savings in Ukraine and a number of selected countries, and also take into account the agrarian sector development, which is important in terms of substantiation of the expediency of a significant increase in natural agricultural production in the Ukrainian agrarian sector. The paper presents the results of constructing a model based on World Bank data for the period from 2009 to 2017, for Ukraine and 13 other countries that are neighbors of Ukraine and belong to the lower middle-income group. From the list of indicators provided by the World Bank to characterize the state of the environment in the world, 13 indicators are chosen that most fully characterize the situation in the selected countries. Based on the analysis of the panel data formed, the result is that agricultural land (% of land area), energy use per capita (kg oil equivalent), and agricultural productivity (value added per worker) have the most significant impact on the adjusted net savings. With that, the first two indicators show a positive impact, while the third one has a negative impact, indicating that the increase in productivity in the agrarian sector of the economy results in the environmental deterioration. All this allows us to conclude about the necessity to introduce natural agro-production technologies in order to improve the environment, especially considering the fact that in Ukraine, the share of the agrarian sector in GDP increases every year.

Received on: 15th of June, 2018
Accepted on: 19th of July, 2018

Keywords gross savings, environmental, agricultural productivity, consumption of fixed capital, adjusted net savings, economic growth

JEL Classification O13, O44

Liudmyla Katan, Dr. of Economics, Professor, Head of the Department of Finance and Banking, Dnipro State Agrarian and Economics University, Ukraine.

Olena Dobrovolska, Ph.D. in Economics, Associate Professor of the Department of Finance and Banking, Dnipro State Agrarian and Economics University, Ukraine.

José Manuel Recio Espejo, Professor, The Department of Botany, Ecology and Plant Physiology, University of Cordoba, Spain.

INTRODUCTION

The country's economic development depends on many factors that are both quantitative and qualitative. At the present stage of development, the consistency of the economic development and the environmental health, which is stipulated by the goals of the sustainable development concept, becomes of paramount importance. This concept continues to be explored despite the fact that it is actively implemented by world organizations and is attached to by most of the world (Dobrovolska, 2018). On the one hand, the increase in the economic growth rate requires more intensive use of natural capital, which worsens the state of the environment, which in turn puts in question the sustainable economic development in general as is understood within the sustainable development concept. On the other hand, the higher the level of the country's economy development, the more actively green financial instruments are used and a more significant financial resource is contributing to the development of the "green economy", which contributes to improving the environmental health. To monitor the environmental health, the World Bank has, over the past 10 years, formed the so-called Little Green Data Book, which provides data on the main indicators that may reflect both positive and negative changes in the environmental condition in terms of agriculture, forests and biodiversity, oceans, energy and emissions, water and sanitation, environment and health, national savings aggregates – savings, depletion and degradation, and which are consistent with the 17 sustainable development goals. In each country, the impact of these components manifests itself in different ways, depending on the level of economic development, population density, its structure, geographical location, the agricultural development, the size of agricultural land, the availability of forest zone, etc. This study is an attempt to determine what indicators and how impact adjusted net savings, which, unlike the gross national income (GNI), takes into account the environmental degradation influenced by economic development.

1. LITERATURE REVIEW

Ward et al. (2016) drew interesting conclusions. Applying a rather simple mathematical model, they concluded that GDP growth cannot be sustained indefinitely, since GDP growth of the country cannot be separated from the increase in the need to use material resources and energy sources. The authors note the impossibility of simultaneous GDP growth and the achievement of the sustainable development goals. Given the calculations, they conclude that in order for GDP growth to be sustainable, it should be separated from the use of energy and materials, as well as the environmental impact.

According to the authors, "If GDP growth as a societal goal is unsustainable, then it is ultimately necessary for nations and the world to transition to a steady or declining GDP scenario. We contend that it will be easier to start this transition now, while there is still capacity for technological gains, rather than go down the path of decoupling and be forced to make a transition post 2050 when we are closer to the theoretical limits to technological efficiency gains. We argue that now is the time to recognize the biophysical limits, and to begin the overdue task of re-orienting society around a more achievable and satisfying set of goals than simply growing forever".

The most popular and widely debated is Simon Kuznets's hypothesis. While exploring the situation in Taiwan, which has developed quite rapidly, Kuznets concluded that the economy growth by an average of 10% per year triggers a protracted destructive process, which results in structural changes in the economy, changes in working and living conditions of the population. In 1991, on the basis of this theory, Grossman and Krueger described the existing relationship between economic growth and the quality of the environment in the long run as an Inverted-U curve (Environmental Kuznets Curve) and concluded that with an increase in per capita income, the environment deteriorates in the early stages of the economic growth, but it gradually improves with the improvement of the economic climate. This theory is taken as the basis for various studies, in particular, Franklin and Ruth (2012) agree with such a relationship and study the relationship between GDP and CO2 emissions, as well as the main factors of human capital and natural capital, while in this study, the adjusted net savings are taken into account. This indicator is determined by international organizations as that reflecting the accumulated national savings, adjusted for the rate of natural resources depletion and damage from environmental pollution, that is, it can be considered an indicator that to some extent characterizes the state of "greening" the country's economy. This indicator is determined by the World Bank for different countries, indicating a significant divergence with their traditional macroeconomic development indicators. This is especially true for those countries where a significant share of the GDP is formed at the expense of natural resources. That is, traditional macroeconomic measures can indicate the economy growth while simultaneously degrading the state of natural resources. Patrick Wijaya Tjoek and Pei-Ing Wu (2018) also made an elegant analysis of this hypothesis. Neve and Hamaide (2017) explored the potential impact of the overall structure of the population, employment, trade and energy prices on the relationship between income level and pollution level. Aşici (2013) analyzed the impact of economic growth on environmental sustainability by assessing panel data from 213 countries. Gosselin and Callois (2018) investigated the relationship between economic growth and biodiversity indicators, including those that are disappearing or have already disappeared, as well as the state of deforestation. Chowdhury and Islam (2017) investigated the ecological efficiency index in relation to GDP, using the BRICS countries' indicators.

On the other hand, Ben Youssef, Hammoudeh, and Omri (2016) used various statistical tests for different groups of countries to test the hypothesis and found a two-way nonlinear relationship between economic growth and environmental health. Bakaki and Bernauer (2018) note that there is no compromise between the growth of the economy and the environment.

In Ukraine, studies are also being conducted to determine the interaction between economic growth and the state of the environment. In this context, Tunytsia (2006) states that "... the Kuznets theory adapted to modern conditions may have a positive effect on the formation of an economic policy of balanced environmental management, which in turn will contribute to the implementation of the sustainable development concept in both the national economies and the world economy".

Given that according to the results of a number of scientific studies conducted, the GDP figure, which is recognized as the basis for assessing economic growth in the country, does not take into account how its growth depletes the natural resources, as well as the negative impact of its growth on the environmental health, the authors of the current study will rely on the adjusted net savings measure. In this study, using a regression model, it will be analyzed and determined which of the indicators characterizing the environmental health in Ukraine and a number of selected countries have the most significant impact on the adjusted net savings indicator and take into account the state of the agribusiness development, which is important in terms of substantiating the expediency of substantial increase of natural agricultural production in the Ukrainian agricultural sector. In this context, the research by Bazylevych, Kupalova, Goncharenko, Murovana, and Grynchuk (2017) should be emphasized concerning the problems of introduction of natural agricultural production in Ukraine, as well as its key advantages for the implementation of the sustainable development concept in Ukraine. In addition, the introduction of natural agricultural production can significantly improve the state of food security not only in Ukraine but also in the world, which, according to Vasylieva (2017), will be reflected in improving the quality of food products, which will also contribute to the achievement of sustainable development goals.

1.1. Output data of research

To construct the model, World Bank data for the period 2009–2017, reflecting the state of the economic and environmental development, was used. These indicators are presented in the Little Green Data Book and represent 50 indicators, most of which are used to monitor the achieving the sustainable development goals. Of the total list, 13 indicators have been selected, which more closely reflect the situation in Ukraine and the countries under study (Table 1).

The choice of countries was based on the fact that, firstly, they are neighbors of Ukraine, and therefore these countries' environmental health has a direct

Table 1. Code names of input indices

No.	Index's name	Index's code name	Unit of measure
1	Gross National Income per capita	GNI_pp	$
2	Adjusted net national income per capita	NetInc_pp	$
3	Urban population	Urb_pop	% of total
4	Agricultural land	Agr_land	% of land area
5	Agricultural productivity, value added per worker	Productiv_agr_prod	$
6	Cereal yield	Yield_grain	kg per hectare
7	Forest area	Forests	% of land area
8	Deforestation avg. annual %, 2000–2015	Forests_cut	%
9	Energy use per capita (kg oil equivalent)	Energy_pp	kg
10	Energy from biomass products and waste (% of total)	Biomass_energ	%
11	Gross savings (% of GNI)	Gross_savings	%
12	Adjusted net savings (% of GNI)	Net_saving	%
13	Consumption of fixed capital (% of GNI)	Cons_fix_cap	%

impact on the state of the Ukraine's environment, and vice versa, the situation in Ukraine can have both a positive and a negative impact on their economic development. Secondly, the list of countries includes those that do not have a direct border with Ukraine, but which, according to the World Bank criteria, belong to the lower middle-income group, which includes Ukraine, and which were formed on the territory of the Soviet Union. Thus, a group of 14 countries (Belarus, Bulgaria, Armenia, Czech Republic, Kazakhstan, Kyrgyzstan, Latvia, Moldova, Poland, Russian Federation, Slovak Republic, Slovenia, and Ukraine) was formed.

2. METHODOLOGY

The study of the economic climate influenced by natural resources was carried out using regression analysis in the following sequence:

1) constructing a set of input indicators – panel data;
2) determining the dependent variable and explanatory (actual) variables;
3) selecting the largest values of explanatory variables and the structure of the relationship between them by the principal components method;
4) determining the optimal number of components by the Kaiser method;
5) monitoring the tightness of the linear relationship between the explanatory and control variables by constructing a correlation matrix;
6) choosing the type of model that it is advisable to construct based on panel data (fixed effects model or random effects model), based on the Wald test, the Breusch-Pagan test, and the Hausman test;
7) taking the logarithm of the model with random effects;
8) constructing the regression model equation of the first type;
9) interpretation of the results.

Key factors affecting the volume of adjusted net savings were determined using the STATA 13.0 statistical package, and the built-in Longitudinal/Panel data module, which allows the processing of panel data, and the special operators *xtreg* and *areg*.

A regression model of type (1) is used to investigate panel data and detect the coupling force between factor variables and a resultant variable.

$$y_{it} = \alpha + X_{it}^{*}\beta + \nu_{it},\ i = 1,...,N;\ t = 1,...,T, \quad (1)$$

where i – counting number of the study subject, t – exploration period, α – intercept term, β – vector of coefficients of dimension $K \cdot 1$, y – dependent variable, X_{it}^{*} – row vector of the matrix K of the explanatory variables; ν_{it} – regression error.

$$\nu_{it} = u_i + \varepsilon_{it}, \quad (2)$$

where u_i – individual effects of examination, ε_{it} – model residuals.

As a dependent variable, the share of adjusted net savings in the structure of gross national income will be used; the share of urban population, the share of agricultural land from the total land area, agricultural production efficiency (added value per worker), yield of grain crops, share of forests from the total land area, average annual deforestation, the amount of energy consumed per capita (in oil equivalent), the share of gross savings in the GNI structure and the share of consumption of fixed capital in the GNI structure will be used as factor (explanatory) variables; GNI per capita or adjusted net income per capita are control variables.

3. FINDINGS

Before directly constructing a regression model, it is necessary to reduce the number of explanatory variables, selecting the most significant ones. To do this, the principal components method was used. This method will allow not only to reduce the number of variables, but also to determine the structure of the relationship between them. Using the special built-in STATA command of pca, (principal component analysis) the following components were obtained (Table 2). During the

Table 2. Results of the principal components method

Component	Eigenvalue	Share of aggregate dispersion	Cumulative fraction of aggregate dispersion
Component 1	4.02298	0.3352	0.3352
Component 2	1.54851	0.1290	0.4643
Component 3	1.19724	0.0998	0.5641
Component 4	1.09678	0.0914	0.6555
Component 5	0.996228	0.0830	0.7385
Component 6	0.843925	0.0703	0.8088
Component 7	0.756336	0.0630	0.8718
Component 8	0.502299	0.0419	0.9137
Component 9	0.498041	0.0415	0.9552
Component 10	0.312347	0.0260	0.9812
Component 11	0.171963	0.0143	0.9956
Component 12	0.053349	0.0044	1.0000

principal components method, all variables were taken into account except for the dependent one, so 12 could be the maximum possible number of selected components.

The second column of Table 2 presents the eigenvalues (dispersions) of each of the selected components, the third column presents the proportion of each component in the total dispersion, the fourth – the cumulative (accumulation) fraction of the dispersion. As can be seen, the first component explains 33.5% of the total dispersion, the second component explains 12.9%, which amounts to 46.4% of the total dispersion. That is, the first two components account for almost half of the entire dispersion. In order to find the optimum quantity of components that should be left in the study, it is necessary to use the Kaiser method and the scree plot.

According to the Kaiser method, the study should leave the components with eigenvalues greater than 1. Thus, the first four components meet this condition. Using the scree plot (Figure 1), one can also determine the optimum quantity of components.

A place on the graph, where the reduction of the eigenvalues of components is as slow as possible from left to right, is the margin for determining the optimum quantity of components. In this case, the first four components that explain 65.5% of the entire dispersion are their optimum number. Table 3 identifies the factor loadings that made it possible to identify the variables having the greatest impact on the overall structure of the research.

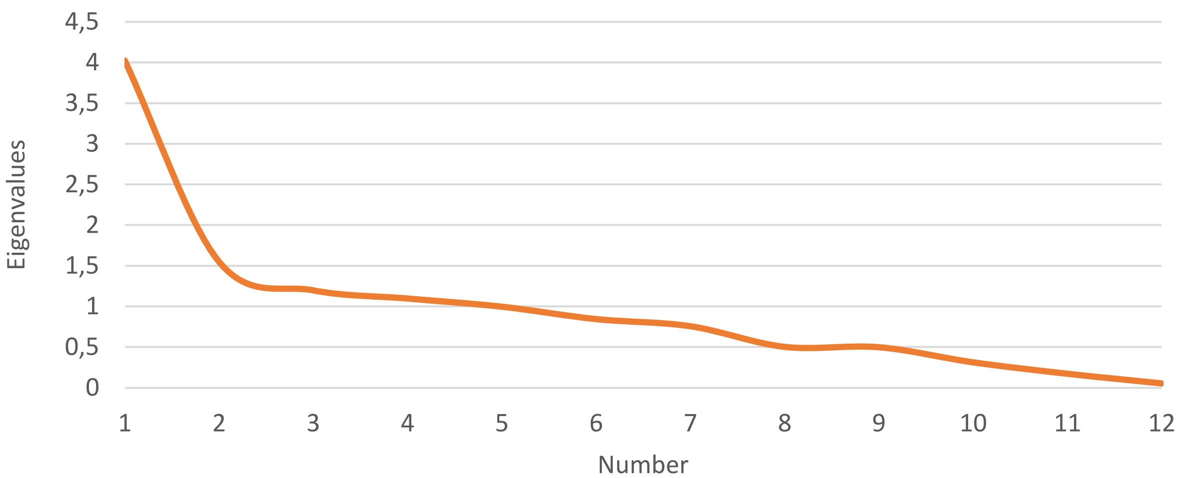

Figure 1. Scree plot

Table 3. Distribution of variables in selected components

Variable	Component 1	Component 2	Component 3	Component 4
Agr_land	–0.3713	0.1731	–0.1416	0.2580
Productiv_agr_prod	0.2967	0.2901	–0.3974	–0.1138
Yield_grain	–0.0327	0.2269	–0.1158	0.6467
Forests	0.4554	–0.1841	0.0700	–0.1165
Forests_cut	–0.0021	0.4863	0.5486	–0.0266
Energy_pp	–0.0232	0.4914	0.2675	–0.4440
Biomass_energ	0.3130	–0.1836	0.0603	0.0601
Gross_savings	–0.0591	0.1088	0.1623	0.3833
Cons_fix_cap	0.2994	0.3230	0.0909	0.2545
GNI_pp	0.4417	0.1264	–0.0881	0.1008
NetInc_pp	0.3915	0.1351	–0.1461	0.0989
Urb_pop	0.1602	–0.3720	0.6031	0.2357

Since the first component has the highest percentage of the allocated dispersion (more than 33%), the authors have left the variables, factor loadings (coefficients of correlation with the component) of which are greater than 0.3 according to the absolute value. Thus, the list of indicators decreased to seven: the share of agricultural land from the total land area, agricultural production, the share of forests from the total land area, the share of energy received from biomass and waste, the share of consumption of fixed assets in the structure of GNI, gross national per capita income and adjusted net per capita income.

The correlation analysis showed that there is no close linear relationship between the explanatory and control variables, which may negatively affect the final regression model. Table 4 shows a correlation matrix of 8:8.

Having analyzed the correlation matrix (Table 4), one can say that there is a close relationship between the two control variables (correlation coefficient is 0.7889), between the variables of the GNI per capita and the share of forests per total land area (correlation coefficient is 0.7417), the variables of the share of forests from the total land area and the share of agricultural land from the total land area (correlation coefficient is –0.8393). To eliminate this phenomenon, some variables have been removed from further research. After analyzing the correlation coefficients of these explanatory variables with the dependent variable, two out of five were excluded, which caused a high correlation: the adjusted net income per capita and the share of forests from the total land area. Repeated construction of the correlation matrix without taking into account these variables (Table 5) confirmed the absence of a close relationship between the explanatory variables (correlation coefficients is less than 0.7), that is, the multicollinearity was eliminated. Thus, six explanatory variables, one of which is a control variable, are involved in constructing a regression model.

Table 4. Correlation matrix

Variables	Net_saving	Agr_land	Productiv_agr_prod	Forests	Biomass_energ	Cons_fix_cap	GNI_pp	NetInc_pp
Net_saving	1.0000	–	–	–	–	–	–	–
Agr_land	–0.2867	1.0000	–	–	–	–	–	–
Productiv_agr_prod	0.0987	–0.3320	1.0000	–	–	–	–	–
Forests	0.2760	–0.8393	0.4804	1.0000	–	–	–	–
Biomass_energ	0.2176	–0.3988	0.1395	0.5710	1.0000	–	–	–
Cons_fix_cap	–0.3197	–0.1642	0.3762	0.3740	0.4152	1.0000	–	–
GNI_pp	0.1485	–0.5565	0.5373	0.7417	0.4166	0.5463	1.0000	–
NetInc_pp	0.0774	–0.4254	0.4751	0.5723	0.3705	0.4455	0.7889	1.0000

Table 5. Correlation matrix after the two variables exclusion

Variables	Net_saving	Agr_land	Productiv_agr_prod	Biomass_energ	Cons_fix_cap	GNI_pp
Net_saving	1.0000	–	–	–	–	–
Agr_land	–0.2867	1.0000	–	–	–	–
Productiv_agr_prod	0.0987	–0.3320	1.0000	–	–	–
Biomass_energ	0.2176	–0.3988	0.1395	1.0000	–	–
Cons_fix_cap	–0.3197	–0.1642	0.3762	0.4152	1.0000	–
GNI_pp	0.1485	–0.5565	0.5373	0.4166	0.5463	1.0000

Conducting research based on panel data provides the possibility of building two basic types of models:

- fixed effects model;
- random effects model.

The feature of a fixed effects model is that each factor variable is not random, that is, it was added to the model only after a detailed study of one or another phenomenon and its unique effect on the resultant variable. Unlike a fixed effects model, in a model with random effects, the authors select a certain set of indicators from a large set of variables and use this particular set in further studies, that is, they do not exclude the possibility of accidental possible effects of those indicators that were excluded from the analysis. In order to determine which type is best suited for a particular set of panel data, the following criteria (tests) were used: Wald test, Breusch-Pagan test, and Hausman test. According to the Hausman test results, the values of the criterion *chi2* = 10.57 and the probability p for this 0.1026 indicate that it is necessary to choose a model with random effects. In addition, the Breusch-Pagan test also confirms this thesis. Therefore, when constructing a regression equation, the authors use the built-in function in STATA *xtreg* with the corresponding identifier at the end of RE (random effects). The obtained simulation results are presented in Table 6.

The obtained parameters of the regression equation show that only two ones are statistically significant: the parameter near the variable of consumption of fixed capital and the intercept term. In general, the model is statistically significant, since $p = 0.000$, which is less than 0.05 with a confidence level of 0.95, but the determination coefficient $R^2 = 0.42$ shows an inadequate relationship between the explanatory variables and the dependent variable. To improve the results of the model, logarithm of all variables was taken and a new model was constructed. The results of the new regression model are presented in Table 7.

Table 6. Results of the regression model with random effects

Variable	Regressor	Standard error	z	p	Result
Agricultural land	–0.1005071	0.0638678	–1.57	0.116	Not statistically significant
Agricultural productivity	0.0104055	0.0207421	0.50	0.616	Not statistically significant
Energy from biomass products and waste	0.0644652	0.1795521	0.36	0.720	Not statistically significant
Consumption of fixed capital	–1.064107	0.1337304	–7.96	0.000	Statistically significant
Gross national income per capita	0.3379091	0.196773	1.72	0.086	Not statistically significant
Intercept term	23.27867	4.458594	5.22	0.000	Statistically significant

Note: $R^2 = 0.42$, w*ald chi2* = 79.61, $p = 0.000$.

Table 7. Results of a random effects regression model based on variables after taking the logarithm

Variable	Regression equation parameter	Standard error	z	p	Result
Agricultural land	0.1280044	0.3017685	0.42	0.021	Statistically significant
Agricultural productivity	–0.0316323	0.123798	–0.26	0.798	Not statistically significant
Energy from biomass products and waste	0.2393915	0.0925169	2.59	0.010	Statistically significant
Consumption of fixed capital	–0.1408401	0.0212767	–6.62	0.000	Statistically significant
Gross national income per capita	0.238069	0.1958744	1.22	0.224	Not statistically significant
Intercept term	2.674028	1.321778	2.02	0.043	Statistically significant

Note: $R^2 = 0.65$, *Wald chi2* = 52.97, $p = 0.000$.

After taking the logarithm of the variables, the results of the model were improved. Three of five parameters have become statistically significant: agricultural land, energy from biomass products and waste, and consumption of fixed capital. In general, the model remained statistically significant as p = 0.000, which is less than 0.05 with a confidence level of 0.95, and the determination coefficient R^2 = 0.65, which shows a quite strong correlation between the explanatory variables and the dependent variable. Consequently, the general view of the model for measuring the impact of variables on the amount of adjusted net savings will be as follows:

$$\begin{aligned} &Net\ saving = 2.674 + 0.128 Agr\ land - \\ &-0.032 Productiv\ agr\ prod + \\ &+0.239 Biomass\ energy - \\ &-0.141 Cons\ fix\ cap + 0.238 GNI\ pp. \end{aligned} \quad (3)$$

The obtained simulated values of the adjusted net savings (% of *GNI*) indicator for each country for the analyzed period are shown in Figure 2.

Consequently, the results of the survey show that a number of countries (Latvia, the Czech Republic, Kazakhstan, Poland, and Moldova)

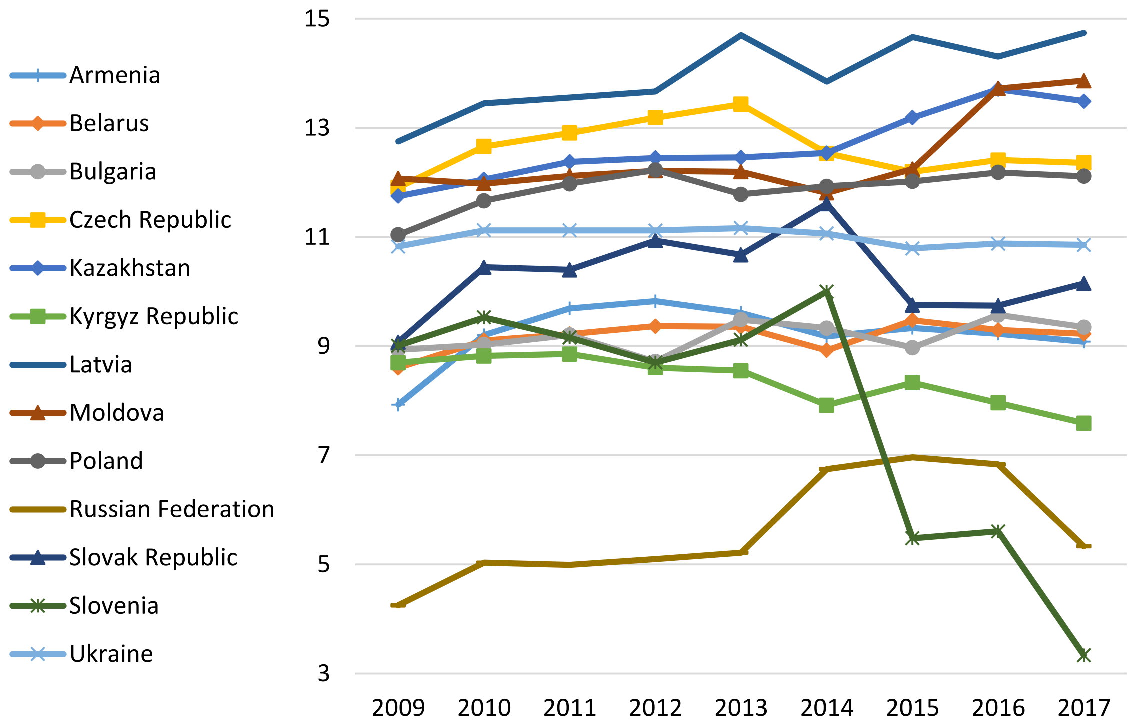

Figure 2. Adjusted net savings (% of GNI), simulated value

have not only a high adjusted net saving indicator in comparison with other countries during the analyzed period, but also demonstrate its improvement, indicating a favorable situation in the country as regards the environmental state, as well as positive dynamics in shaping a sustainable economy. Among other countries, Ukraine shows a steady behavior of the indicator, but with a slight downward trend. At the same time, a number of countries demonstrate a much worse state of the index, which indicates its downward dynamics (the Slovak Republic, the Kyrgyz Republic, and Bulgaria). Against the background of all countries, indicators for Slovenia and the Russian Federation are significantly highlighted. Especially negative is the dynamics of Slovenia, which shows sharp downward dynamics from 2014 onwards. The situation of the Russian Federation is significantly different from that of other countries, and in spite of positive developments during the period 2014–2016, in 2017, negative dynamics was demonstrated.

CONCLUSION

According to the study results, it can be concluded that with a 1% increase in the share of agricultural land from the total land area, the percentage of adjusted net savings in the structure of gross national income will increase by 0.13%, respectively; with a 1% increase in per capita energy consumption (in oil equivalent), the percentage of adjusted net savings in the structure of gross national income will increase by 0.24%; with an increase in the share of consumption of fixed capital in the structure of gross national income by 1%, the share of adjusted net savings in the structure of gross national income will decrease, respectively, by 0.14%; with an increase in the productivity of agricultural production per capita by 1%, the share of adjusted net savings in the structure of gross national income will decrease by 0.03%. This indicator is not statistically significant, but it cannot be ignored, since it can serve as a signal that the growth of agricultural productivity is due to the depletion of the capital stock of countries. This requires faster and more intensive implementation of the natural agroproduction technologies, which helps to preserve the land, increase the soil fertility without the use of chemical fertilizers, pesticides, herbicides, etc., with the aim of improving the natural environment, especially considering the fact that in Ukraine the share of the agrarian sector in the country GDP increases every year.

REFERENCES

1. Aşici, A. A. (2013). Economic growth and its impact on environment: A panel data analysis. *Ecological Indicators, 24,* 324-333. https://doi.org/10.1016/j.ecolind.2012.06.019
2. Bakaki, Z., & Bernauer, T. (2018). Do economic conditions affect public support for environmental policy? *Journal of Cleaner Production, 195,* 66-78. https://doi.org/10.1016/j.jclepro.2018.05.162
3. Bazylevych, V., Kupalova, G., Goncharenko, N., Murovana, T., & Grynchuk, Y. (2017). Improvement of the effectiveness of organic farming in Ukraine. *Problems and Perspectives in Management, 15*(3), 64-75. https://doi.org/10.21511/ppm.15(3).2017.06
4. Ben Youssef, A., Hammoudeh, S., & Omri, A. (2016). Simultaneity modeling analysis of the environmental Kuznets curve hypothesis. *Energy Economics, 60*(1), 266-274. https://doi.org/10.1016/j.eneco.2016.10.005
5. Chowdhury, T., & Islam, S. (2017). Environmental Performance Index and GDP growth rate: evidence from BRICS countries. *Environmental Economics, 8*(4), 31-36. https://doi.org/10.21511/ee.08(4).2017.04
6. Dobrovolska, O. (2018). Contemporary paradigm of sustainable development: the evolution of formation and development. *Environmental Economics, 9*(1), 69-82. https://doi.org/10.21511/ee.09(1).2018.06
7. Franklin, R. S., & Ruth, M. (2012). Growing up and cleaning up: The environmental Kuznets curve redux. *Applied Geography, 32*(1), 29-39. https://doi.org/10.1016/j.apgeog.2010.10.014
8. Gosselin, F., & Callois, J.-M. (2018). Relationships between human activity and biodiversity in Europe at the national scale: Spatial density of human activity as a core driver of biodiversity erosion. *Ecological Indicators, 90,* 356-365.
9. Grossman, G. M., & Krueger, A. B. (1991). *Environmental Impact a North American Free Trade Agreement* (Working paper 3914). National Bureau Economic Research, Cambridge, MA.
10. Kuznets, S. (1955). Economic Growth and Income Inequality. *American Economic Review, 45*(1), 1-28.
11. Neve, M., & Hamaide, B. (2017). Environmental Kuznets Curve with Adjusted Net Savings as a Trade-Off Between Environment and Development. *Australian Eco-*

nomic Papers, 56(1), 39-58. https://doi.org/10.1111/1467-8454.12078

12. The World Bank (n.d.). *The Little Green Data Book. Development Data Group of the Development Economics Vice Presidency and the Environment Department of the World Bank.* Retrieved from https://data.worldbank.org/products/data-books/little-green-data-book

13. Tjoek, P. W., & Wu Pei-Ing (2018). Exploring the environmental Kuznets curve for CO2 and SO2 for Southeast Asia in the 21st century context. *Environmental Economics, 9*(1), 7-21. https://doi.org/10.21511/ee.09(1).2018.01

14. Tunytsia, T. Yu. (2006). *Дослідження можливостей адаптації теорії Кузнеця до вирішення сучасних еколого-економічних проблем сталого розвитку* [*Doslidzhennia mozhlyvostei adaptatsii teorii Kuznetsia do vyrishennia suchasnykh ekoloho-ekonomichnykh problem staloho rozvytku]*. Retrieved from http://base.dnsgb.com.ua/files/journal/Lisove-gospodarstvo-l-p-d-promyslovist/2006_30/167_Tunycia_LG_30.pdf

15. Vasylieva, N. (2017). Economic aspects of food security in Ukrainian meat and milk clusters. *Agris On-line Papers in Economics and Informatics, 9*(3), 81-92. https://doi.org/10.7160/aol.2017.090308

16. Ward, J. D., Sutton, P. C., Werner, A. D., Costanza, R., Mohr, S. H., & Simmons, C. T. (2016). Is decoupling GDP growth from environmental impact possible? *PLoS one*. https://doi.org/10.1371/journal.pone.0164733