THE RELATIONSHIP OF SOCIO-ECONOMIC DEVELOPMENT AND THE DRIVERS OF GREEN ECONOMY

Konstantin Gomonov – Svetlana Balashova – Vladimir Matyushok

Abstract

A modern paradigm of the green economy means an economy that improves people's well-being and ensures social justice while significantly reducing risks to the environment and its degradation. In the article, the authors assess the relationship between the level of the green economy and traditional socio-economic indicators in the European Union based on the green economy index and methods of multidimensional statistical analysis. It is tested how such components of the green economy as the effective use of natural resources; preservation and increase of natural capital; pollution reduction; low carbon emissions; contribute to the growth of the welfare of the population. A priority feature of the green economy's growth is a radical increase in energy efficiency. It was considered that the implementation of a new green rate implies minimization of the use of non-renewable minerals for the production of electricity through investments in renewable energy sources, and the need of energy savings.

Key words: green economy, economic development, innovation

JEL Code: O10, O30

Introduction

The concepts of political and socio-economic development that have emerged in modern science have increased the well-being of the population of many countries, but at the same time led to uneven economic growth and gave rise to social inequality. The last factor determines the active discussion of the international community about the need to build a new level of economic thinking, considering account not only the broader interests of people, but also our planet as a whole. This global development model is called the "green economy". There is no generally accepted definition of a green economy. Experts of the United Nations Environmental Protection Organization (UNEP) offer the broadest understanding of this concept, considering the "green" economy as an economic activity, "which improves people's well-being and ensures social justice and significantly reduces environmental risks and depletion of nature." In the narrow sense, "green" economy is understood as the development, production and operation of technologies and equipment for controlling and reducing emissions of pollutants and greenhouse gases, monitoring and predicting climate change, as well as energy and resource saving technologies and renewable

energy. A green economy promotes an attractive green revolution to the present economic crises affecting developing countries for sustainable economic and environmental improvements (Attahiry et al., 2019)

In green economy, the concepts like sustainable design, green products, clean technologies, eco-friendly processes have pushed the organizations to opt for change management initiatives, to accomplish sustainable development. Organizational sustainability has been defined using a triple bottom concept which addresses environmental issues, economic aspects, and social concerns (Thakur et al, 2019). The European Union has developed a set of environmental policies whose main objective.es have been to protect natural capital and to develop a resource-efficient and green economy (Garcia-Alvarez et al., 2018). Green economy/green growth, on the other hand, is a new terminology for what is known since 40 years as ecological modernisation. It is indeed overdue, but with its focus on efficiency and innovation (Lorek et al, 2014). The sustainable exploitation of natural resources is nowadays an important challenge for governments and institutions, considering the expected increase of the world population. In order to respond to this emergent criticality, the principles of green economy have been introduced in the European policy discussion to achieve a good compromise between the sustainability and the profitability of productions by increasing the efficiency of farming operations (Aiello et al, 2018). Sustainable development pathways that are identical to the green economy were addressed in *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - UNEP*. The report provides evidence that the transition has economic and social justification and offers governments and the private sector means to contribute to the shift. How the UN system could coherently support countries in transitioning to a green economy is revealed in *Working Towards a Balanced and Inclusive Green Economy* –Environmental Management Group, United Nations. An assessment of the level of green economy is carried out in *Measuring Progress Towards a Green Economy - UNEP*. And the issues of creating new jobs and the rejection of hydrocarbons in *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World - UNEP, ILO*. To indicate sources of factors of the green economy development and to propose a solution for a "grow first and clean up later" strategy it was made the analysis of factors affecting the development of a green economy in *The Green Economy Development Factors. Green management in public administration entities*. The German Development Institute (Deutsches Institut für Entwicklungspolitk (DIE)) distinguishes 4 main areas of green economy regulation (Altenburg et al, 2019) : regulation of energy efficiency, incl. technical standards for building construction and transport; regulating long-term development of energy systems and industry; regulating the

development of breakthrough technologies; regulating agricultural development and environmental protection.

The objective of this study is to analyze the relationship between the green economy indicator and a number of macroeconomic indicators. To characterize the green economy development, the following indicators are selected by the OECD methodology: production-based CO_2 productivity; demand-based CO_2 productivity; non-energy material productivity; environmentally adjusted multifactor productivity growth; loss of natural and semi-natural vegetated land, % since 1993; gain of natural and semi-natural vegetated land, % since 1993; mean population exposure to PM2.6. The research methodology is based on multivariate statistical analysis. As a statistical base the data of the World Bank, OECD, and The Global Green Economy Index (GGEI) of Dual Citizen LLC are used.

1.   Indicators of the Green Economy

At present, a certain theoretical and practical experience of developing indicators of sustainable development has been accumulated. International organizations and individual countries offer quite diverse indicators and their systems, which often contain a very complex system of indicators. At least four groups of indicators used in assessing sustainability can be distinguished: 1 - integral indicators, aggregating various indicators to obtain a single index. Most often, economic, social and environmental indicators are aggregated; 2 - indicator systems that combine private indicators that reflect selected aspects of sustainability. Such systems may include economic, social, environmental and institutional indicators; 3 - private indicators that use indicators of the nature and intensity of pollution (specific pollution), reflecting the costs of natural resources and pollution (emissions, waste, etc.) per unit of the final result (macro level - GDP); 4 - indicators obtained on the basis of sociological surveys, which reflect the attitude of the population to certain problems of sustainable development.

Four directions have been identified to reflect the main components of green growth: 1 - environmental and resource productivity (shows the need for effective use of natural capital and those aspects of production that are rarely calculated in economic models and accounting systems); 2 - economic and environmental assets (show that the reduction of assets creates risks for growth, since it is necessary to maintain assets for sustainable growth); 3 - environmental quality of life (reflecting the direct impact of the environment on people's lives in terms of access to water or the harmful effects of air pollution); 4 - economic opportunities and political decisions (show policy opportunities in ensuring green growth and areas where the greatest effect is observed).

The Global Green Economy Index (GGEI) was the first green economy index released in 2010 and today is the most widely used product of its kind at the international level, which is used by politicians, international organizations, civil society and the private sector. Like many indices, GGEI is used to evaluate performance, inform about areas that need improvement, and show various stakeholders how they can also contribute to progress. GGEI is also useful as a basis for creating specialized sustainability measurement frameworks for a wide range of stakeholders. This index consists of two ranks:

1. *Performance index.* The 2018 GGEI performance index is defined by 20 basic indicators, each of which is contained in one of the four main aspects of leadership and climate change, efficiency sectors, markets and investments, and the environment.

2. *Perception survey.* The perception survey for the 2018 GGEI shows how people assess national green performance on the four main dimensions of leadership & climate change, efficiency sectors, markets & investment, and the environment.

2. Comparison of the level of development of the green economy with the level of socio-economic development.

2.1 Descriptive approach

Based on the OECD and GGEI methodology, the authors carry out a statistical assessment of the relationship between the green economy and key macroeconomic indicators. For the study, authors selected 19 industrially developed countries belonging to the OECD, as well as Russia. The collected data panel for 20 countries is divided into 4 groups according to the quartile of the values of the GGEI index a for 2014–2018:

Group 1 - low level GGEI <0.514475. As of 2018, the first group is included Australia (100 rank in Global Green Economy Index 2018), Czech Republic (69 rank), Russia (105 rank).

Group 2 - moderate level GGEI [0.517, 0.57). Moved to group 2 from group 1in 2018 - Greece, Italy, USA. In group 2, moderate level - Portugal and Spain (Spain lowered the indicator).

Group 3 - high level GGEI [0.57, 0.64). Belgium and Canada (growth rate from low in 2014 to high in 2018), France (growth from moderate to high), Ireland (decline to 1 group in 2014), the Netherlands and the United Kingdom (growth from a moderate level).

Group 4 – the leaders GGEI > 0.64. The leaders in the green economy index are GGE> 0.64 - Austria (9th rank), Denmark (7th rank), Finland (5th rank), Germany (6th rank), Switzerland (2nd rank) (transition from level 3), permanent leaders - Norway (4th rank), Sweden (1st rank)

Thus, countries demonstrate a different level of development of the green economy. However, these countries are fairly homogeneous in terms of the development of a market economy (advanced economies according to the IMF classification, with the exception of Russia and in terms of national income (countries with high incomes, with the exception of Russia)).

Aggregating data for 2014-2018 for the selected groups we can draw the following conclusions. There is a close relationship between the level of development of the green economy and the level of well-being (GDP per Capita) and human development (HDI). However, the GDP growth rate (Real GDP, Index 2000 = 100) has the highest average value for the first group. The highest GDP index has Russia, then Australia and the Czech Republic. Countries with a higher level of development of the green economy have lower GDP growth rates (considering the period from 2000 to 2018); for the second to fourth quartiles, we can talk about the relationship between the GDP growth rate and the level of development of the green economy. There is a Relationship between the level of development of the green economy and inflation, similarly to the above consideration, with the GDP growth rate. The high rate of inflation for the first group of observations is made by Russia, in which the growth rate of consumer prices in 2015 was more than 15%. There is no relationship with the global green economy index with the unemployment rate (Fig.1).

Fig.1 Comparison of the level of development of the green economy with the level of socio-economic development.
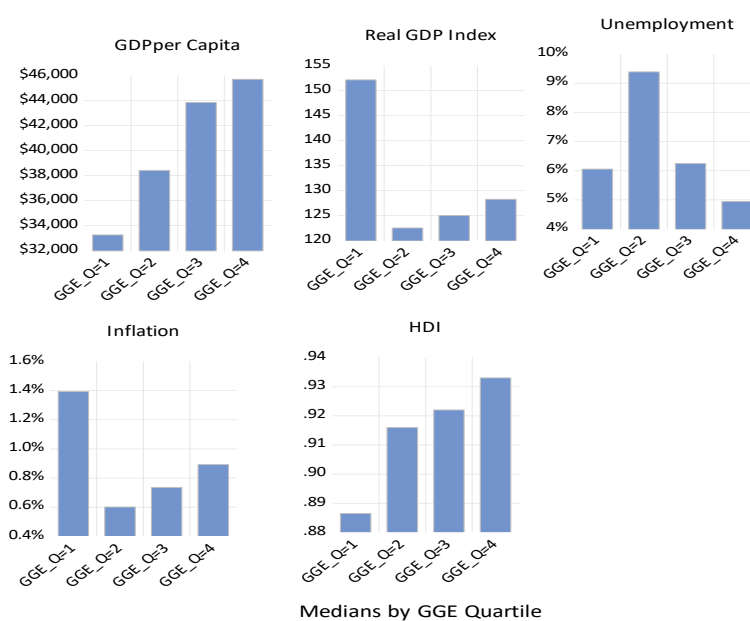
Source: compiled by the authors

2.2 Regression analysis

For the analysis we use a regression model with fixed effects. The panel includes observations from 1990 to 2018 for 19 OECD countries. The data source is the database of the OECD and the World Bank. Table 1 presents headline indicators of green economy.

Table 1. Headline indicators of green economy

Headline indicators of green economy						
Production-based CO2 productivity, GDP per unit of energy-related CO2 emissions	Demand-based CO2 productivity, GDP per unit of energy-related CO2 emissions	Non-energy material productivity, GDP per unit of DMC	Environmentally adjusted multifactor productivity growth	Loss of natural and semi-natural vegetated land, % since 1993	Gain of natural and semi-natural vegetated land, % since 1993	Mean population exposure to PM2.6
US dollars per kilogram, 2011	US dollars per kilogram, 2011	US dollars per kilogram, 2011	Percentage points	Percentage, 1993	Percentage, 1993	Micrograms per cubic metre

Source: OECD

Hypothesis 1. While controlling the growth rate of welfare, the productivity of CO2 increases in developed countries (Table 2).

**Table 2. OLS Estimation of Parameters of the regression models**

Dependent variable/Factors	Y21	d(log(Y21))		Y22	Y21
	eq01	eq02	eq03	eq04	eq05
d(log(GDP_CAP))	1.8	0.46	0.38	2.9	—
Trend	0.1	0.001	0.001	0.11	—
SCAN*DLOG(GDP_CAP)	—	—	0.33	—	—
RNW*GGE_Q	—	—	—	—	0.023
GGE	—	—	—	—	0.3
VA_IND	—	—	—	—	-0.12
Cross-section fixed	YES	YES	YES	YES	No
R2	0.91	0.12	0.13	0.94	0.54
N	520	520	520	220	461

Note. Here y21 is Production-based CO2 productivity, GDP per unit of energy-related CO2 emissions, US dollars per kilogram, 2011. y22 - Demand-based CO2 productivity, GDP per unit of energy-related CO2 emissions, US dollars per kilogram, 2011; GDP_CAP - Real GDP per capita, US dollars, 2011; Scan – dummy variable = 1 for Nordic countries; GGE_Q – categorical variable =1 for low level of green economy, =2 for low-middle level, =3 for upper-middle level, =4 for high level; RNW -   Renewable energy supply, % TPES; VA_IND - Value added in industry, % of total value added; Trend =0 ÷28 (=0 for 1990).

Source: compiled by the authors.

Evaluation of equation 1 has a good fit quality and, for most observations, reproduces actual observations well (Fig. 2). GDP per capita growth of 1% corresponds to a CO2 productivity increase of 1.8 dollars per kg. Taking into account the fact that the average productivity of CO2 is equal to 4.5 dollars per kg, this is an average of 0.4%. The same result is obtained when using the model for productivity growth rates of eq02. When controlling the rate of growth of GDP per capita, the productivity of CO2 increases on average by 0.1 dollar per kg of CO2 per year. Eq02 - the equation for the growth rate, we have a low quality fit. Especially large emissions are observed for the Scandinavian countries and Germany. The introduction of the dummy variable Scan = 1 for designated countries (Denmark, Sweden, Switzerland, Norway, Finland, Germany) allows us to distinguish the relationship between GDP growth rate and CO2 productivity for the Scandinavian and all other countries. It turns out that in Scandinavian countries GDP growth per capita leads to more GDP per unit of CO2 than in other countries (eq03).

**Fig.2 Actual and calculated values of CO2 productivity.**
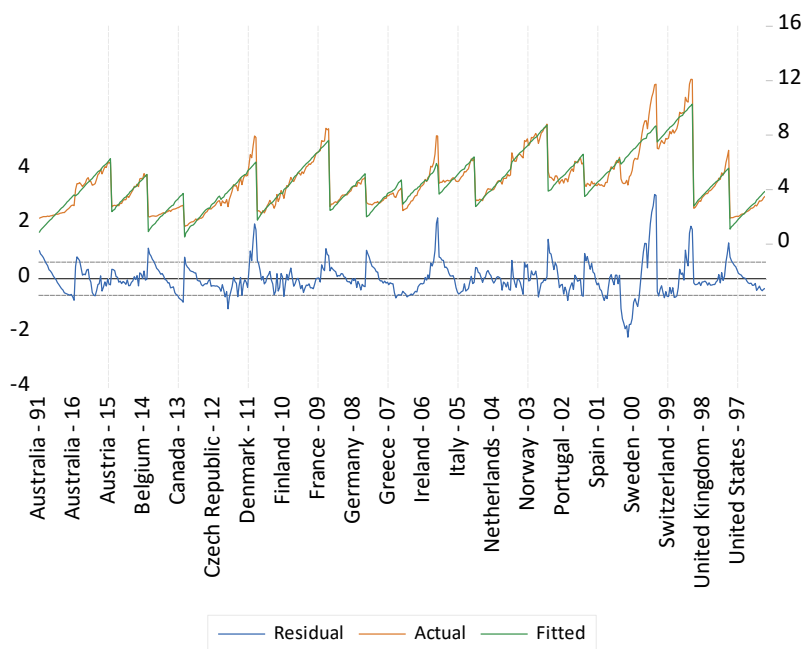
Source: compiled by the authors.

Hypothesis 2. The productivity of CO2 in terms of demand y22 is lower than y21 and tends to increase almost for all countries (Fig.3). In Figure 3 the last square shows the values for Russia, which are the opposite of the trends prevailing in other countries: CO2-unit CO2-energy emissions in Russia, according to OECD's estimates. Estimation of the dependence of y22 On GDP growth per capita and parameters of the time trend is very close to the estimates obtained for y21 (eq01 and eq04, table 2).

Hypothesis 3. The productivity of CO2 is associated with the share of energy from renewable sources and the relationship is closer, the higher the level of development of the green economy. To test this hypothesis, we used the division of observations into 4 categories corresponding to 4 levels of green energy development from 1 (low level of green economy development on the GGEI) to 4 (leaders in the development of green economy on the GGEI). Data omissions are filled in according to the following algorithm: Assigning the value of 2014 for all previous observations. The value 2018 is assigned to 2017. The value 2015 = 2016. The scatterplot with regard to the division into categories shows (Fig. 4) that for the leaders of the green economy this relationship is closer and more intense. Estimates of the corresponding regression equation are shown in Table 2 (eq05).
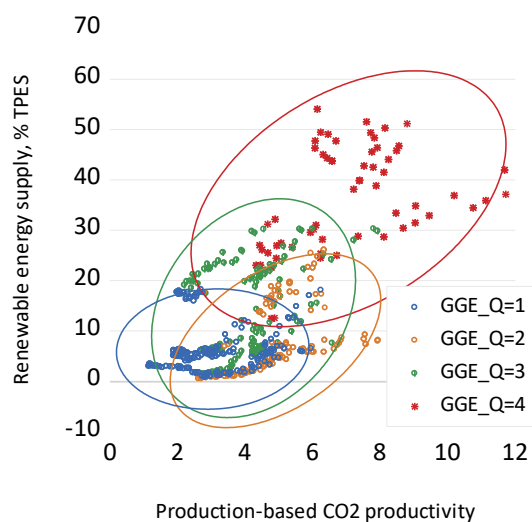
Fig.3 CO2 Productivity.
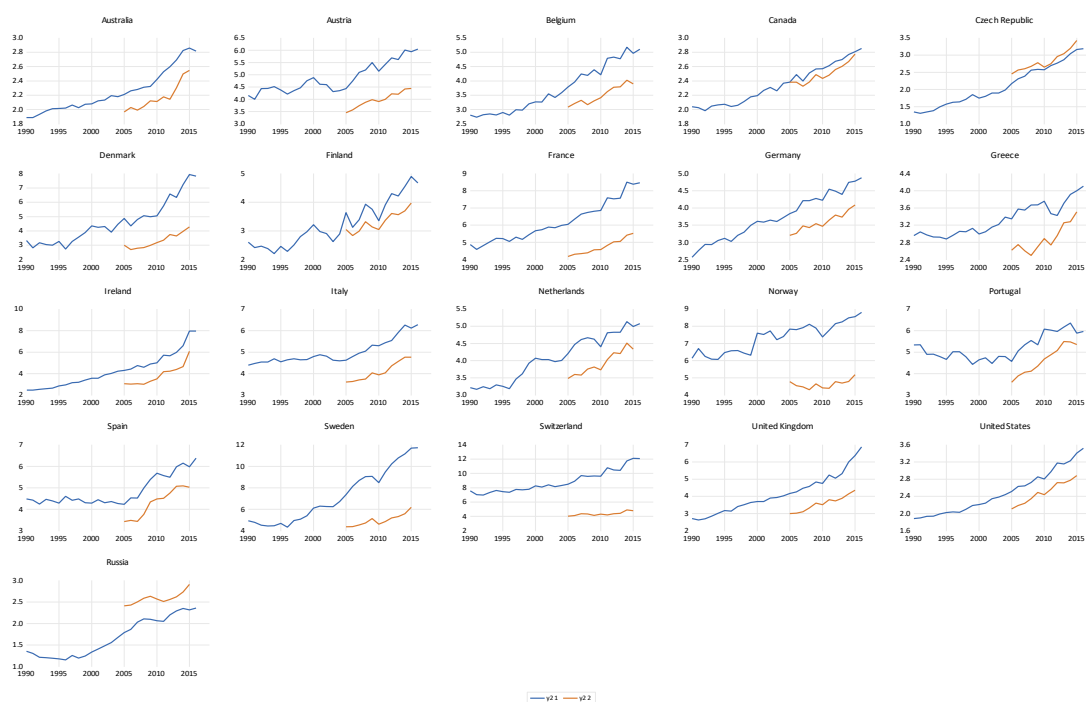
Note. Blue line - Production-based, red line - Demand-based

Source: compiled by the authors.

Figure 4. Categorical Scatter

Source: compiled by the authors.

Conclusion remarks

In the article, the authors assess the relationship between the level of the green economy and traditional socio-economic indicators in the European Union and Russia. Based on various methods of green economy development it is verified how such components of the green economy work as the efficient use of natural resources; preservation and enhancement of natural capital; pollution reduction; low carbon emissions; promote the growth of the welfare of the population. Our ability to sustain economic and social progress in the long run will depend on our capacity to reduce dependence on natural capital as a source of growth, abate pollution, enhance the quality of physical and human capital and reinforce our institutions.

Acknowledgment

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Contact

GOMONOV Konstantin

RUDN University

117198, Russia, Moscow, Miklukho-Maklaya str.6

k.gomonov@gmail.com

BALASHOVA Svetlana

RUDN University

117198, Russia, Moscow, Miklukho-Maklaya str.6

sveta.b2@gmail.com

MATYUSHOK Vladimir

RUDN University

117198, Russia, Moscow, Miklukho-Maklaya str.6

vmatyushok@mail.ru