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Olga Gavrić
University of Belgrade
Faculty of Agriculture
Department of Economics

Đorđe Mitrović
University of Belgrade
Faculty of Economics
Department for Economic Theory and Analysis

DEVELOPMENT OF GREEN ECONOMY AND COMPETITIVENESS OF EU COUNTRIES: MACRO-LEVEL EMPIRICAL ANALYSIS

Razvijenost zelene ekonomije i konkurentnost EU zemalja – empirijska analiza na makro nivou

Abstract

In the past two decades, continuous changes caused by environmental degradation and global warming have contributed to the emergence and actualization of the green economy concept. Applying green principles enables economic growth and development while respecting all aspects of the environment. Green economy is a function of sustainable development as a dominant trend in the global framework, but it is also a sort of a challenge and opportunity for improving national economic competitiveness as the main indicator of success in the world market. The focus of the paper's analysis are four indicators that are relevant to different segments of applying the green economy concept, which are grouped by the DEA method into the composite index GEDI (Green Economy Development Index). Bearing in mind that innovations are very important for the adoption and implementation of the green economy, the emphasis of the research was on examining the relationship between GEDI and the third subindex of the Global Competitiveness Index, which focuses on innovations in the European Union countries. The aim of this comparative analysis is to define future guidelines and recommendations for more efficient implementation of environmental standards and to achieve a sustainable competitive advantage in the long run.

Keywords: *green economy, competitiveness, DEA analysis, composite index.*

Sažetak

Kontinuirane promene uslovljene degradacijom životne sredine i globalnim zagrevanjem u poslednje dve decenije su doprinele nastanku i aktuelizaciji koncepta zelene ekonomije. Primena zelenih principa omogućava rast i razvoj privrede uz istovremeno uvažavanje svih aspekata životne sredine. Zelena ekonomija kao takva je u funkciji održivog razvoja kao dominantnog trenda u globalnim okvirima, ali i svojevrstan izazov i mogućnost za unapređenje konkurentnosti privrede kao pokazatelja uspešnosti na svetskom tržištu. U fokusu analize rada bila su četiri indikatora koji su relevantni za različite segmente primene zelene ekonomije, a koji su korišćenjem DEA metoda grupisani u kompozitni indeks GEDI (Green Economy Development Index). Imajući u vidu da su inovacije veoma značajne za usvajanje i primenu zelene ekonomije, akcenat istraživanja bio je na ispitivanju relacije između GEDI indeksa i trećeg podindeksa globalnog indeksa konkurentnosti čiji su fokus inovacije u zemljama Evropske Unije. Cilj komparativne analize je i definisanje budućih putokaza i preporuka za efikasniju primenu ekoloških standarda i sticanje održive konkurentske prednosti u dugom roku.

Ključne reči: *zelena ekonomija, konkurentnost, DEA analiza, kompozitni indeks.*

Introduction

Globalization, the ongoing Industry 4.0, as well as climate changes, are the attributes of modern economies. Dynamic and volatile business environment, convergence of different industries, and also a higher degree of ecologic sensitivity, have all contributed to the relativization of the positions of companies in the context of new business models. The said tendencies, as well as a proactive market approach in the form of change management, have enticed the development of the green paradigm for companies, and this has further conditioned the implementation of the green economy concept. In this respect, energy efficiency, recycling and the use of renewable energy resources become the imperatives of doing business, and this additionally emphasizes the importance of the environment for companies and economies. In other words, it is necessary to acknowledge all environmental aspects in order to gain global competitive advantage.

Having in mind the abovementioned, the green economy concept represents an economy whose performance leads to improvement of human well-being and social equality, while significantly decreasing environmental risks [4]. As such, it is also compatible with the term of green growth, which aims to decrease the use of nonrenewable resources that are one of the reasons of environmental devastation. Pursuant to this, green economy and green growth are inseparable links that serve the ultimate goal of sustainable economic development. For the purpose of as effective as possible implementation of the green economy standards and principles, both technology innovations, as well as the support of governmental industrial policies, are absolutely necessary.

On the other hand, national economic competitiveness has always been the focus of many economists' work. Intuitively, it is an important indicator of economic success in international terms. As such, national economic competitiveness makes a distinction between more and less effective economies in the world. There are several indicators of competitiveness, and the GCI (Global Competitiveness Index) is the most widely used one. Each year, the World Economic Forum publishes a report ranking 140 countries based on GCI indicators.

The focus of this paper is to identify and analyze the possible correlations between green economy and national economic competitiveness. In other words, one of the goals of the paper is to determine if the countries that have implemented the green economy principles are also more competitive than the ones that have not. For the purpose of a more comprehensive analysis, by applying the DEA (Data Envelopment Analysis) method, we will construct a composite index GEDI (Green Economy Development Index), which refers to the degree of green economy development in a national economy. GEDI contains four indicators that refer to different environmental aspects.

In the paper, we will examine the correlations between the GEDI and the indicators of competitiveness within the GCI (Global Competitiveness Index). The emphasis will be on the EU countries that are highly competitive and that are characterized by high engagement and application of the green standards. The obtained result may also be interesting for the less developed economies, such as Serbia, in the context of improving strategic competitiveness as an integral part of the economic policy. One of the aims of this paper is to implicate, precisely through theoretical considerations and comparative analysis, the existing gaps and future guidelines and recommendations for a more effective application of green economy as a precondition for achieving sustainable development and acquiring competitive advantage based on it.

Green economy as a precondition for sustainable economic growth

The imperative of changes caused by an overuse of resources, global warming and environmental devastation has also incited the development and implementation of the green economy concept. Ever since the 1970s, when the idea first emerged, green economy remains an important global topic. As such, at the same time it represents an add-on, but also a necessary condition for achieving long-term sustainability. Taking into consideration the abovesaid, the concept of green growth is an integral part of the green economy concept, that is, economic growth with minimum environmental impact [12].

In general, green economy has many recognizable characteristics. Namely, one of the initial premises of the concept is replacing conventional linear production by a circular economy model. The linear model, simply represented through four stages, *take–produce–spend–dispose*, has numerous limitations and disadvantages embodied in inefficient resources management, environment degradation accompanied by increasing costs of waste disposal and environmental costs of business operations. The problem and possible consequences of irrational exploitation of natural resources is best presented through the Seneca effect, which creates a correlation between resources and economic development. Specifically, the economic growth based on the exploitation of resources is slow and gradual, but it causes increasing pollution and waste pileup, which ultimately implies a fast and plummeting economy collapse [1]. One of the causes of inefficient use of resources is the low price, as well as the absence of a suitable legal framework in the context of decreasing negative environmental externalities and transaction costs [13]. All of the aforementioned tendencies have conditioned the transition to take direction of circularity and sustainability.

Although there is no single uniform definition in the literature, circular economy as the very core of the green economy concept emphasizes energy efficiency, recycling and greater use of renewable energy sources with minimum waste (the zero-waste principle). The reuse of outputs or its segments in the form of new (secondary) inputs results in lower costs of energy, raw materials, storage and environmental costs for companies. In other words, implementation of circular economy contributes to the increase of companies' business efficiency and more rational resource management.

As a result, green products most often emerge as a second important characteristic of the green economy. Eco-friendly products are completely compatible with the environment, where improvements with respect to design, package, use and quality ensure a higher degree of added value for consumers [5]. Creating eco-friendly products implies changes in the entire product life cycle. Likewise, green products also imply the use of green inputs, whereby they additionally incite companies' innovation potential. In this respect, green products can contribute to the growth of market share and sales volume, which ultimately can also have macro effects in the form of export, GDP and employment increase. Furthermore, the redesigned products may have an important role in the process of increasing the competitiveness of companies and the economy.

The implementation of circular and green economy concepts contributes to bringing the economic and environmental principles closer together, which have more often than not been diametrically opposite. Pursuant to this, it is necessary to refocus the micro and macro objectives from economic maximization to sufficiency and sustainability. With the purpose of applying and spreading the green economy concept as successfully as possible, the aforementioned support of the government and its institutions such as universities, consumers, markets, nongovernmental agencies etc., cannot be omitted [3]. However, innovations have an immanent importance in spreading the green economy.

We differ two types of innovations:

- Innovations with the purpose of pollution decrease;
- Innovations with the above-stated purpose, but with an increase of the resources' productivity.

From the aspect of environmental conservation, the second type of innovations is far more important, and it is also closely linked to creating green products. Specifically, the authors find that technological innovations play a key role in the application of environmental standards and improvement of competitiveness derived therefrom [8], [12]. In addition to this, green economy entails using and investing in cleaner technologies, which further encourages the investment activities of the economy. On the other hand, investments in cleaner technologies also imply cleaner productions.

Having in mind all of the above-stated characteristics, green economy can also be observed from the perspective of Porter's Diamond Model of national competitiveness. As such, green economy creates a climate for gaining competitive advantage, which is crucial in global economic flows. Likewise, all characteristics and attributes of green economy confirm its potential as the carrier of long-term sustainable economic development.

Competitiveness as the measure of national economies' success – Concept, factors, indicators

Globally speaking, national economic competitiveness is an important indicator of the economy's efficiency, which determines the position of a national economy in the international market, its export potential, standard of living and GDP. As economic theory developed, the concept itself has evolved, and two views of competitiveness have emerged. According to the first one, the classical approach, national economic competitiveness is based on natural resources and it is, basically, a zero-sum game. Namely, if a country has an abundance of a particular production factor which it uses for products or services it exports, it will be competitive. Adam Smith and David Ricardo were the pioneers of this concept, and they viewed competitiveness in the context of absolute and competitive advantages, where success of one national economy in the world means failure for another national economy.

According to the second view, which prevailed in the modern world, national economic competitiveness is the result of productiveness, that is, efficient use of the production factors in the process of creation of main export products. Success of a national economy in the world market depends on its ability to improve and innovate itself. Compliant with this is the contemporary definition of the World Economic Forum, which defines competitiveness as a set of institutions, factors and policies which determine the level of productiveness of a country [18]. One of the main proponents of the second approach is Michael Porter, who starts with the premise that competitiveness is not inherited, but created [15]. In Porter's view, competitiveness is a win-win situation where several economies can be competitive at the same time. This concept emphasizes the close connection, but also recognizes the difference between macro competitiveness and competitiveness of companies as the basic subjects of every economy.

In this respect, the existence of macro competitiveness does not a priori mean that the national economy is also competitive. Bearing this in mind, micro and macro factors have a significant role in competitiveness. Although essentially different, both approaches are highly complementary and maintain the goal of providing an integral and comprehensive picture of national economic competitiveness in the world. The factors of company's competitiveness are observed through the concept of five competitive forces (power of customers, power of suppliers, potential of new entrants into the industry (entry barriers), competition in the industry and threat of substitute products) that are basically opportunities or threats to company performance in their own right. On the other hand, macro competitiveness is analyzed based on the abovementioned Porter's Diamond Model of national competitiveness which provides, through four dimensions (factor conditions, related and supporting industries, company strategy and demand conditions), an insight into the nature of economic climate from the aspect of potentials and limitations in which companies operate.

There are two more concepts relevant to this analysis which are also very close to the concept of competitiveness: competitive advantage and distinct competitiveness [11]. Both terms are related to micro competitiveness and thus show a company's potential for high-quality business performance, successful positioning and creating value.

An important step in competitiveness analysis is measuring it. Having in mind the complexity and multifactor character of the concept, all relevant micro and macro factors and drivers of a country's success in the global market must be taken into consideration while conceptualizing the indicators. Pursuant to this, one of the most common indicators in the economic analysis is GCI. This is one of the most comprehensive tools for ranking world economies. GCI emphasizes the importance of productivity for a country's prosperity in the sense that higher values of this index imply higher productivity and better prosperity [16]. Distinctiveness of the index itself is reflected in the multidimensional approach, since it observes competitiveness from the aspect of different indicators that are grouped into twelve pillars. The twelve pillars basically cover the factors that are represented based on the Porter's Diamond Model and the Five Competitive Forces Model.

One especially interesting segment of global competitiveness is the 3rd subindex, which focuses on

innovations and business sophistication. The main results of a company's research and development (R&D) processes are precisely innovations, but also improvement of business operations and creating value based thereon. Accordingly, there is a two-way connection between innovations and business sophistication. In other words, growth of innovative potential improves the business sophistication and vice versa.

Besides institutional support and market incentives, the diffusion of innovations in a national economy is crucial for implementation and application of the green economy standards and its principles [9]. On the other hand, observed from the aspect of long-term sustainability, the greatest potential for a country lies in competitiveness based on innovations. Having in mind the importance of innovations both for green economy implementation, as well as for competitiveness, in the next step of our analysis we will try to provide the answer to the question of whether there is a relationship between the applying environmental principles and the improvement of competitiveness derived therefrom, observed through the prism of the 3rd subindex.

Green economy development index

In accordance with the abovesaid peculiarities of green economy, the main emphasis in the paper will be on the application of the DEA (Data Envelopment Analysis) method for the purpose of constructing a composite index. The DEA analysis, as a unique linear programming tool, enables comparison of different economy segments, starting from ICT use, environment, education, demography, micro and macroeconomy etc. [14]. The main advantage of the DEA method is in that it relies on the composite index instead on several different individual indicators that represent individual elements of the selected areas. Specifically, we will construct a Green Economy Development Index (GEDI), which refers to the degree of the green economy development in an economy.

In constructing the GEDI, we will focus on four indicators: 1) environmental taxes by economic activities (i.e., green taxes – GT), (2) circular material in use (CM), (3) share of renewable energy in gross energy consumption (SRE), and (4) trade in recyclable raw materials (TR). The indicators were selected to represent different green economy aspects, starting from the state of the environment, dispersion of green production, and the amount of investments in the environment, and all this for the purpose of a comprehensive macro-level empirical analysis. While selecting indicators, the starting point was previous research of other authors with similar topics – application of composite indices in the field of the environment (e.g., sustainable energy) [10], [19]. In addition to this, according to Harris and Goodstein, green taxes are a relevant indicator for the analysis, having in mind that green taxes systems are an effective way to internalize the negative externalities, which occur as the consequence of economic activities [7], [9]. Similarly, a heavier reliance on alternative energy sources, such as the energy of the Sun, wind and water, decreases GHG[1] emission and the greenhouse effect. Finally, the use of recycled inputs and the green products trade underlies the total potential of circular economy as one of the main characteristics of industrial ecology.

The official Eurostat data for 2014 have been used to calculate the GEDI. Their original values are presented in Annex 1. The data shown refer to 25 European Union countries.

The application of the DEA method requires determining an adequate number of national economies to be included in the analysis. The most often used rule is that the number of the observed units (national economies) should be at least two times larger than the number of indicators [6]. The GEDI structure, with accompanying indicators, is presented in Table 1.

Table 1: GEDI and individual indicators

Main index	Indicators used
Green economy development index (GEDI)	1. Environmental taxes by economic activities (**GT**) (million EUR)
	2. Circular material in use (**CM**) (%)
	3. Share of renewable energy in gross energy consumption (**SRE**) (%)
	4. Trade in recyclable raw materials (**TR**) (tonne)

Source: Authors' illustration.

1 GHG – greenhouse gasses. GHG emission refers to excessive atmospheric concentration of CO2 and SO2, which are among the main causes of the greenhouse effect and climate change.

Generally speaking, calculation of the composite index is an iterative process containing several steps (Figure 1). After defining the selection of individual indicators, as well as the year representative for the analysis, normalization of their values has been performed. The reason for this lies in the fact that higher values of some indicators imply better, while higher values of other indicators imply worse performance of an observed country. Normalization is conducted in the interval from 0 to 1. In the next step, the weights necessary in the final calculation of the composite index are set for each subindex. The DEA methodology is specific in that the weights of individual indicators are determined endogenously, that is, they are different for each individual economy [19], [20]. The obtained weight value is such that there is no other combination of weights that would bring the analyzed economies in a better position. Optimal weights are calculated based on the following relations:

$$CI_j = max \sum_{i=0}^{n} y_{ij} w_{ij}$$

$$\sum_{i=0}^{n} y_{ij} w_{ik} \leq 1 \quad w_{ij} \geq 0$$

where $i=0,1,...,n$, $j=0,1,...,m$, i $k=0,1,...,m$.

In the above equation, y_{ij} is the value of the indicator i for the country j, where higher values denote better performance, by using m indicators for n countries. The symbol w_{ij} denotes the value of the ponders used for aggregation of the indicators, while CI_j denotes the composite index that we are calculating.

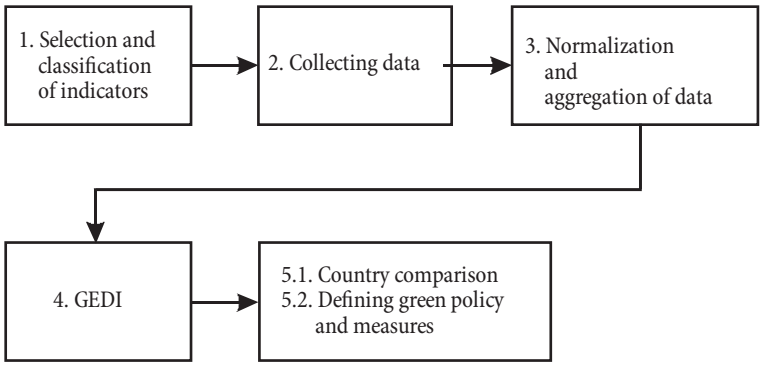
The main limitation of GEDI and DEA methods in general is the static character of the analysis. This means that the calculated values show only the achieved level of green economy development, as well as the advantages and the disadvantages of each economy. It is not possible to analyze the specific samples and possible consequences of the existing state due to the lack of a dynamic component.

Research context and results

In the calculation of GEDI, we used four indicators that relate to different environmental fields, starting from the costs in the form of green taxes, to the use of renewable energy sources and recycled inputs obtained as the result of circular economy, to the benefits in the form of added value and green products trade. The analysis included 25 EU countries: Austria, Belgium, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom, which are characterized by a certain degree of application of green economy standards. We have excluded countries such as Cyprus, Luxembourg and Malta from our analysis due to lack of data that relate to specific indicators. The data used are the official data from Eurostat statistical base for 2014.

All of the selected indicators show the same trends in the sense that higher values contribute to better environmental performance of a national economy. For example, the innovated materials and recycled raw materials that emerge as the consequence of circular economy implementation contribute to the growth of the

Figure 1: GEDI construction process



Source: Authors' illustration.

production of eco-friendly products, higher added value for consumers, as well as higher green export potential. Likewise, the growth of the share of renewable energy sources contributes to the decrease of the GHG emissions. The analysis has shown that there is a positive correlation between green taxes by economic activities, the level of investments, opening new (green) job positions and green products trade (0.66 and 0.54, respectively). On the other hand, there is a weak negative correlation between the share of renewable energy sources in gross energy consumption and the other stated indicators (–0.34 and –0.39, respectively), which is explained by the fact that the use of alternative energy sources cannot produce the same cumulant of energy as in the case when a combination of nonrenewable and renewable resources is used, which further brings into question the functioning of the entire production, industry and national economy in general. The graphic representation of the indicators with the interrelated correlation coefficient is provided in Figure 2.

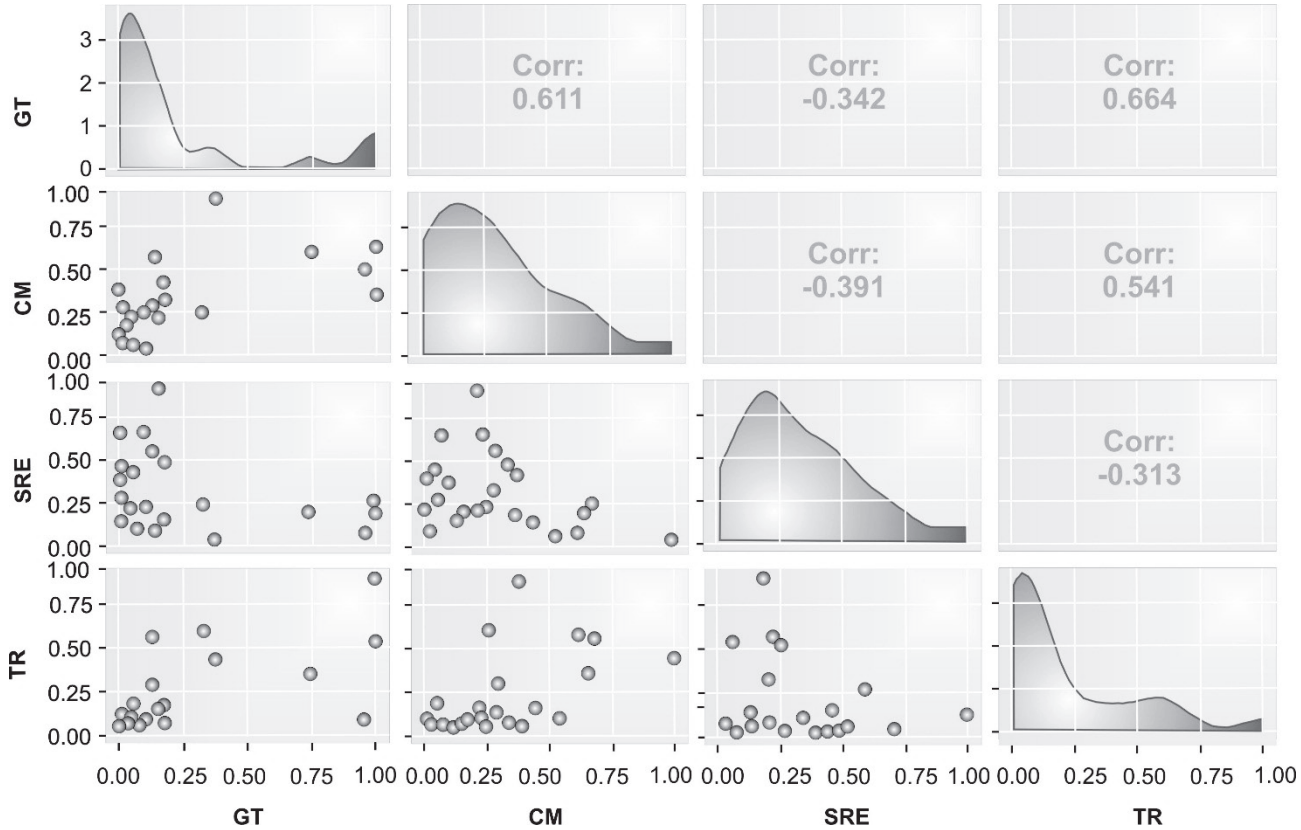
After selecting the indicators, we normalized the values of each indicator in the next stage of the DEA method in order to obtain the final composite index. The normalized indicator values are shown in Table 2.

In the next step, we calculated the GEDI for the EU economies whose values are in the interval between 0 and 1, where the values close to 0 imply poor green performances, while the values approaching 1 show remarkable results in environmental principles implementation. In this regard, Germany, Italy, Sweden and the UK are the most successful countries observed from the aspect of green economy development. The values of individual indicators,[2] which refer to different aspects of the environment, further confirm this statement. Namely, national economies with the best performances have high values of at least three out of the four stated indicators that are included in the composite index. On the other hand, Slovakia, Hungary, Greece, and the Czech Republic scored lowest, that is, they have performed poorly with respect to the green standards implementation.

In accordance with all of the above stated, in the next stage of our research, we examined the correlation

2 The values of individual indicators are shown in Annex 1.

Figure 2: Correlation between individual indicators



Source: https://fvidoli.shinyapps.io/compind_app/.

Table 2: Normalized values of individual indicators

Country name	GT	CM	SRE	TR
1. Austria	0.12	0.28	0.58	0.27
2. Belgium	0.13	0.61	0.05	0.57
3. Bulgaria	0.01	0.05	0.26	0.01
4. Croatia	0.01	0.04	0.47	0.01
5. Czech Republic	0.04	0.21	0.20	0.06
6. Denmark	0.17	0.33	0.51	0.02
7. Estonia	0.00	0.38	0.44	0.00
8. Finland	0.09	0.23	0.71	0.01
9. France	0.74	0.65	0.19	0.33
10. Germany	1.00	0.37	0.17	1.00
11. Greece	0.10	0.00	0.20	0.04
12. Hungary	0.03	0.16	0.19	0.04
13. Ireland	0.07	0.02	0.06	0.00
14. Italy	0.99	0.67	0.24	0.55
15. Latvia	0.01	0.07	0.71	0.02
16. Lithuania	0.00	0.09	0.38	0.01
17. Netherlands	0.37	1.00	0.00	0.42
18. Poland	0.17	0.44	0.12	0.11
19. Portugal	0.05	0.04	0.45	0.14
20. Romania	0.05	0.01	0.41	0.00
21. Slovakia	0.01	0.13	0.13	0.02
22. Slovenia	0.01	0.27	0.34	0.08
23. Spain	0.32	0.25	0.22	0.60
24. Sweden	0.15	0.21	1.00	0.11
25. United Kingdom	0.95	0.53	0.03	0.05

Source: Authors' calculation.

Table 3: GEDI and 3rd subindex of GCI in EU countries (2014)

Country	GEDI	Normalized values of the 3rd subindex of GCI
Austria	0.82	0.78
Belgium	0.85	0.75
Bulgaria	0.26	0.00
Croatia	0.47	0.07
Czech Republic	0.37	0.33
Denmark	0.74	0.78
Estonia	0.73	0.34
Finland	0.79	1.00
France	0.89	0.66
Germany	1.00	0.97
Greece	0.26	0.07
Hungary	0.31	0.13
Ireland	0.11	0.64
Italy	1.00	0.39
Latvia	0.70	0.14
Lithuania	0.39	0.27
Netherlands	1.00	0.87
Poland	0.54	0.15
Portugal	0.53	0.33
Romania	0.41	0.02
Slovakia	0.23	0.08
Slovenia	0.54	0.25
Spain	0.72	0.36
Sweden	1.00	0.92
United Kingdom	0.95	0.79

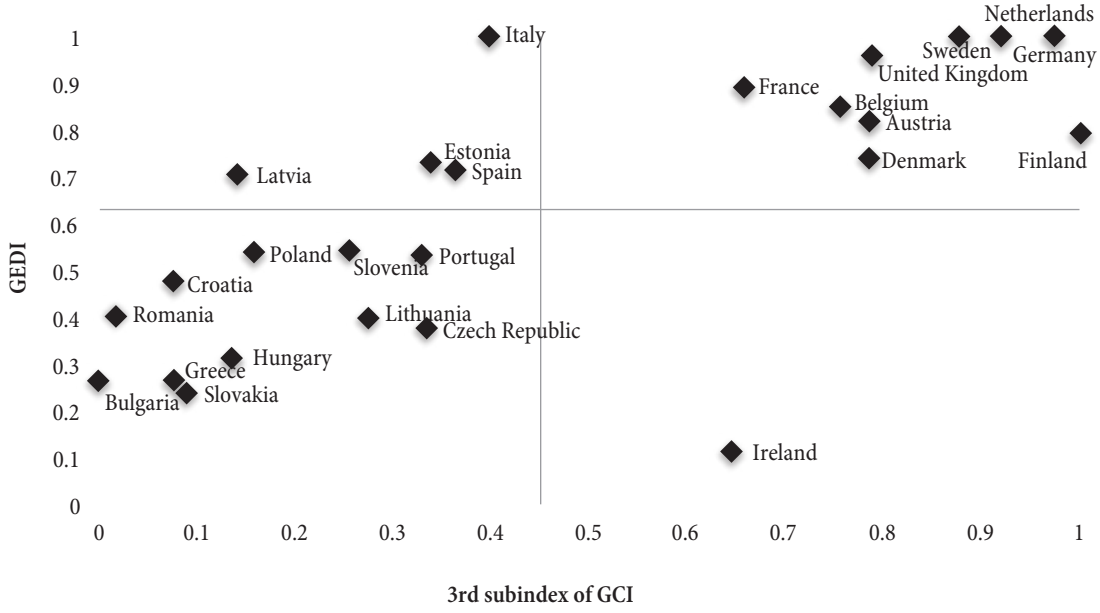
Source: Authors' calculation.

between GEDI and the 3rd subindex of GCI, which measures competitiveness through the prism of innovation and business sophistication of companies. As in the case of GCI, the value of the observed 3rd subindex fluctuates within the interval between 1 and 7, where values closer to 7 imply better innovativeness and business sophistication. The data for the subindex values is taken from the official data base of the World Economic Forum. The values of GEDI and the 3rd subindex of global competitiveness per country for 2014 are summarized in Table 3.

Finally, normalization of the 3rd subindex of GCI values is performed in the last iteration, and we observe the degree of correlation with the data relevant for GEDI, for the purpose of correlation coefficient calculation. The analysis has shown that there is a moderately strong correlation between the stated variables, and the Pearson's coefficient of 0.72 also confirms this correlation. Therefore, we have confirmed the starting assumption that the green principles implementation and application can to a certain extent improve national economic competitiveness. The argument in favor of the achieved result is also the fact that other micro and macro indicators, such as institutional and market efficiency, exchange rate levels, foreign debt levels, transparency of companies' business operations, availability of education and health care, also impact the national economic competitiveness, therefore, respecting the environment and its postulates does not represent a dominant factor for a country's global success, but it does have a certain impact.

Having in mind the obtained results, in the final iteration, the authors prepared a graphic illustration (Figure 2) in the form of a matrix, where national economies were classified according to two criteria: (1) value of GEDI, and (2) value of the 3rd subindex of GCI, respectively. The graphic illustration also points out to the advantages and disadvantages of the EU countries observed from the perspective of green economy, innovations and competitiveness based thereon.

Figure 3: Matrix GEDI and 3rd subindex of GCI – EU Countries



Source: Authors' illustration.

Namely, the combined values of the two indices classified national economies into quadrants, where the most successful countries are in the top right quadrant. In other words, Germany, Sweden, the Netherlands, the United Kingdom, France, Austria, Finland, Denmark and Belgium indicate that implementation of the green dimension contributes to improving the innovative potential and economy sophistication. Specifically, respecting the environmental postulates in these countries is a direct implication, and also the result of global environmental measures and policies, investments in equipment and systems for reduction of noxious gasses emission and pollution, as well as efficient climate change management. Having in mind the long-term perspective, the green principles' application in the stated countries may be observed as a source of competitive advantage in its own right and in the service of achieving the goals of sustainable development.

On the other hand, the analysis has also shown that certain EU countries are in the initial stages of green economy development, and also exhibit a low degree of competitiveness (bottom left quadrant). In this regard, observed from the aspect of the stated criteria, Croatia, Romania, Slovenia, Lithuania, Bulgaria, Poland, Greece, the Czech Republic and Portugal show the poorest performance, which is most often the consequence of inefficient green policy or the lack of proper infrastructure or financial institutional support. Also, moderate reliance on renewable resources or insufficient use of potential circular economy may also be the cause of the obtained results.

The greatest exception to the rule is noticeable in the cases of Italy, Spain and Ireland. Globally speaking, despite the fact that they have achieved significant results in the environmental domain (GEDI=1 and GEDI=0.72, respectively), Italy and Spain have reached a medium level of competitiveness, which is a direct consequence of the impact of substantial public debts, high unemployment rate, presence of corruption in public institutions and insufficiently used innovative potential in the research and development context. The calculated results may serve as a sort of guidance in the direction of improving the existing drivers and carriers of competitiveness.

On the other hand, if measured based on the 3rd subindex of GCI, Ireland boasts better national economic competitiveness than Italy and Spain, but it also records significantly lower environmental achievements. In this respect, it is necessary that Ireland enforces the laws and regulations regarding environmental protection more effectively, and also to focus on using alternative energy sources, internalizing negative externalities through the green taxes system, as well as on completing the transition towards the industrial ecology model.

Conclusion

The main objective of this paper is to investigate if there is a link between green economy standards implementation and national economies' competitiveness. An empirical research, conducted by focusing on the DEA method and simple correlation, confirmed the initial premises of the paper and indicated that green economies do indeed achieve a higher degree of competitiveness, with the emphasis on innovation and business sophistication, and also strike a better position in the global market. In other words, green standards implementation is becoming an important element of global competitiveness, that is, one of the important factors that differentiate successful from the less successful countries.

Generally speaking, abandonment of conventional linear production models, as well as transition in the direction of circularity, energy efficacy and renewability additionally integrates economic and environmental objectives that have more often than not been divergent. The change of the paradigm that companies are the main subjects of the economy has conditioned refocusing the objectives from economic maximization to sufficiency and sustainability. Lesser exploitation of nonrenewable resources, as well as recycling, further incite innovative processes within companies, which results in products that are more sophisticated and have higher added value. Therefore, increase of export and competitiveness based thereon further leads to higher employment rates and higher GDP.

The analysis in this paper makes a distinction between countries that have achieved significant results in the context of adoption of environmental standards and improvement of competitiveness based on innovations, and the countries that have not. Specifically, national economies that usually dominate European and global markets at the same time have the greatest potential to achieve green growth and adopt environmental postulates. The results obtained in the analysis could be important from the aspect of future research in the field of industrial ecology.

Examples of good practice can, as such, further be used as guidelines and benchmarks to identify the existing gaps and improve performances of the lesser developed economies within the EU, but also of the countries that are not EU members, such as the Republic of Serbia. Also, in addition to the abovesaid attributes, the wide range of the benchmark analysis enables defining specific measures and policies that enable better results, and that are at the same time crucial for achieving long-term sustainability.

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Annex 1: Raw values of the individual indicators

Country name	GT (mil. EUR)	CM (%)	SRE (%)	TR (tonne)	3rd subindex of GCI
Austria	8,334.23	8.60	8.00	6,619,411	5.14
Belgium	1,167.82	16.90	18.00	216,462	5.07
Bulgaria	3,281.30	2.70	15.00	856,109	3.28
Croatia	10,621.56	2.40	29.60	368,610	3.46
Czech Republic	58,177.37	6.90	13.80	11,366,205	4.07
Denmark	533.10	9.80	26.30	114,578	5.14
Estonia	4,641.24	11.00	8.70	91,836	4.08
Finland	6,522.96	7.30	15.30	557,843	5.65
France	19,382.00	17.80	16.10	6,899,891	4.84
Germany	43,661.00	10.70	14.70	3,882,296	5.59
Greece	1,390.87	1.40	27.80	216,909	3.46
Hungary	58,174.99	5.40	17.10	6,331,576	3.60
Ireland	853.59	1.90	38.70	307,552	4.81
Italy	633.88	18.50	23.60	176,839	4.22
Latvia	2,690.98	3.10	14.60	550,141	3.61
Lithuania	22,255.00	3.80	5.50	4,915,224	3.93
Netherlands	7,973.60	26.70	33.00	3,124,073	5.36
Poland	10,562.10	12.50	11.50	1,396,079	3.65
Portugal	3,933.90	2.40	27.00	1,694,945	4.06
Romania	3,516.57	1.70	24.80	141,439	3.32
Slovakia	1,452.67	4.80	21.50	1,041,595	3.49
Slovenia	1,349.44	8.40	11.70	383,410	3.88
Spain	5,909.74	7.70	38.70	186,278	4.14
Sweden	9,535.75	6.70	52.50	1,358,874	5.46
United Kingdom	55,672.85	14.90	7.00	696,311	5.15

Source: Eurostat.

Olga Gavrić

is Teaching Assistant at the Faculty of Agriculture, Department of Economics, University of Belgrade. She received her bachelor and master's degree at the Faculty of Economics, University of Belgrade. Currently, she is a PhD student of business management at the said university. She has authored several articles in national scientific journals. Her fields of interest refer to competitiveness analysis and environmental management.

Đorđe Mitrović

graduated in 1999 from the University of Belgrade, Faculty of Economics. In 2010, he obtained his PhD degree at the University of Belgrade, Faculty of Economics. He has been employed at the Faculty of Economics, University of Belgrade since 2000, and was appointed Assistant Professor in 2011 and Associate Professor in 2016. His main fields of interest and research are: transition, macroeconomics, information and communication technologies, digital divide, circular economy and environmental economics. Professor Mitrović teaches the following undergraduate courses: Principles of Economics and Economics of Transitions. He is member of the Scientific Society of Economists in Serbia.