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FACULTY OF ECONOMICS

CIRCULAR ECONOMY: TRENDS AND PERSPECTIVES

Editors:

Vladislav Marjanović

Dejan Đorđević

Niš, October 18th, 2024

CIRCULAR ECONOMY:
TRENDS AND PERSPECTIVES

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P R E F A C E

On October 18, 2024, the Faculty of Economics of the University of Niš organized its traditional conference for the 55th time, this time dedicated to the current topic of the circular economy. Entitled "CIRCULAR ECONOMY: TRENDS AND PERSPECTIVES", the conference brought together 150 participants from 9 countries, from the fields of economics, ecology and social sciences.

The conference participants were addressed by Prof. Dr. Vladislav Marjanović, Dean, and Prof. Dr. Dejan Đorđević, Vice-Dean for Science, who in their welcoming speeches emphasized the importance of this topic in the context of the global challenges we face, such as climate change and resource scarcity, and wished all participants successful work and constructive discussion.

The conference was opened by keynote speakers of European renown. Mr. Michael Dell from Austria spoke about innovation as the driving force of the circular economy and sustainability. He presented numerous examples of companies that have successfully implemented circular business models and highlighted the importance of cooperation between academia, industry and government. The second keynote speaker at the conference, Professor Eleftherios Thalassinos from Greece, analyzed the connection between corporate governance, corporate social responsibility and financial and non-financial reporting using the example of a European country. He emphasized the importance of transparency and the company's responsibility towards society and the environment.

After the introductory presentations, a panel was held on smart and sustainable cities, which are key to the transition to a circular economy. The panel was moderated by Professor Emeritus Dr. Pavle Petrović, and the panelists were eminent experts from the country and abroad. The panel participants agreed that it is necessary to invest in infrastructure development, promote renewable energy sources and encourage citizens to behave responsibly. They also particularly emphasized the importance of regional cooperation in the field of environmental protection.

The conference continued with four parallel sessions, dedicated to different aspects of the circular economy. Participants discussed new concepts of development based on sustainability, the challenges faced by small and medium-sized enterprises in the transition to circular business models, as well as the role of finance and artificial intelligence in the modern economy. Special attention was paid to educating young people in circular entrepreneurship and developing new business models that are in line with the principles of the circular economy.

The conference participants agreed that the circular economy is the inevitable future and that urgent measures must be taken to reduce the negative

impact on the environment. They also emphasized the importance of international cooperation, knowledge exchange and best practices in this area. The conference was an excellent opportunity to exchange knowledge and ideas, and lectures by eminent experts from various fields provided a comprehensive insight into the latest trends and challenges in the circular economy. The 43 papers presented at the conference were fruitful and inspiring, opening new perspectives for research and application of circular principles in practice. As a result of this successful event, a collection of papers was printed (some of them selected for publication in the Faculty's journal “Economic Themes” and University's journal “Facta Universitatis”), which will serve as a valuable source of information for all those involved in this topic.

Editors

Vladislav Marjanović, PhD, Dean
Dejan Ž. Đorđević, PhD, Vice-Dean for Science

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Faculty of Economics, University of Niš
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**CIRCULAR ECONOMY:
TRENDS AND PERSPECTIVES**

Pregledni naučni rad

INFLUENCE OF CIRCULAR ECONOMY COMPETITIVENESS AND INNOVATION ON ECONOMIC GROWTH: CASE OF EU MEMBER STATES

Jelena Živković*

Milan Kostić, PhD•

Abstract: *Research aims to analyse relationship between circular economy competitiveness and innovation indicators and economic growth in EU member states. Analysis covered period from 2012 to 2021. Circular economy concept is new economic model which should minimize waste with long – term sustainable development and well – being. Circular economy competitiveness and innovation indicators are Private investment and gross added value related to CE sectors, Persons employed in CE sectors, and Patents related to recycling and secondary raw materials. Economic growth is measured by real GDP per capita. The correlation analysis and linear regression analysis is applied. The results of regression analysis showed that there is statistical significant impact of circular economy competitiveness and innovations on economic growth in EU member states.*

Keywords*: circular economy, competitiveness, innovation, economic growth, European Union*

1. Introduction

An economic model known as a circular economy (CE) aims to minimize waste, retain long – term value, reduce the use of primary resources, and create closed loops for products, product parts, and materials while still protecting the environment and generating socioeconomic benefits. By severing the link between economic growth and the detrimental

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effects of resource depletion and environmental deterioration, a CE has the ability to promote sustainable development. In the field of science, conceptual innovation with the goal of increasing material and energy consumption effectiveness and efficiency is not new. However, the regenerative idea, which calls for a complete transformation of the economic system, encompassing both production and consumption, is so novel that it is referred to as a paradigm shift for a beneficial reason. It is CE concept. Both at the macroeconomic and microeconomic levels, the CE has operational as well as strategic implications through the concept of 7Rs (redesign, reduce, reuse, repair, renovate, recycle, and recover). Even though recycling and reuse are crucial, a true CE cannot be centered solely on these activities. Instead, an integrated vision – one that starts with innovation and design and offers measurable, economically competitive, and sustainable solutions – is required one that also makes use of synergies across numerous industries. With the globe experiencing symptoms of resource depletion and rising volatility in the global economy, a new economic paradigm has become imperative.

The economic approach to competitiveness, which integrates economic outcomes with higher living standards and real income, includes the concept of competitiveness and innovation in CE. When an economy applies the CE principles in comparison to other economies during the development process, it can reach and maintain a competitive advantage as well as economic and social progress. This is known as CE competitiveness. One of the anticipated outcomes of such a change is still the increase in competitiveness as a result of the shift to CE. This can be great impact on countries' economic growth. The objective of this paper is to examine the impact of CE competitiveness and innovation on economic growth within European Union member states, given the prominent adoption of the CE concept in the European Union.

The paper is structured into several interconnected sections. Following the introduction, the foundational theoretical concepts of the CE will be presented. Subsequently, a description of the data and the applied econometric methods will be provided. Following the discussion of the results, conclusions will be drawn regarding the relationship between the principles of the CE and the economic growth of European Union member states.

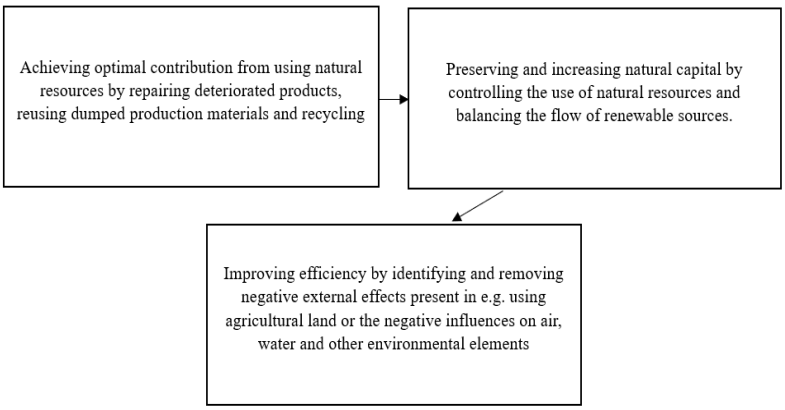
2. Circular Economy – Theoretical approach

The CE model, unlike the current linear economy, is considered a sustainable economic system in which economic growth is organized through the reduction of usage and recirculation of natural resources (Korhonen et al., 2018). The more developed countries of the European Union have been increasingly moving away to this model of economy in recent years. The CE represents the concept of creating value through the rational use of resources and minimizing the negative impact of manufactured products on the environment at all stages of the product life cycle, which enable the reuse of used materials, as well as promoting the concept of mitigating the harmful impact of products produced by companies on the environment (Seroka – Stolka, & Ociepa – Kubicka, 2019).

The concept of the CE originated in the 1970s as a response to the need for reducing the use of inputs in industrial production. Major contributions have been made by Pearce and Turner (1989), who investigated how natural resources affect economic systems and how they affect both linear and open – ended viewpoints. This idea is influenced by

Boulding's (1966) study, "The Economics of the Coming Spaceship Earth," which accepts that the economy and environment should coexist in equilibrium and defines the earth as a closed, circular system with limited assimilative capacity. They contend that the old linear economy cannot be sustained without recycling components and that a CE must take its place. The circular approach diverges significantly from the conventional linear business model characterized by the sequence of take – make – use – dispose and an industrial system predominantly dependent on fossil fuels. In the CE, the business objective shifts from merely generating profits through the sale of products to generating profits through the continuous flow and reutilization of materials and products over time (Bocken et al., 2016). Initially, the focus was on minimizing the consumption of raw materials and mitigating waste generation within industrial processes. However, over time, the principles of the CE have been recognized as applicable beyond industrial contexts (Stahel, 2016). The CE paradigm has evolved to encompass a broader range of resources, including water, energy, and biological materials. This comprehensive approach promotes the sustainable management and regeneration of resources across various sectors. By extending the lifecycle of products, reusing materials, and recycling waste, the CE aims to create a more sustainable and resilient economic system. Consequently, the principles of CE can be effectively applied to any resource, driving innovation and efficiency in resource management while fostering economic growth and environmental sustainability. It is crucial to remember that the CE is founded on three fundamental principles. These principles are: achieving optimal contribution from using natural resources; preserving and increasing natural capital; and improving efficiency by identifying and removing negative external effects present (Figure 1).

Figure 1. Principles of CE



Source: Grdić, Z. S., Krstinic Nizic, M. & Rudan, N. (2020). Circular Economy Concept in the Context of Economic Development in EU Countries. *Sustainability, MDPI, 12*(7). p. 13.

Ghisellini et al. (2018) defines CE as a new model of economic development which promotes the maximum reuse (recycling) of materials, goods and components in order to decrease waste generation to the largest possible extent. It aims to innovate the entire chain of production, consumption, distribution and recovery of materials and energy according to

a cradle to cradle vision. Geissdoerfer et al., (2017) argue that CE is a regenerative system where energy leakage, emissions, and loss of resources are reduced by reducing speed, shutting and condensing the content as well as energy cycles. This might be attained by persistent creation, upkeep, and repair, recycling, repurposing, restoring and reusing. According to Webster (2017) the goal of a CE is "to create products, components, and materials with the highest service value over time". The Ellen MacArthur Foundation (2015) emphasizes that CE distinguishes between technological and biological cycles and strives to maintain goods, components, and materials at their maximum utility and worth at all times. It is restorative and regenerative by design. CE is an economic system that substitutes material recovery, recycling, and reduction in manufacturing, distribution, and consumption processes for the notion of "end – of – life." Its operations are focused on achieving sustainable development, which will benefit present and future generations by fostering social equity, economic prosperity, and environmental quality at the micro, meso, and macro levels (products, companies, and consumers), as well as ecoindustrial parks. Innovative company strategies and conscientious customers make it possible.

Kirchherr et al. (2023) analyzed 221 definitions of the CE and concluded that it is essential that policymakers need a common definition of CE. It strengthens the capacity to integrate policy efforts across political jurisdictions (e.g., states, countries, and regions), industries, life – cycle stages, and other issue areas (e.g., extraction, processing, and end – of – life management). It does this by providing a common basis of assumptions and targets on which policymaking can be developed. In addition to helping businesses coordinate their CE adoption efforts with those of other suppliers and partners, a consensual understanding gives academics a foundation upon which to construct studies that engage in discursive interactions across disciplines, industries, and contexts. Since the scope of the CE transition is inherently large, it is critical that conflicting and divergent interpretations of the idea do not produce. Nobre and Tavares (2021) proposed following definition of CE: "CE is an economic system that targets zero waste and pollution throughout materials lifecycles, from environment extraction to industrial transformation, and to final consumers, applying to all involved ecosystems. Upon its lifetime end, materials return to either an industrial process or, in case of a treated organic residual, safely back to the environment as in a natural regenerating cycle. It operates creating value at the macro, meso and micro levels and exploits to the fullest the sustainability nested concept. Used energy sources are clean and renewable. Resources use and consumption are efficient. Government agencies and responsible consumers play an active role ensuring correct system long-term operation."

As the CE is a current issue in the scientific sense, but also in a practical sense, it is necessary to provide appropriate strategies and regulations that will ensure the application of its principles. In this regard, the European Union put primacy to the CE and it`s promotion. According to the CE Action Plan, which was unveiled in March 2022, the European Commission suggested the first set of steps to accelerate transition to a CE in accordance with the EU's 2050 climate neutrality goal under the Green Deal. Increasing the use of sustainable products, educating customers about the green shift, reviewing the building product legislation, and developing a plan for sustainable textiles are some of the recommendations. All actions, instruments, plans, and strategies should be systematically aligned to support sustainable development and the enhancement of economic growth. This alignment ensures that each initiative not only contributes to immediate economic objectives but also promotes long–term environmental sustainability and social well–being. By integrating these principles into policy–making and strategic planning, it can be created

a resilient economic framework that addresses current needs without compromising the ability of future generations to meet their own needs. Such a comprehensive approach is essential for fostering a balanced and inclusive economic growth trajectory.

2. Data and Methodology

The research analyses influence of the CE competitiveness and innovation on economic growth in 27 EU member states. Research covered period from 2012 to 2021. Data are retrieved from Eurostat database. All variables, that are included in analysis, are presented in Table 1.

Table 1. Description of variables

Variable	Description
priv_inv	Private investment and gross added value related to CE sectors
persons_ce	Persons employed in CE sectors
patents_ryc	Patents related to recycling and secondary raw materials
real_gdppc	Real gross domestic product per capita

Source: Authors

CE competitiveness and innovation have three indicators. These three indicators are model's explanatory variables. First variable is *Private investment and gross added value related to CE sectors* which covers three sectors: the recycling sector, repair and reuse sector and rental and leasing sector. *Private investment in CE sectors* is related to gross investment in tangible goods of mentioned three sectors. This investment is defined as investment during the reference year in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use, having a useful life of more than one year including non–produced tangible goods such as land. Investments in intangible and financial assets are excluded. *Gross added value related to CE sectors is* the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated as the sum of turnover, capitalized production, other operating income increases minus decreases of stocks, and deducting the following items: purchases of goods and services, other taxes on products which are linked to turnover but not deductible, duties and taxes linked to production. Value adjustments (such as depreciation) are not subtracted. Second variable is *Persons employed in CE sectors* which measures number of employed in the following three sectors: the recycling sector, repair and reuse sector and rental and leasing sector. Jobs are expressed in number of persons employed and as a percentage of total employment. Number of persons employed is defined as the total number of persons who work in the observation unit, i.e. the firm as well as persons who work outside the unit who belong to it and are paid by it – e.g. sales representatives, delivery personnel, repair and maintenance teams. It excludes manpower supplied to the unit by other enterprises, persons carrying out repair and maintenance work in the enquiry unit on behalf of other enterprises, as well as those on compulsory military service. Third indicator is *Patents related to recycling and secondary raw materials*. The attribution to recycling and secondary raw materials was done using the relevant codes in the Cooperative Patent Classification (CPC). The term 'patents' refers to patent families, which include all documents relevant to a distinct invention (e.g.

applications to multiple authorities), thus preventing multiple counting. Economic growth is dependent variable of the model and it is measured by *Real gross domestic product (GDP) per capita*. The correlation analysis and linear panel data regression analysis is applied.

In case of the research, regression model has the following form:

$$real\_gdppc_{i,t} = \alpha + \beta_1 priv\_inv_{i,t} + \beta_2 persons\_ce_{i,t} + \beta_3 patent\_ryc_{i,t} + \mu_{i,t} \quad (1)$$

where *i* is country as entity of observation (*i= 1,... 27*), while *t* is time of research (from 2012 to 2021). Also, β_1, β_2 and β_2 are coefficients associated with the independent variables of the model and μ_{it} is the random error term.

3. Results and Discussion

In this section it will be presented analysis results. In the Table 2 is presented descriptive statistics. In case of Private investment and gross added value related to CE sectors mean value for EU countries from 2012 to 2021 is 3,299.79. The maximum value has been reached in Germany in 2018. Minimum value is 33 and it is recorded in Cyprus in 2014. Germany had the most Persons employed in CE sectors in 2020, while the smallest number of workers in CE sectors was in Luxembourg in 2012. In observed period average number of persons employed in CE sectors is 137,247.50. When we talk about patents related to recycling and secondary raw materials average value is 11.97 (in table 2 11.96807). However, it is a great difference between countries with best and worst results. Specifically, there are several countries with no patents related to recycling and secondary raw materials, during the whole observed period. Some of them have no patents in the majority of the observed period. Bulgaria had no these patents in 2012, 2013, 2019 and 2020. Estonia has zero patents related to recycling and secondary raw materials only in three years during period from 2012 to 2020. Croatia has positive this indicator only in 2012 and 2016. Greece had no patents on the beginning the observed period. Cyprus has the worst score. This country has zero score almost within all period. It had score of 1 only in 2015. Other countries where the zero score is presented are: Latvia, Lithuania, Malta, Slovakia and Slovenia.

Zero score for patents related to recycling and secondary raw materials in only one year is in Hungary and Portugal. The best result for patents related to recycling and secondary raw materials has Germany with the high value. In this country is recorded maximum value of 103.78 patents. Concerning economic growth, the appropriate measure is real GDP per capita. Mean value of real GDP per capita is 25,827.98 euro. Maximum value of 84,750.00 euro is in Luxembourg in 2016. Minimum value of 5,390.00 euro was in Bulgaria in 2012.

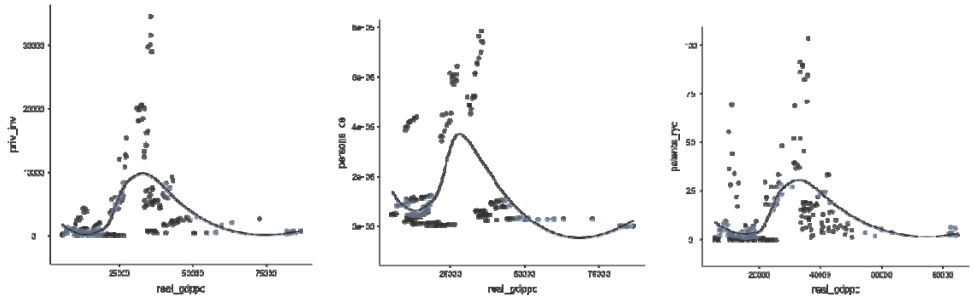
Table 2. Descriptive statistics

	priv_inv	persons_ce	patents_ryc	real_gdppc
Mean	3,299.79	137,247.50	11.96807	25,827.98
Median	741.00	51,855.00	3.86000	20,310.00
Maximum	34,489.00	764,770.00	103.78000	84,750.00
Minimum	33.00	1,722.00	0.00000	5,390.00
Std. Dev.	5,754.96	191,738.50	19.02613	16,844.57

Source: Authors' calculation

Given that the results of the regression analysis will be presented in the subsequent sections, it is essential to first provide a graphical representation of the data through scatter plots. These scatter plots serve as a preliminary step to visualize the relationship between the independent (explanatory) and dependent variables, allowing for a more intuitive understanding of the underlying patterns and correlations. By examining the scatter plots, insights can be gained into the distribution and trends within the dataset, which will facilitate a more comprehensive interpretation of the regression analysis results presented later.

Figure 2. Scatter plots



Source: Authors' calculation

Scatter plots show that there is connection between CE competitiveness and innovation indicators and real GDP per capita. The outliers that appear are the result of large differences between countries in economic growth, considering that 27 countries are included in the analysis. Due to the presence of outliers, a logarithmic transformation of the variables will be applied.

First, correlation analysis will be applied. Given that the Shapiro –Wilk test showed that the data were not normally distributed, Spearman's correlation coefficient will be applied. The results of the correlation analysis are shown in Table 3.

Table 3. Correlation matrix

	log_private_inv	**log_persons_ce**	**log_patents_ryc**	**log_real_gdppc**
log_private_inv	1.000			
log_persons_ce	0.765*** < 0.001	1.000		
log_patents_ryc	0.865*** < 0.001	0.692*** < 0.001	1.000	
log_real_gdppc	0.455*** < 0.001	-0.052 0.391	0.447*** < 0.001	1.000

Note: * p < 0.05, ** p < 0.01, *** p < 0.001

Source: Authors' calculation

Spearman's correlation coefficient shows that there are positive statistically significant moderate correlation between Private investment and gross added value related

to CE sectors and real GDP per capita and Patents related to recycling and secondary raw materials and real GDP per capita. This indicates that variations in these variables move in the same direction. The positive statistically significant strong correlation is present between Private investment and gross added value related to CE sectors and Persons employed in CE sectors and Private investment and gross added value related to CE sectors and Patents related to recycling and secondary raw materials. Also, there is positive statistically significant correlation between Persons employed in CE sectors and Patents related to recycling and secondary raw materials. There is no statistically significant correlation between Persons employed in CE sectors and real GDP per capita in EU member states from 2012 to 2021.

Table 4. Regression analysis results

log_real_gdppc	Coef	Std. Err.	t	p-value
C	12.5078700	0.2639356	10.50	0.0000
log_priv_inv	0.4760534	0.0337509	-17.65	0.0000
log_persons_ce	-0.4760534	0.0269743	5.01	0.0000
log_patents_ryc	0.1633913	0.0326429	47.39	0.0000
F(3, 188)				136.8800
Prob > F				0.0000
R – squared				0.6860
Adj R – squared				0.6809

Source: Authors' calculation

Regression analysis results show that there is statistical significant positive influence of the Private investment and gross added value related to CE sectors on the real GDP per capita in EU member states from 2012 to 2021. When private investment and gross added value related to CE sectors increase for 1 million euro, the real GDP per capita increase for 0.48 euro per capita. On the other hand, there is negative statistically significant influence of the Persons employed in CE sectors on the economic growth in EU member states. When persons employed in CE sectors increase for 1 person, the real GDP per capita would decrease for 0.48 euro per capita. Regression analysis also showed that there is statistical significant positive impact of the Patents related to recycling and secondary raw materials on the economic growth in EU member states. When indicator Patents related to recycling and secondary raw materials increase for 1 patent real GDP per capita would increase for 0.16 euro per capita. This regression model is adequate because the R – squared is 0.6860 and adjusted R – squared is 0.6809. This means that 68.10 percentages of the variation in the dependent variable can be explained by the variation in the independent variables. In other words, 68 percentages of the variations in real GDP per capita can be attributed to variations in the specified indicators: Private investment and gross added value related to CE sectors, Persons employed in CE sectors, and Patents related to recycling and secondary raw materials. The adjusted R squared value, which accounts for the number of predictors, similarly indicates that a substantial portion of the variance is explained by the model.

4. Conclusion

The integration of CE principles into the economic strategies holds significant potential for enhancing competitiveness and driving innovation. By rethinking traditional linear models of production and consumption, the CE encourages the efficient use of

resources, fostering the development of innovative technologies and practices that can lead to sustainable economic growth. The evidence suggests that economies that actively pursue circularity not only mitigate environmental impact but also create new economic opportunities, improve resource efficiency, and enhance their competitive position in global markets. Therefore, the CE is not just a pathway to sustainability, but also a catalyst for economic resilience and long–term prosperity. This is particularly important for the EU because it is the one that advocates the application of circular economy principles and is directed towards strategies and tools that will contribute to the improvement of competitiveness and innovation.

Based on the presented results, it can be concluded that there is a statistically significant impact of the CE competitiveness and innovation on the economic growth of the EU member states from 2012 to 2021. There are positive impacts of the Private investment and gross added value related to CE sectors and the Patents related to recycling and secondary raw materials on the real GDP per capita. On the other hand, there is negative impact of the Persons employed in CE sectors on the real GDP per capita. This result underscores the imperative for EU countries to intensify efforts in enhancing the competitiveness and innovation within the circular economy to stimulate more robust economic growth. As the global landscape increasingly shifts towards sustainability, it becomes crucial for EU member states to leverage the principles of the circular economy as a strategic advantage. By fostering a competitive environment that encourages innovation in resource efficiency, waste reduction, and the development of circular business models, countries can not only secure their economic futures but also contribute to a more sustainable global economy. The need for policy initiatives, investment in research and development, and collaboration across industries is evident to ensure that the circular economy becomes a driving force behind economic expansion in the European Union.

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UTICAJ KONKURENTNOSTI I INOVATIVNOSTI CIRKULARNE EKONOMIJE NA EKONMSKI RAST: SLUČAJ ZEMALJA ČLANICA EU

***Rezime**: Cilj istraživanja je analiza veze između indikatora konkurentnosti i inovativnosti cirkularne ekonomije i ekonomskog rasta u zemljama članicama EU. Analiza je obuhvatila period od 2012. do 2021. godine. Koncept cirkularne ekonomije je novi ekonomski model koji bi trebalo da minimizira otpad uz dugoročni održivi razvoj i blagostanje. Indikatori konkurentnosti i inovativnosti cirkularne ekonomije su: Privatne investicije i bruto dodata vrednost u sektorima cirkularne ekonomije, Broj zaposlenih u sektorima cirkularne ekonomije i Patenti koji se odnose na reciklažu i sekundarne sirovine. Ekonomski rast se meri realnim BDP po stanovniku. Primenjene su korelaciona i regresiona analiza. Rezultati regresione analize su pokazali da postoji statistički značaj uticaj konkurentnosti i inovativnosti cirkularne ekonomije na ekonomski rast u zemljama članicama EU.*

***Ključne reči:** cirkularna ekonomija, konkurentnost, inovativnost, ekonomski rast, Evropska unija*

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