ISSN 2520-6303

Economics, Management and Sustainability
journal home page: https://jems.sciview.net

Simionescu, M. (2023). The circular economy and sustainable development in the European Union's new member states. *Economics, Management and Sustainability, 8*(1), 6-15.
doi:10.14254/jems.2023.8-1.1.

The circular economy and sustainable development in the European Union's new member states

Mihaela Simionescu

Institute for Economic Forecasting of the Romanian Academy, Bucharest, 050711, Romania
mihaela.simionescu@unibuc.ro; mihaela.simionescu@ipe.ro

Article history:
Received: December 19, 2022
1st Revision: April 11, 2023
Accepted: May 06, 2023

JEL classification:
Q56
O44
O47
C33
J21

DOI:
10.14254/jems.2023.8-1.1

Abstract: The transition to a circular economy could not be avoided, but it should be oriented to ensure the achievement of sustainable development. The limited data availability and lack of enough studies for new EU member states are the main gaps in the literature partially covered by this research. A macroeconomic approach based on panel data models and Bayesian random linear regression models was conducted for Cyprus, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia from 2008-2020. The results indicated that gross investment in tangible goods and more employed people in circular economy sectors are necessary to support economic growth. Moreover, mapping the jobs in a circular economy is required to support a sustainable circular economy.

Keywords: circular economy, economic growth, employment, panel data models, sustainable development

1. Introduction

The excessive emissions and industrial waste generated air pollution, acid rains, erosion of arable land, fewer areas covered by forests, desertification, less arable lands, global warming, endangering biological diversity, and depleting the ozone layer. All these issues affect the life and health of human beings, disturb the ecological system and limit the development of the world economy. The analysis of environmental issues suggests that the cause of the current crisis is the result of the fast development of consumption, industry, and agriculture.

The solutions to this global crisis have been developed since the 1960s and one of the first theories of circular economy belongs to Boulding (1965), who proposed space ship theory. According to this theory, the environmental concerns could be understood better by studying the economic issues related to the environment. The Earth is seen as a spatial nave flying in space that consumes its limited resources to keep it life. If humans continue to consume limited resources and deteriorate the environment without trying to repair it, the Earth will be destroyed like a spatial nave. The economy of this nave should be a circular economy that replaces the traditional economy based on

Corresponding author: *Mihaela Simionescu*
E-mail: *mihaela.simionescu@unibuc.ro*

consumption. The necessity to keep the resources for the next generations was highlighted in various conferences and official documents like the Conference on Environment of the United Nations in 1972, the Report of the World Commission on Environment and Development in 1987, the Declaration of the Conference on Environment and Development in 1992, Summit of the United Nations for Sustainable Development in 2002, COP26 Summit in 2021.

The evolution of the natural ecological system is circular, and the materials are reused to develop plants, animals, and microorganisms. Natural waste is transformed into more raw materials that become again waste using solar energy. In the last 300 years, the linear model for economic development has contributed to pollution, fewer fossil fuels, and a lack of resources. The circular economy is based on recycling and waste reuse. The scope of a circular economy is to minimize the number of natural resources used in production, the pollutants eliminated in the environment, and the global ecological damage produced by an economy.

A circular economy might be a path to economic development with high efficiency and recycling, but also reduced emissions, contrasting with a linear economy based on industrialization. A circular economy might be considered an ecological economy based on ecological norms instead of market norms to ensure economic development in equilibrium with the environment.

The circular economy might also be considered a new model of production and a new economic and technological paradigm based on the fact that the status of the environment is a limiting factor for economic growth, and a healthy ecological environment might increase the general public wealth. The pass to a regenerator model will enhance economic activity in innovation, remanufacturing, renovation, and the creation of new jobs. Organizations should improve adaptability and flexibility to innovate and develop new business models that exploit market movement. The technology significantly influences how resources are managed to construct a sustainable economy.

If technological and natural ecological approaches are combined, the circular economy presents three main characteristics:

-technological characteristic, because de the development of a circular economy is based on scientific and technological progress that allows society to improve the efficiency in resources recycling;

-systematic characteristic because the circular economy is based on each field and link within the production chain, and it has a social character;

-the presence of more levels of circular economy (for example, the industrial system of the circular economy presents three levels: enterprise level, industrial level and regional level for the general circulation.

Sehnem et al. (2019) discuss the concept of circular economy in the context of sustainable development and depletion of limited resources. The author considers that circular economy should employ the model provided by nature, and waste acquisition, transformation, and decomposition should be made using solar energy. In this context, Sehnem et al. (2019) presented the potential and drivers for developing a circular economy. The value added to industrial products is maintained because it will be used in another production cycle at the end of the life cycle. The circular economy rejects the linear production model because that model considers unlimited resources that are always available at low costs. This assumption is not fulfilled in the real world and could not determine long-term economic growth.

Sustainable development harmonizes economic and social progress with natural equilibrium, well-being, and better living conditions for populations with overexploited natural resources.

Eco-development combines economy and friendly ecology to support economic development for the environment. Sustainable ecological development ensures an optional interaction between human, economic, environmental, and technological systems (Lantitsou, 2017). This model becomes operational if it is applied to all sub-systems like agriculture, energy, industry, investment, biodiversity, and human settlements.

According to a World Economic Forum report (2014), one billion dollars and 100,000 new jobs could be generated by 2025 if the companies build circular supply chains to increase recycling, reuse, and re-manufacturing (Kalmykova et al., 2018). The development of a circular economy will allow companies to find new markets, pass from selling products to providing services, and develop business models based on leasing, sharing, repairing, modernizing products, or recycling individual components. All these initiatives should conduct to economic growth and increase employment at the national level. However, at the empirical level, no evidence supports the significant impact of circular economy development on economic growth. In this context, the hypothesis of this study states that the extension of the circular economy in the last years significantly enhances economic growth and employment in a sample of European countries.

2. Literature review

From the theoretical point of view, the circular economy was designed to be a *driver of economic growth*. Innovative product designers and business leaders support decoupling economic growth from environmental impact and positive social outcomes (Lüdeke-Freund et al., 2019). Businesses need to reinvent, and the circular economy offers up-and-coming prospects.

The circular economy promotes big changes in how resources are used. This involves creating long-lasting products, modularization, reutilisation of components, and designing products with less material (Gu & Sosale, 1999). If appropriate incentives are used, innovation will deliver more sustainable materials. A significant change in product design is an essential step for any company.

A circular economy should be an *economic opportunity to ensure the equilibrium between the environment and the economy*. The global economic and environmental risks like financial crises, resource constraints, and issues related to food, education, and health could be solved through solutions that promote economic and social benefits in a safe environment. The circular economy involves activities that reduce, reuse and recycle materials along the production chain, reducing the harmful effects of economic activities on the environment (Ormazabal et al., 2018). The final goal is to decouple growth from the depletion of natural resources and environmental degradation. In this context, state authorities and public-private partnerships are necessary. The supply chains should be reorganized to facilitate reuse and remanufacturing. Optimizing global supply chains requires the development of smart infrastructure technologies and the improvement of information exchange along the supply chain (Bastein et al., 2013). Progress in materials science contributes to the transition to the circular economy for managing climate changes and water issues. Replacing fossil fuels with renewable energy resources releases issues determined by the volatility of resource prices.

The circular economy depends on *political factors*. A favorable environment for promoting the circular economy depends on strong policies that provide incentives to increase resource efficiency and waste reduction. The state and local public administrations, emerging corporations, and innovators must have a balanced mix of administrative and market instruments and indirect investment (McDowall et al., 2017).

The state and local public administrations act in new markets and create policies supporting their viewpoint on emerging corporations and innovators specializing in business creativity. In this regard, corporations understand business needs and test the level of innovation and the scale of innovation support. Emerging innovators help understand business needs and provide corporations with emerging technologies and solutions.

The circular economy integrates more clean productions and green industries in a system that includes individual companies, chains of companies, "eco-industrial" parks, and infrastructure for optimizing resources, as follows:

- at the company level: the consumption of resources and the emissions of pollutants must be reduced, and reusable resources from recycled products should be enhanced;
- chain of companies and industrial parks must recycle and reuse resources to ensure the flow of resources in the local production system;
- at the regional level: different production systems need to be integrated to ensure the flow of resources between industries and urban systems (Barreiro-Gen and Lozano, 2020).

The circular economy involves constructing a new economic system characterized by cooperation between national and local institutions, businesses, and consumers. The government should use legislative, political, and administrative measures to promote the circular economy. It is essential to balance the combinations between these tools for maximum effect. The government must recognize its role in setting rules, providing incentives, and supervising. The business environment and civil society must take the initiative and implement the circular economy programs. Legislation must establish a set of regulations and standards for recycling, reuse, and reduction of waste, such as administrative methods of mandatory collection of packaging and used products, standards for water and energy, lists of technologies, materials, equipment, and products to be phased out, banning the use of toxic materials, etc. (Hu et al., 2018).

Economic growth should be decoupled from environmental pressures to maintain Eco-systems' resilience and prevent the impact on human well-being. Increasing the efficiency of resource use is essential for achieving well-being. The circular economy aims to increase resource efficiency and plays a key role in achieving the objective of the EU's 7th Environment Action Program, which does not fully address the conservation of natural capital and prevention of environmental risks to human health and well-being. The circular economy can be represented as the core of the green economy, which has grown the field from using waste and materials by including the resilience of the Eco-system, human health, and well-being (Geng et al., 2016).

Mitchell and James (2015) showed how a circular economy could bring economic advantages such as lower structural unemployment and more material productivity in Europe. In this context, the authors recommend the connection between a circular economy and more economic outcomes, such as opportunities for the labor market related to job creation in Europe by 2030 and improvements in material use. From this point of view, our paper assesses the impact of the circular economy on economic growth and labor market outputs to evaluate the progress and recommend future actions to improve the benefits of the circular economy at the macroeconomic level.

Circular economy practices contribute to sustainable development goals. From this point of view, Schroeder et al. (2019) showed that a circular economy contributes to sustainable economic growth and decent work. Ghosh (2020) considers that a circular economy can enhance job creation, economic growth, innovation, and resource conservation. In practice, two paths are possible: efforts to reconcile economic growth and circular economy, on the one hand, and a post-growth direction to circular economy, on the other hand. Bauwens (2021) argued that the second path is the most viable for the EU. Post-growth businesses should be based on efficiency, durability, and frugality, which are key points of the circular economy (Khmara & Kronenberg, 2018). Job creation should be combined with community building and empowerment to improve well-being (Nesterova, 2020). These targets might be achieved by considering a suitable redistribution of economic surplus and by democratic decision-making (Bauwens et al., 2016).

George et al. (2015) constructed a circular economy model where the determinants of economic growth refer to the recycling ratio, the marginal product of the recyclable input, the degree of pollution resulting from the employment of the polluting input, and the cost of using the environmentally polluting input. On the other hand, innovation and human resources for environmental advantages positively affect economic growth (Lyasnikov et al., 2014). The channels through which circular economy contributes to economic growth are renewable energy (Pao et al., 2013), innovative businesses with friendly-environmental products (Cotae, 2015), recycling rate, and productivity of resources (George et al., 2015). Suitable policy instruments are necessary to enhance economic growth through a circular economy (Hysa et al., 2020).

Starting from these empirical studies, this paper assesses the impact of the circular economy measured through various indicators on economic growth and employment in some new EU member states.

3. Methodology

Prior estimation, cross-sectional dependence, and the presence of unit roots in panel data are checked. The CD test developed by Pesaran et al. (2008) is used to check for cross-sectional dependence:

$$CD = \left(\frac{TN(N-1)}{2}\right)^{1/2}\bar{\hat{P}} \quad (1)$$

$$\bar{\hat{P}} = \left(\frac{2}{N(N-1)}\right)\sum_{i-1}^{N-1}\sum_{j-i+1}^{N}\hat{P}_{i\,j} \quad (2)$$

$\hat{P}_{i\,j}$ - pair-wise correlation coefficient of the cross-sectional residuals based on Augmented Dickey-Fuller regression, T – number of periods, N-cross-section dimension, respectively.

Im-Pesaran-Shin unit root test is used to check for stationarity. The main advantage of this test is that it allows for simultaneous stationary and non-stationary series (Barbieri, 2009). Moreover, it allows for correlated residuals and heterogeneity of the dynamics and error variances across groups.

For data series that are not cointegrated, panel ARDL models could be built. We will start with the ARDL model:

$$\ln\ \_gdp_{it} = \alpha_i + \sum_{l=1}^{p}\beta_0 \ln\ \_gdp_{it-l} + \sum_{l=0}^{q}\beta_1 \ln\ \_gi_{it-l} + \sum_{l=0}^{q}\beta_2 \ln\ \_va_{it-l} \sum_{l=0}^{q}\beta_3 \ln\ \_employment_{it-l} + e_{it}$$

i is the index for the country, and t is the time index

After parameterization, the previous equation becomes:

$$\Delta \ln \_gdp_{it} = \alpha_i + \Phi_i(\ln \_gdp_{it-l} - \theta_1 \ln \_gi_{it-l} - \theta_2 \ln \_va_{it-l} - \theta_3 \ln \_employment_{it-l}) + \sum_{l=1}^{p-1} \lambda_{il} \Delta \ln \_gdp_{it-l} + \sum_{l=0}^{q-1} \lambda'_{il} \Delta \ln \_gi_{it-l} + \sum_{l=0}^{q-1} \lambda''_{il} \Delta \ln \_va_{it-l} + \sum_{l=0}^{q-1} \lambda'''_{il} \Delta \ln \_employment_{it-l} + e_{it}$$

In this case, λ, λ', λ'' , λ''' represent the short-run coefficients for lagged endogenous variables, *gi, va*, and employment, respectively. θ_1, θ_2, and θ_3 are the long-run coefficients for *gi, va*, and employment. The speed of adjustment is given by Φ_i.

The variables used in the models are taken in the logarithmic form and refer to:

- Value added at factor cost in circular economy sectors - million euro (2010=100)- the gross income based on operating activities after the adjustment of indirect taxes and operating subsidies denoted by *va*;
- Gross investment in tangible goods - million euro (2010=100) in circular economy sectors denoted by *gi*;
- Number of persons employed in circular economy sectors denoted by employed;
- Real GDP per capita, denoted by GDP;
- The employment rate (%)- share of the population aged between 20 and 64 that is employed denoted by employment;
- The unemployment rate (%) is denoted by unemployment.

The panel data series for these variables refer to 2008-2020 and the following countries: Cyprus, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia. The data availability for the countries in the region conditions the selection of the new member states in the EU. The descriptive statistics are presented in Table 1.

Table 1: Descriptive statistics

Variable	Mean	Standard deviation	Minimum value	Maximum value
ln_unemployment	2.19	0.38	1.31	2.97
ln_va	6.43	0.98	4.96	8.55
ln_gi	4.79	1.13	2.29	6.63
ln_employed	10.75	1.12	8.70	12.79
ln_gdp	4.79	1.13	2.29	6.63
ln_employment	4.23	0.062	4.09	4.35

Source: own calculations in Stata 17.

According to Table 1, the maximum unemployment was registered in Latvia in 2010. Poland achieved the maximum value added at factor cost and gross investment in tangible goods in circular economy sectors in 2019, with a growth of 8.55% compared to the previous year for value-added and 6.63% for gross investment.

4. Results, discussion, and robustness check

Prior to estimation, two characteristics of the panel data are checked: cross-sectional (in)dependence and the presence of unit root/stationarity.

First, the CD test of Pesaran et al. (2008) is applied to check for cross-sectional dependence. This association is justified by the common challenges in the circular economy at the European level and by the fact that the sample countries were previously members of the same communist block and made the transition to the market economy after 1990.

Table 2: The results of the CD test

Variable	CD-test	p-value	correlation	abs(correlation)
ln_unemployment	9.36*	0.000	0.533	0.644
ln_va	10.57*	0.000	0.618	0.623
ln_gi	5.26*	0.000	0.335	0.499
ln_employed	8.60*	0.000	0.512	0.551
ln_gdp	12.05*	0.000	0.686	0.709
ln_employment	10.17*	0.000	0.579	0.658

Note: * indicates the rejection of the null hypothesis of cross-sectional independence at 5% significance level.
Source: own calculations in Stata 17.

According to Table 3, the logarithmic values of the unemployment rate, value-added, and number of persons employed in circular economy sectors are stationary in the first level. At the same time, the data series for the other variables are stationary in the level at a 5% significance level.

Table 3: The results of the Im-Pesaran-Shin unit root test

Variable	Data in level		Data in the first difference	
	Statistic	p-value	Statistic	p-value
ln_unemployment	3.6111	0.9998	-2.6791*	0.0037
ln_va	1.3573	0.9127	-2.8754*	0.002
ln_gi	-4.0556	0.000	-	-
ln_employed	-1.0035	0.1578	-4.3347*	0.000
ln_gdp	-3.7147	0.0007	-	-
ln_employment	-1.9675*	0.0246	-	-

Note: * indicates the rejection of the null hypothesis of unit roots in all panels at 5% significance level.
Source: own calculations in Stata 17.

Given the different orders of integration for data series, panel autoregressive distributed lag models (panel ARDL models) are built in this case under two types of estimators: pooled mean group (PMG) estimator that assumes homogenous long-term equilibrium across countries and heterogeneous short-term relationship and Common Correlated Effect Mean Group (CCEMG) estimator based on long-run homogeneity and contemporaneous correlation that ensures estimator efficiency and consistence (Pesaran et al., 2008).

According to estimations in Table 4 based on the PMG estimator, there is a significant long-run connection between economic growth, employment rate, and gross investment in tangible goods in circular economy sectors. More employment does not support economic growth, while gross investment in tangible goods in circular economy sectors enhances long-term economic growth. However, a short-run relationship between these variables was not depicted. Value added at factor cost in circular economy sectors positively influences employment, while gross investment in tangible goods negatively affects employment in the short run.

Table 4: The panel ARDL estimations (PMG estimator) to explain economic growth and employment in the analyzed countries (period 2008-2020)

	Variable (in the log)	ln_gdp_t	$ln\_employment_t$
Long-run relationship	ln_gi_t	0.3828 (0.000)	-0.2947 (0.711)
	$ln\_employment_t$	-2.7562 (0.000)	-
	ln_va_t	-	0.8134 (0.0706)
Error correction term		-0.0123 (0.0564)	-0.0177 (0.443)
Short-run relationship	ln_gi_t	-0.1803 (0.228)	-0.0207 (0.027)
	$ln\_employment_t$	0.1133 (0.474)	-
	ln_va_t		-
	Constant	0.3869 (0.635)	-0.0002 (0.983)
Residuals	-	I(0)	I(0)

Note: p-values in brackets.
Source: own calculations in Stata 17.

For robustness, the CCEMG estimator is applied. According to estimations in Table 5 based on the CCEMG estimator, the growth of employed people in circular economy sectors positively impacts economic growth at a 10% significance level.

Table 5: The panel ARDL estimations (CCEMG estimator) to explain economic growth and employment in the analyzed countries (period 2008-2020)

Variable	ln_gdp_t	$ln\_employment_t$
ln_gdp_{t-1}	-0.4086 (0.645)	-
ln_gi_t	0.0527 (0.928)	0.0217 (0.660)
$ln\_employed_t$	0.3151 (0.0569)	-
$ln\_employment_{t-1}$	-	-0.4413 (0.0588)
ln_va_t	-	-0.0657 (0.456)

Note: p-values in brackets.
Source: own calculations in Stata 17.

According to the Bayesian model in Table 6, the impact of gross investment in tangible goods in circular economy sectors is low but positive. In contrast, the number of employed people in these sectors has a stronger and more positive influence on economic growth in the analyzed countries in 2008-2020.

Table 6: Bayesian random linear regression model to explain economic growth in the analyzed countries (period 2008-2020)

Variable	Mean	Standard deviation	MCSE
ln_gi_t	0.0097	0.0213	0.0018
$ln\_employed_t$	0.2399	0.0335	0.0096
$ln\_employment_t$	-0.2261	0.0217	0.0017
Constant	7.1670	0.3340	0.0998
Posterior predictive summary	Mean	Standard deviation	P(T>=T_obs)
p min	8.7593	0.0369	0.783
p max	10.1888	0.0479	0.796

Source: own calculations in Stata 17.

All in all, more gross investment in tangible goods in circular economy sectors and more employed people in these sectors are necessary to support economic growth. These results allow us to make a few policy recommendations: adaptation of regulatory instruments to enhance the transition to a circular economy and map future jobs and skills in this field for each country. A financial plan should be developed by following more steps: proposal of actions to achieve the objectives of a circular economy, estimation of outcomes, and allocation of resources and budget for these actions. The aim of the final plan should be implementing this strategy that presents advantages compared to a linear economy, but it implies economic, environmental, social, and opportunity costs (Palm & Bocken, 2021). These countries' labor supply and demand could be matched by mapping job opportunities in circular economy sectors. This practice could help the states to identify the most vulnerable sectors of the circular economy that need a labour force. Our results align with Busu (2019), which showed the role of labor employed in environmental protection in achieving economic growth in the EU-27 countries in 2008-2017.

5. Conclusions

The future of the European Union is based on enhancing the circular economy to achieve sustainable development. However, this goal could be achieved if the strengths and limitations related to implementing the practices to support this type of economy are identified. In this context, this study is focused on the impact of the circular economy on economic growth and employment in the period 2008-2020 in some new EU member states for which data are available. More methods were applied to ensure robustness (Bayesian random linear regression and panel ARDL models). Investment in tangible goods and more employed people in circular economy sectors are long-run factors that could contribute to sustainable development in these countries. A few limitations of the research could be identified. These results depend on data availability, but more indicators related to a circular economy could be introduced in the models. Besides this panel data approach, cross-country analysis is necessary to identify particularities for each state, allowing for recommending specific policy measures to develop a circular economy.

This paper could serve as starting point for further research by identifying actions to transform a linear economy into a circular one in the EU's new member states or by assessing the effects of this transformation on economic growth and employment. Investment and mapping jobs in circular economy sectors are already current practices in developed countries. However, in the long run, more actions should be taken in Eastern Europe to ensure a faster transition to a circular economy with the direct impact of sustainable development.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and material

The data are available on request.

Competing interests

The authors declare no conflict of interest or competing interests.

Funding

This work received no funding.

Acknowledgments

This research is part of the research plan of the Institute for Economic Forecasting of the Romanian Academy for 2023 titled "Unemployment among higher educated young people from Romania."

Citation information

Simionescu, M. (2023). The circular economy and sustainable development in the European Union's new member states. *Economics, Management and Sustainability, 8*(1), 6-15. doi:10.14254/jems.2023.8-1.1.

References

Barbieri, L. (2009). Panel unit root tests under cross-sectional dependence: An overview. *Journal of Statistics: Advances in Theory and Applications, 1*(2), 117-158.

Barreiro-Gen, M., & Lozano, R. (2020). How circular is the circular economy? Analysing the implementation of circular economy in organisations. *Business Strategy and the Environment, 29*(8), 3484-3494. https://doi.org/10.1002/bse.2590

Bastein, A. G. T. M., Roelofs, E., Rietveld, E., & Hoogendoorn, A. (2013). *Opportunities for a circular economy in the Netherlands* (pp. 1-13). Delft: TNO.

Bauwens, T. (2021). Are the circular economy and economic growth compatible? A case for post-growth circularity. *Resources, Conservation and Recycling, 175*, 105852. https://doi.org/10.1016/j.resconrec.2021.105852

Bauwens, T., Gotchev, B., & Holstenkamp, L. (2016). What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science, 13*, 136-147. https://doi.org/10.1016/j.erss.2015.12.016

Boulding, K. E. (1965). *Earth as a space ship*. Washington State University Committee on Space Sciences, 10.

Busu, M. (2019). Adopting circular economy at the European Union level and its impact on economic growth. *Social Sciences, 8*(5), 159. https://doi.org/10.3390/socsci8050159

Cotae, C. E. (2015). Regional performances in the context of a transition towards the circular economy: Structuring the assessment framework. *Ecoforum Journal, 4*.

Geng, Y., Sarkis, J., & Ulgiati, S. (2016). Sustainability, well-being, and the circular economy in China and worldwide. *Science, 6278*(Supplement), 73-76.

George, D. A., Lin, B. C. A., & Chen, Y. (2015). A circular economy model of economic growth. *Environmental Modelling & Software, 73*, 60-63. https://doi.org/10.1016/j.envsoft.2015.06.014

Ghosh, S. K. (Ed.). (2020). *Circular economy: Global perspective*. Singapore: Springer. https://doi.org/10.1007/978-981-15-1052-6

Gu, P., & Sosale, S. (1999). Product modularization for life cycle engineering. *Robotics and Computer-Integrated Manufacturing, 15*(5), 387-401. https://doi.org/10.1016/S0736-5845(99)00049-6

Hu, Y., He, X., & Poustie, M. (2018). Can legislation promote a circular economy? A material flow-based evaluation of the circular degree of the Chinese economy. *Sustainability, 10*(4), 990. https://doi.org/10.3390/su10040990

Hysa, E., Kruja, A., Rehman, N. U., & Laurenti, R. (2020). Circular economy innovation and environmental sustainability impact on economic growth: An integrated model for sustainable development. *Sustainability, 12*(12), 4831. https://doi.org/10.3390/su12124831

Kalmykova, Y., Sadagopan, M., & Rosado, L. (2018). Circular economy–From review of theories and practices to development of implementation tools. *Resources, conservation and recycling, 135*, 190-201. https://doi.org/10.1016/j.resconrec.2017.10.034

Khmara, Y., & Kronenberg, J. (2018). Degrowth in business: An oxymoron or a viable business model for sustainability?. *Journal of Cleaner Production, 177*, 721-731. https://doi.org/10.1016/j.jclepro.2017.12.182

Lantitsou, K. I. (2017). Eco-development and environmental spatial planning. *Fresenius Environmental Bulletin, 26*(2), 1291-1300.

Lüdeke-Freund, F., Gold, S., & Bocken, N. M. (2019). A review and typology of circular economy business model patterns. *Journal of Industrial Ecology, 23*(1), 36-61. https://doi.org/10.1111/jiec.12763

Lyasnikov, N., Dudin, M., Sekerin, V., Veselovsky, M., & Aleksakhina, V. (2014). The national innovation system: the conditions of its making and factors in its development. *Life Science Journal, 11*(6), 535-538.

McDowall, W., Geng, Y., Huang, B., Barteková, E., Bleischwitz, R., Türkeli, S., ... & Doménech, T. (2017). Circular economy policies in China and Europe. *Journal of Industrial Ecology, 21*(3), 651-661. https://doi.org/10.1111/jiec.12597

Mitchell, P., & James, K. (2015). *Economic growth potential of more circular economies*. Waste and Resources Action Programme (WRAP): Banbury, UK.

Nesterova, I. (2020). Degrowth business framework: Implications for sustainable development. *Journal of Cleaner Production, 262*, 121382. https://doi.org/10.1016/j.jclepro.2020.121382

Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R., & Jaca, C. (2018). Circular economy in Spanish SMEs: challenges and opportunities. *Journal of Cleaner Production, 185*, 157-167. https://doi.org/10.1016/j.jclepro.2018.03.031

Palm J, Bocken N. (2021). Achieving the circular economy: exploring the role of local governments, business and citizens in an urban context. *Energies. 14*(4), 875. https://doi.org/10.3390/en14040875

Pao, H. T., & Fu, H. C. (2013). Renewable energy, non-renewable energy and economic growth in Brazil. *Renewable and Sustainable Energy Reviews, 25*, 381-392. https://doi.org/10.1016/j.rser.2013.05.004

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal, 11*(1), 105-127. https://doi.org/10.1111/j.1368-423X.2007.00227.x

Schroeder, P., Anggraeni, K., & Weber, U. (2019). The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology, 23*(1), 77-95. https://doi.org/10.1111/jiec.12732

Sehnem, S., Vazquez-Brust, D., Pereira, S. C. F., & Campos, L. M. (2019). Circular economy: benefits, impacts and overlapping. *Supply Chain Management: An International Journal*, *24*(6), 784-804. https://doi.org/10.1108/SCM-06-2018-0213

Economics, Management and Sustainability (ISSN: 2520-6303) is published by **Scientific Publishing House "CSR", Poland, EU** and **Scientific Publishing House "SciView", Poland**
Publishing with **JEMS** ensures:
• Immediate, universal access to your article on publication
• High visibility and discoverability via the JEMS website
• Rapid publication
• Guaranteed legacy preservation of your article
• Discounts and waivers for authors in developing regions
Submit your manuscript to a JEMS at http://jems.sciview.net or submit.jems@sciview.net