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# Changes in enterprise potential in a circular economy: A comparative analysis of EU countries in 2013 and 2020

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**ABSTRACT**

**Objective:** The article aims to identify and assess the spatial disparity of entrepreneurship and its links to the circular economy (CE) at the EU country level and to identify the practical implications of these phenomena for economic and regional policies that support sustainable development.

**Research Design & Methods:** We employed literature analysis and statistical analysis. We used the TOPSIS method to create synthetic measures. We collected the empirical data by the spatial distribution of EU countries (including Eastern Bloc countries). The results of the analysis were presented in 2013 and 2020 (this is linked to the two programming periods of EU funds). It allowed for capturing the dynamic aspects of the studied phenomena and controlling the phenomenon of deviations related to the cyclical changes occurring in the economy.

**Findings:** Entrepreneurship is an important element of economic growth that impacts the social sphere, improves the quality of life, and creates new jobs. The interaction between entrepreneurship and the circular economy is multidimensional, highlighting the importance of both entrepreneurship and the circular economy. The research shows a positive change in both areas, both in terms of entrepreneurship, compared to earlier years. Depending on the country, the situation regarding entrepreneurship and the circular economy varied. Malta, the Czech Republic, and the Netherlands were in a better situation in the entrepreneurship aspect, while Italy, Spain, and Greece were in a weaker situation. In the case of the circular economy, countries with better performance included the Netherlands, Slovenia, and Italy, while Denmark, Portugal, and Greece were worse off. Poland experienced growth in the area of entrepreneurship, while the situation remained more stable in the area of the closed economy, which affected the country's position in the international ranking.

**Implications & Recommendations:** The obtained measures depend on the number and type of variables adopted for the study. Authorities can use this knowledge to assess the effectiveness of the development instruments and policy tools used so far. The results of the clustering can be the beginning of further in-depth research to determine which variables have had a decisive impact on the process of transformation and changes in the entrepreneurship area. Further empirical research is needed on the implementation of the CE, the relationship with the variables of demography, the financial situation, and environmental changes, as well as their impact on changes in the area of entrepreneurship. Actions taken in this aspect must be based on analyses that facilitate comparisons and on current information necessary for effective action.

**Contribution & Value Added:** The study makes international comparisons between the studied areas, i.e., entrepreneurship and CE. The value of the article is the set of variables and the results of the analysis presenting the indicated relationship in the EU countries, with an indication of the Eastern Bloc countries in 2013 and 2020. It is an important stimulus in the discussion on strengthening the effectiveness of CE implementation in the conditions of a country and its impact on entrepreneurship changes.

| | |
|---|---|
| **Article type:** | research article |
| **Keywords:** | Entrepreneurship; development potential; circular economy; multidimensional approach; synthetic measure; CRITIC-TOPSIS method |
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## INTRODUCTION

The differentiation in regions' development levels is a natural phenomenon. It results from, among other things, access to factors of production, the scale and scope of resources use, the previous level of development or level of entrepreneurship, demographic aspects, the labour market, and infrastructure. Unbalanced growth dynamics means the parallel occurrence of stages of growth and stagnation resulting in multiple trajectories of change, creating a hybrid picture of transformations taking place in space.

In terms of regional development, we can analyze entrepreneurship from the point of view of individuals, businesses, or local government units. It is an important way of increasing economic performance and stimulating development, as well as empowering individuals (Olanrewaju *et al*., 2020; Poliakov *et al*., 2024; Bekzhanova *et al.*, 2024). It is considered a key component of job creation, economic growth, and innovation in regional development. High levels of entrepreneurship lead to sustainable economic growth and technical change (Apostu & Gigauri, 2023). However, the spatial distribution of entrepreneurship is uneven, as presented by Gao *et al*. (2022), which is an important determinant of regional economic disparities.

Among other things, natural conditions, communication accessibility, the distribution of large settlement centres, access to capital, infrastructure equipment, the level of economic activity, access to knowledge, and the policy of local government units determine the level of differentiation between regions and entrepreneurial activity. This is also due to the structural characteristics of the regions and the endogenic factors present in their area. Among the factors shaping a region's entrepreneurship, we find the demographic characteristics of the region, the regional labour market, the quality of human capital, housing stock, and infrastructure facilities (Audretsch *et al*., 2024; Andronicеanu, 2024). As defined by Awoa *et al.* (2022), raw material pensions increase incentives for profit-oriented activities, which impact the level of resource allocation and often undermine entrepreneurial dynamism. Medase *et al.* (2023) emphasize that entrepreneurial activity can promote the accumulation of resource annuity, which is a valuable asset for enterprise activity.

The transition to a circular economy (CE) should support competitiveness and innovation by stimulating new business models and technologies (Andronicеanu, 2024; García-Agüero *et al*., 2024; Batlles-delaFuente *et al*., 2024; Andronicеanu, 2025). The goal of this approach is to provide the conditions for creating more jobs while using fewer resources (Florek-Paszkowska & Hoyos-Vallejo, 2023). As Evans (2023) describes, the idea of a closed loop is to so-called incorporate sustainable thinking at every stage of. The goal of this approach is to provide the conditions for creating more jobs while using fewer resources. As Evans (2023) describes, the idea of a closed loop is the so-called incorporate sustainable thinking at every stage of working with a product or service. It represents a way of solving environmental problems and challenges, as well as a sustainable approach to society, the economy, and the environment. On the other hand, Cullen and De Angelis (2021) describe the circular economy as a shift toward a more economical industrial model in which economic growth is decoupled from the consumption of finite natural resources. It is a multifaceted phenomenon.

The article aims to identify and assess the spatial disparity of entrepreneurship and its links to the circular economy at the EU country level and to identify the practical implications of these phenomena for economic and regional policies that support sustainable development.

We collected the empirical data in the spatial context of all EU countries, including former Eastern Bloc countries. The results of the analysis were published in 2013 and 2020, *i.e.*, during the two periods of programming of EU funds. It allowed for capturing the dynamic aspects of the studied phenomena and controlling the phenomenon of deviations resulting from changes in economic conditions. We employed the literature analysis on the subject and a statistical, synthetic measure – according to the TOPSIS method, in the process of achieving the aim. Weformulated research questions to solve the problem: What is the spatial differentiation between entrepreneurship and CE in the EU countries?; How has the concentration and rate of change in entrepreneurship and CE changed?; To what extent does CE affect changes in entrepreneurship?

The article points to a gap in research on the interdependence between CE and entrepreneurship, which scholars usually analyse separately. The article highlights the uneven pace of CE implementation across EU countries, leading to differences in transformation between Western and Eastern European countries. The value of the article lies in the new analysis of variables and results that show how EU policies affect CE adoption and business competitiveness in different regions. The study highlights the need for a more balanced and coherent approach to CE implementation, taking into account the specificities of local markets and transformation challenges.

The article consists of five parts. The introduction described the problem's context and the study's significance. The second section will present a literature overview and the hypothesis development. The third section presents the research method used in the study. Subsequent sections include the main results, discussion, and summary.

## LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The circular economy has an important impact on entrepreneurship, creating new business opportunities, innovative models, and markets while increasing the operational efficiency of companies (Amin *et al.*, 2024). Early adopters of circular economy principles can reduce costs, improve competitiveness, and contribute to the creation of new jobs in sectors related to recycling, sustainable production, and green technologies. Integrating CE into business not only promotes sustainability but also encourages the development of new and innovative products and services, which has a direct impact on business dynamism.

According to a study by Sun *et al.* (2020) and Sutthichaimethee *et al.* (2024), achieving sustainable development goals requires addressing environmental, social, and economic issues, especially in the context of resource scarcity and population growth. In this context, entrepreneurship becomes an important tool for regional development. According to Trapp and Kanbach (2021), significant environmental degradation combined with technological advances has highlighted the importance of entrepreneurial opportunities. As Xie *et al.* (2021) indicate, it is the main driver of regional economic development.

Di Vaio *et al.* (2022) point to entrepreneurship as a driver of economic and social development. It is under increasing pressure to consider the impact of ever-increasing production, distribution, and consumption of products, as well as the number of wastes and resources. Furthermore, Endovitskaya *et al.* (2019) note that proponents of endogenous development recognize that entrepreneurship enables sustainable and long-term development. With the rise of consumerism, entrepreneurship can lead to environmental degradation, depletion of natural resource reserves, and constraints on future industrial production. The negative impacts of the linear model threaten the stability of economies. Therefore, we hypothesised that:

**H1:** The implementation of a circular economy in EU regions, including Eastern regions, supports the development of entrepreneurship, the creation of new business models, and the achievement of sustainable development goals, while stimulating regional economic growth and adaptation to a changing environment.

Moreover, it identifies the circular economy as a tool to support sustainable business development.

Cardoso Marques and Mendes Teixeira (2022), Gedvilaite and Ginevicius (2024) see the adoption of a circular economy as an opportunity to reduce the problem of overexploitation of natural resources. An important aspect of this problem is the generation of excessive waste. This problem can be mitigated in circular economy (Potkány *et al.,* 2024; Zdonek *et al.*, 2024). The circular economy can mitigate this problem. The attractiveness of the transition to CE is underpinned by the need to achieve sustainable development goals and improve resource efficiency and employment. To make progress towards CE, policies should focus on environmental awareness, clear indicators of social, environmental, and sustainable development, and the decoupling of growth-related variables from environmental pressures. The move towards CE as a pre-entrepreneurial act involves their strategic policies, business models,

structures and processes, thus contributing to society and the economy. The circular economy is multifaceted. Dragan *et al.* (2024) indicate that a circular economy is a production and consumption model that involves sharing, reusing, repairing, renewing and recycling existing materials and products for as long as possible. It aims to improve resource efficiency, focusing on urban and industrial waste and renewable resources to achieve a better balance in the economy, environment and society. This new development model is linked to the 3Rs principle (reduce, reuse, recycle), and extended to the 5Rs model (reduce, reuse, renew, repair and recycle). This can determine environmental and economic benefits by reducing business-related waste, as well as social benefits (Ravikumar *et al.*, 2024).

According to research by Gutberlet *et al.* (2023), the closed-loop economy provides a model for improving resource efficiency through ecosystem regeneration, resource conservation, and waste elimination, as well as improving business models. Companies engaged in micro-level activities, such as recycling, contribute to the broader concept of a closed loop. In addition, Findik *et al.* (2023) indicate that it requires restructuring in several areas, such as economic growth, employment, environmental quality, and the introduction of new forms of production. The basis of CE is the prioritization of renewable raw materials and the recycling of by-products and waste in the production of goods and services. By implementing CE, it will be possible to move towards a low-emission economy. According to Silvério *et al.* (2023), the adoption of CE as a future economic model requires enormous environmental, economic, social, and legal efforts. Braz and Marotti de Mello (2022) indicate that CE promises to promote sustainable development and reduce environmental pressures and impacts through the creation of new sustainable businesses and jobs and the reduction of commodity price volatility, natural resource scarcity, and costs. Thus, we hypothetised that:

**H2:** The transition to a circular economy in the eastern regions of the EU increases enterprises' competitiveness, creates sustainable jobs, and reduces the pressure on the environment and resources, thus responding to the challenges of resource depletion and pollution.

Scholars seeentrepreneurship as a driver of regional growth and adaptation to challenges, while CE in the second group responds to the need to reduce the environmental impact of economic activity and improve resource efficiency.

## RESEARCH METHODOLOGY

We presented the empirical data used in the study in spatial terms of the EU countries (including the EU Eastern Bloc: Czech Republic, Estonia, Slovenia, Lithuania, Latvia, Hungary, Slovakia, Poland, Bulgaria, Romania, Croatia) for the years 2013 and 2020, which allowed to capture the dynamic aspects of the studied phenomena as well as to control the phenomenon of deviations related to the cyclical changes occurring in the economy.

In the first stage of the ongoing research, we selected diagnostic variables to describe the phenomenon under study. We conducted statistical verification of the variables based on the value of the coefficient of variation ($|V_i| \leq 0.10$; critical value). We evaluated correlations based on the inverted matrix method (the diagonal value does not exceed 10). This allowed us to eliminate so-called quasi-constant variables. We wrote the resulting observation matrix – a set of objects and diagnostic variables – as (1):

$$X_{ij} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \quad (1)$$

in which; $X_{ij}$ – denotes the values of the j-th variable for the i-th object, i – object number (i = 1, 2, ..., n), j – variable number (j = 1, 2, ..., m).

Table 1 shows the selected diagnostic variables. These variables formed the basis for developing two synthetic measures of entrepreneurship and CE. The selected variables allowed us to assess the impact of the circular economy on entrepreneurship, considering both environmental and economic aspects. Variables such as recycling rates, the use of circular materials, and resource efficiency show

how the circular economy reduces negative environmental impacts and improves the efficiency of businesses. In turn, variables on employment, private investment, and value-added in the CE sector show how it supports the development of new industries and jobs. These variables make it possible to monitor the progress of business transformation, assess the effectiveness of policies, and compare EU countries in terms of their adaptation to the circular economy.

**Table 1. Selected diagnostic variables for the construction of a synthetic measure of entrepreneurship and Circular economy**

| variables | Unit of measure | S/D |
|---|---|---|
| **Entrepreneurship** | | |
| Unemployment by sex and age – annual data | Percentage of population in the labour force | D |
| Deaths of enterprises in t – number 5. Business demography main variables | number per capita | D |
| Births of enterprises in t – number 7. Business demography main variables | number per capita | S |
| The population of active enterprises in t – number 8. Business demography main variables | number per capita | S |
| Employment and activity by sex and age – annual data | Percentage of total population | S |
| **Circular economy (CE)** | | |
| Recycling rate of waste of electrical and electronic equipment (WEEE) separately collected | Percentage | S |
| Recycling rate of municipal waste | Percentage | S |
| Circular material use rate | Percentage | S |
| Trade in recyclable raw materials | Tonne per capita | S |
| Generation of municipal waste per capita | Kilograms per capita | D |
| Resource productivity | Euro per kilogram, chain-linked volumes (2015) | S |
| Material footprint | Tonnes per capita | S |
| Material import dependency | Percentage | S |
| Greenhouse gas emissions from production activities | Kilograms per capita | D |
| Consumption footprint | Per inhabitant | D |
| Private investment and gross added value related to circular economy sectors | Percentage of gross domestic product (GDP) | S |
| Persons employed in circular economy sectors | Full-time equivalent (FTE) per cpaita | S |

Note: S stimulant; D destimulant.
Source: own study.

In the next step, we used zero-based unitization procedures, according to the formula (2), (3):

$$X_j \in S;\ Z_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (2)$$

$$X_j \in D;\ Z_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (3)$$

in which: S-stimulant, D-destimulant, $max_{xij}$ – the maximum value of the j-th variable (i=1, 2...n; j=1, 2...m), $min_{xij}$ – the minimum value of the j-th variable, $x_{ij}$ – denotes the value of the j-th variable for it object (Kukuła & Bogocz, 2014).

This resulted in a matrix of unitarized values ($Z_{ij} \in [0;1]$) of the j-th variable for the i-th object (4):

$$Z_{ij} = \begin{bmatrix} z_{11} & z_{12} & \dots & z_{1m} \\ z_{21} & z_{22} & \dots & z_{2m} \\ \dots & \dots & \dots & \dots \\ z_{n1} & z_{n2} & \dots & z_{nm} \end{bmatrix} \quad (4)$$

In the next step, by using the criteria importance through the intercriteria correlation (CRITIC) method, we determined weights for diagnostic variables based on standard deviations and

correlations. The method gives more weight to criteria with high standard deviation, high coefficient of variation, with low correlation with other variables (Hassan *et al.,* 2023; Rostamzadeh *et al*., 2018), according to the formulas (5), (6):

$$w_j = \frac{C_j}{\sum_{k=1}^{K} C_k}, j = 1,2,\ldots,K \tag{5}$$

$$C_j = S_{j(Z)} \sum_{k=1}\left(1 - r_{jk}\right), j = 1,2,\ldots K \tag{6}$$

in which: $C_j$ denotes a measure of the information capacity of the jth $S_{j(Z)}$ is the standard deviation calculated from the normalized values of the jth variable, $r_{jk}$ correlation coefficient between the j-th and k-th variables. A larger value of *Cj* indicates that one can obtain more information from the given criterion. The normalized values of the diagnostic variables are multiplied by the weighting coefficient $w_j$ ($Z^*_{ij} = Z_{ij} * w_j$) (Wang *et al.,* 2023).

We determined the value of the synthetic measure (separately for entrepreneurship and CE) based on the formula (7):

$$q_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{7}$$

in which: $q_i \in [0; 1]$; $d_i^-$ – means the distance of the object from the anti-pattern (from 0), $d_i^+$ – denotes the distance of the object from the pattern (from 1).

The CRITIC-TOPSIS method allows for an objective evaluation of alternatives, considering correlations and weights of criteria, automatically calculated from the data. It combines multi-criteria analysis with an intuitive approach to classification, making it effective for spatial and economic analyses.

At the final stage of the research, we grouped countries in terms of entrepreneurship and CE. We also preseted maps of spatial variation, bag charts, and descriptive statistics (performed in Statistica software). In addition, we calculated Spearman's rank correlation coefficient.

The EU countries surveyed, based on a synthetic measure including mean ($\overline{x}$) and standard deviation ($S_d$), were divided into four groups. The size of the synthetic measure in the first group indicated the better unit. In subsequent groups, it indicates weaker units. We performed grouping according to the formula (8):

$$\begin{aligned} &\text{group 1: } \overline{x} + S_d \leq q_i \\ &\text{group 2: } \overline{x} \leq q_i < \overline{x} + S_d \\ &\text{group 3: } \overline{x} - S_d \leq q_i < \overline{x} \\ &\text{group 4: } q_i < \overline{x} - S_d \end{aligned} \tag{8}$$

To assess the differentiation (inequality of distribution) of the study population, we calculated the Gini coefficient (9):

$$G(y) = \frac{\sum_{i=1}^{n}(2\mathrm{i} - \mathrm{n} - 1)y_i}{\mathrm{n}^2 \overline{y}} \tag{9}$$

in which, yi is the value of the i-th observation, and $\overline{y}$ is the average value of all observations yi; G(y) ∈ [0.1] (Prus *et al*., 2021).

## RESULTS AND DISCUSSION

The use of a synthetic measure of entrepreneurship and CE in EU countries (with an indication of the countries of the Eastern Bloc) in 2013 and 2020 is an effective way to compare disparities between countries. The research confirmed that in 2020, there was a positive change in both areas studied in all EU countries compared to 2010. In 2020, the value of the synthetic measure of entrepreneurship ranged from 0.36 to 0.79 (0.31-0.70 in 2013), and for the synthetic measure of CE in 2020. - 0.39 to 0.58 (in 2013 0.37 to 0.58). In the area of entrepreneurship, Malta, the Czech Republic, and the Netherlands were in a better situation, while Italy, Spain, and Greece were in a weaker situation (in 2020). On the other hand, in CE, the Netherlands, Slovenia, Italy recorded a better situation and Denmark, Portugal, and Greece a weaker one (in 2020). In Poland, the level of q entrepreneurship ranged from 0.50 to 0.62, q CE - 0.46-0.48, resulting in a change in the country's position in the overall

ranking. This shows a growing gap between EU countries and Poland. This shows a widening gap between the countries. This is an unfavourable phenomenon in the context of the policy of equalizing differences in regional development in the European Union. In the relationship of 2020 to 2013, the countries of Austria, Finland, Italy, Luxembourg, Sweden – in the aspect of entrepreneurship – and Austria, Belgium, the Czech Republic, Hungary, Latvia, Luxembourg, Malta, Portugal, and Sweden recorded a decrease in the value of the synthetic measure (Table 2).

**Table 2. The EU country groups by synthetic measure of entrepreneurship in 2013 and 2020**

| Country | group | 2013 q | position | group | 2020 q | position | change q | group | 2013 q | position | group | 2020 q | position | change q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | measure of entrepreneurship | | | | | | | measure of CE (Circular economy) | | | | | | |
| Malta | b | 0.58 | 11 | a | 0.79 | 1 | 0.36 | b | 0.49 | 9 | d | 0.42 | 25 | -0.14 |
| Czechia | a | 0.69 | 2 | a | 0.78 | 2 | 0.13 | b | 0.48 | 11 | c | 0.46 | 16 | -0.04 |
| Netherlands | a | 0.68 | 3 | a | 0.75 | 3 | 0.1 | a | 0.58 | 1 | a | 0.58 | 1 | 0 |
| Hungary | c | 0.52 | 16 | a | 0.71 | 4 | 0.37 | b | 0.48 | 12 | c | 0.46 | 19 | -0.04 |
| Slovakia | c | 0.51 | 17 | a | 0.71 | 5 | 0.39 | b | 0.47 | 16 | b | 0.5 | 9 | 0.06 |
| Estonia | a | 0.65 | 4 | b | 0.7 | 6 | 0.08 | d | 0.39 | 24 | c | 0.46 | 17 | 0.18 |
| Slovenia | b | 0.61 | 8 | b | 0.67 | 7 | 0.1 | b | 0.48 | 13 | a | 0.55 | 2 | 0.15 |
| Portugal | c | 0.49 | 19 | b | 0.66 | 8 | 0.35 | c | 0.45 | 20 | d | 0.39 | 27 | -0.13 |
| Sweden | a | 0.7 | 1 | b | 0.66 | 9 | -0.06 | b | 0.49 | 10 | b | 0.47 | 15 | -0.04 |
| Poland | c | 0.5 | 18 | b | 0.62 | 10 | 0.24 | c | 0.46 | 19 | b | 0.48 | 13 | 0.04 |
| Cyprus | c | 0.48 | 20 | b | 0.61 | 11 | 0.27 | d | 0.37 | 27 | d | 0.42 | 23 | 0.14 |
| France | b | 0.57 | 12 | b | 0.61 | 12 | 0.07 | b | 0.5 | 6 | b | 0.51 | 6 | 0.02 |
| Lithuania | b | 0.61 | 7 | b | 0.61 | 13 | 0 | b | 0.47 | 15 | b | 0.49 | 11 | 0.04 |
| Latvia | b | 0.54 | 15 | b | 0.6 | 14 | 0.11 | a | 0.52 | 5 | b | 0.5 | 8 | -0.04 |
| Ireland | c | 0.48 | 21 | c | 0.59 | 15 | 0.23 | d | 0.39 | 25 | c | 0.43 | 21 | 0.1 |
| Belgium | b | 0.55 | 14 | c | 0.58 | 16 | 0.05 | a | 0.55 | 2 | a | 0.52 | 4 | -0.05 |
| Denmark | b | 0.56 | 13 | c | 0.58 | 17 | 0.04 | d | 0.41 | 23 | d | 0.42 | 24 | 0.02 |
| Austria | b | 0.61 | 6 | c | 0.57 | 18 | -0.07 | a | 0.52 | 4 | b | 0.49 | 10 | -0.06 |
| Finland | b | 0.59 | 9 | c | 0.57 | 19 | -0.03 | c | 0.46 | 17 | c | 0.46 | 18 | 0 |
| Germany | b | 0.58 | 10 | c | 0.57 | 20 | -0.02 | c | 0.46 | 18 | b | 0.5 | 7 | 0.09 |
| Luxembourg | b | 0.63 | 5 | c | 0.56 | 21 | -0.11 | b | 0.5 | 7 | b | 0.47 | 14 | -0.06 |
| Bulgaria | c | 0.45 | 23 | c | 0.54 | 22 | 0.2 | c | 0.43 | 21 | c | 0.44 | 20 | 0.02 |
| Romania | c | 0.44 | 24 | d | 0.48 | 23 | 0.09 | c | 0.43 | 22 | c | 0.43 | 22 | 0 |
| Croatia | d | 0.36 | 25 | d | 0.47 | 24 | 0.31 | b | 0.49 | 8 | a | 0.52 | 5 | 0.06 |
| Italy | c | 0.46 | 22 | d | 0.43 | 25 | -0.07 | a | 0.53 | 3 | a | 0.53 | 3 | 0 |
| Spain | d | 0.31 | 27 | d | 0.37 | 26 | 0.19 | b | 0.48 | 14 | b | 0.49 | 12 | 0.02 |
| Greece | d | 0.31 | 26 | d | 0.36 | 27 | 0.16 | d | 0.38 | 26 | d | 0.39 | 26 | 0.03 |

Note. Sorted by 2020 (q entrepreneurship).
Source: own study based on Eurostat data.

The circular economy seeks to keep materials, raw materials, and product value in the economic cycle for as long as possible and to minimize the amount of waste generated. The realization of these goals in Poland is at a relatively low level. Corsini and Fontana *et al.* (2024) indicate that closed-loop value management requires responsible use of resources in the production of goods and services, as well as proactive and conscious consumption behaviour aimed at preserving closed-loop value. D'Adamo *et al.* (2024) point to a stronger synergy between the technical and sustainability dimensions than between the economic and sustainability components in terms of CE.

We divided EU countries (including the Eastern bloc) into four groups in terms of q entrepreneurship and q CE based on the mean and standard deviation. Figure 1 shows the classification

due to the synthetic measure. The dark colour indicates the group of countries characterized by a better level of the synthetic measure, and the lighter colour – a weaker level.

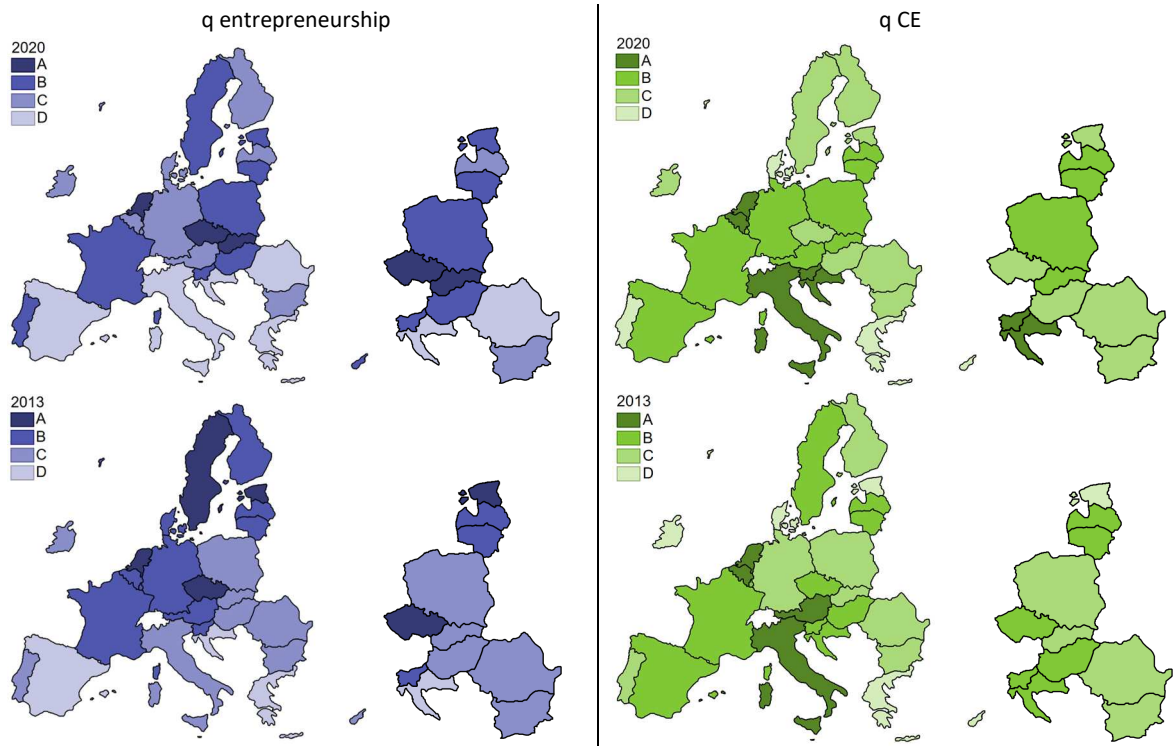


**Figure 1. EU country groups by the synthetic measure of q entrepreneurship and q CE**
Source: own elaboration based on Eurostat data.

The development of entrepreneurship in the European Union is increasingly influencing the degree of competitiveness of member economies, mainly by influencing economic growth or bridging the gap in economic and social development. Possible measures to bridge the disparity in the level of entrepreneurship include reducing barriers to business start-ups, reducing the cost of operating businesses, simplifying the tax and social security system, and increasing the availability of financial capital. Let us also note the leading role of the European Union in promoting and implementing policies to combat climate change and environmental sustainability, which therefore opens up opportunities for technological development and entrepreneurship (Ruiz *et al*., 2023).

Figure 2 provides information on the relationship (dependence) between the synthetic measure of entrepreneurship and the CE measure, and shows outlier observations. For the EU – Eastern Bloc countries, the correlation of the synthetic measure of entrepreneurship and CE in 2020 has a low level (in relation to 2013, it increases). This may indicate an increase in the importance of CE in the process of changing the economy.

We may see the transition to CE by public and private organizations as an entrepreneurial act involving their strategies, business models, structures, and processes. It also underscores the impact of CE principles on organizations that are transitioning to more sustainable development (Dragan *et al*., 2024). Table 3 presents the correlation values (positive, negative) of the synthetic measure of q entrepreneurship and q CE and their diagnostic variables. In the largest section, entrepreneurship was correlated with the rate of use of circular materials, trade-in recyclable raw materials, resource productivity, material footprint, dependence on material imports, greenhouse gas emissions from production activities, and consumption footprint.

The measure of inequality of the distribution of values 0.181-0.175 (2013-2020) for the synthetic measure of entrepreneurship, 0.133-0.120 for the CE measure in the case of EU countries. For the EU – Eastern Bloc countries respectively: 0.282-0.268 and 0.220-0.220. The higher the value of the indicator, the greater the degree of concentration of the synthetic measure and the greater its variation.

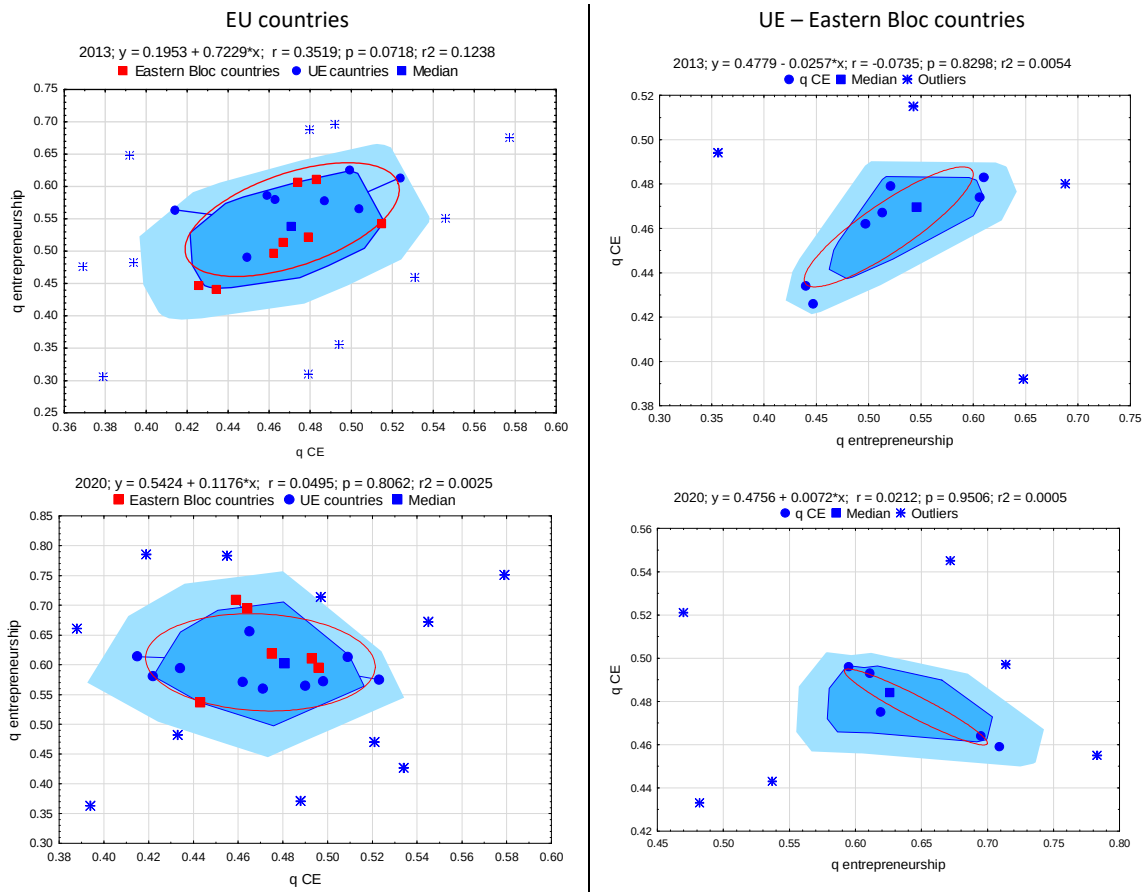


**Figure 2. Differentiation of EU (also Eastern Bloc countries) countries in terms of q entrepreneurship and q CE**
Source: own elaboration based on Eurostat data.

In the process of systemic transformation, the former Eastern Bloc countries, in addition to the barriers to entrepreneurial development inherent in Western European countries, had to overcome obstacles specific to their political and economic situation, administrative and legal solutions, taxation, financial barriers, competition, or the macroeconomic situation. Del Olmo-García *et al.* (2023) indicate that population loss (especially of young people) has fundamental consequences for the economic, social, and environmental sustainability of rural areas, as well as entrepreneurial activity. This phenomenon affects both developing and developed countries, among which Spain is a paradigmatic example, including Poland. As a network approach and an integrative approach (holistic models) in terms of changes in the field of entrepreneurship, especially in the conditions of a circular economy, international entrepreneurial orientation is also becoming an important element. The indicated process enables companies to identify and take advantage of internationalization opportunities, reflects the company's overall proactiveness and aggressiveness in its pursuit of international markets (Wach *et al.*, 2025), as well as exploring global opportunities through specific local businesses (Wach, 2013).

The results of the analysis of the synthetic measure of entrepreneurship and CE in EU countries are of considerable theoretical and practical interest. Theoretically, they confirm the development of the CE concept as a key element of sustainable development and point to the increasing role of innovation and entrepreneurship in achieving environmental goals. Practically, the results provide a basis for the formulation of economic policies that support the transition to a circular economy, especially in countries with lower development levels. They also help to identify areas for support, such as increasing resource efficiency or promoting more sustainable production practices. In particular, it is necessary to increase support for technological innovation and pre-enterprise development in sustainable production, especially in countries with a lower level of CE. It is also important to promote environmental education and awareness among entrepreneurs and consumers. At the same time,

efforts should be made to improve recycling and resource recovery infrastructure and to implement fiscal and regulatory incentive policies to support the transition to a circular economy.

**Table 3. The correlation (Spearman's rank) of the synthetic measure of q entrepreneurship and q CE and their structure variables of EU countries in 2013 and 2020**

| Diagnostic variables | EU countries | | | | UE – Eastern Bloc countries | | | |
|---|---|---|---|---|---|---|---|---|
| | 2013 | | 2020 | | 2013 | | 2020 | |
| | q entrepreneurship | q CE | q entrepreneurship | q CE | q entrepreneurship | q CE | q entrepreneurship | q CE |
| Unemployment by sex and age – annual data | -0.8 | -0.3 | -0.5 | 0.01 | -0.6 | 0.25 | -0.5 | 0.38 |
| Deaths of enterprises in t – number | 0.09 | -0.1 | 0.39 | -0.1 | 0.61 | 0.16 | 0.55 | -0.02 |
| Births of enterprises in t – number | 0.29 | 0.04 | 0.82 | -0.1 | 0.75 | 0.21 | 0.72 | 0.12 |
| Population of active enterprises in t – number | 0.24 | 0.07 | 0.61 | -0.1 | 0.8 | -0.02 | 0.85 | 0.2 |
| Employment and activity by sex and age – annual data | 0.87 | 0.23 | 0.71 | -0.06 | 0.91 | 0.05 | 0.73 | -0.04 |
| Recycling rate of waste of electrical and electronic equipment (WEEE) separately collected | -0.2 | 0.1 | -0.3 | 0.12 | -0.3 | 0.5 | 0.13 | 0.54 |
| Recycling rate of municipal waste | 0.43 | 0.43 | -0.1 | 0.7 | 0.42 | 0.18 | 0.43 | 0.55 |
| Circular material use rate | 0.5 | 0.59 | 0.23 | 0.59 | 0.54 | -0 | 0.66 | 0.15 |
| Trade in recyclable raw materials | 0.09 | 0.16 | -0.1 | 0.18 | 0.05 | 0.41 | -0.6 | 0.59 |
| Generation of municipal waste per capita | 0.14 | 0.06 | -0.03 | -0.1 | 0.04 | 0.39 | 0.36 | 0.47 |
| Resource productivity | 0.16 | 0.54 | -0.1 | 0.37 | 0.2 | 0.71 | 0.46 | 0.74 |
| Material footprint | 0.41 | -0.4 | 0.03 | -0.4 | 0.25 | -0.7 | -0.3 | -0.5 |
| Material import dependency | 0.3 | 0.6 | -0.02 | 0.46 | 0.53 | 0.5 | 0.28 | 0.86 |
| Greenhouse gases emissions from production activities | 0.35 | -0.3 | 0.04 | -0.1 | 0.54 | -0.6 | 0.48 | -0.3 |
| Consumption footprint | 0.43 | 0.22 | 0.11 | -0.03 | 0.74 | 0.32 | 0.34 | 0.29 |
| Private investment and gross added value related to circular economy sectors | 0.25 | 0.37 | 0.07 | 0.28 | -0.1 | -0.1 | -0.5 | 0.19 |
| Persons employed in circular economy sectors | 0.13 | 0.14 | 0.3 | 0.13 | 0.99 | 0.12 | 0.99 | 0.01 |

Note. Marked correlation coefficients are significant with $p < 0.05000$.
Source: own study based on Eurostat data.

## CONCLUSIONS

The use of a synthetic measure to assess entrepreneurship and the circular economy in EU countries in 2013 and 2020 allows for an effective comparison of differences between countries. The research shows that all EU countries have improved in both areas in 2020 compared to 2013, although there are significant regional differences. For entrepreneurship, Malta, the Czech Republic, and the Netherlands are the best performers, while Italy, Spain, and Greece were the worst. For CE, the Netherlands, Slovenia, and Italy were the best performers, while Denmark, Portugal, and Greece were the worst. Poland was in the middle in 2020, with a pre-entrepreneurship level of between 0.50 and 0.62 and a CE level of between 0.46 and 0.48, indicating a gradual widening of the gap between Poland and the rest of the EU, which is unfavourable in the context of policies to equalize regional development. Between 2013 and 2020, some countries, such as Austria, Finland, Italy, and Sweden, showed a decrease in the values of the synthetic measures, indicating changes in the dynamics of entrepreneurship and the circular economy in the EU.

The relationship between entrepreneurship and CE was clearly neither positive nor negative. During the period under review, we noted a trend in both the growth and decline of this relationship (between the circular economy and entrepreneurship). There are some countries (*e.g.*, Malta,

Czech Republic, Estonia) in which a relatively high level of entrepreneurship coincided with a lower level in the aspect of CE. On the other hand, for Spain, Greece, and Romania, we observed low levels of both processes under study. There is also a group of countries (Cyprus, France, Poland) in which, both in terms of entrepreneurship and CE, we observed average values of the studied phenomena. With a circular economy, companies can not only improve their efficiency but also gain a competitive advantage in the marketplace, build a stronger brand image and comply with growing environmental and regulatory requirements. The circular economy promotes the efficient use of resources through reuse, recycling and minimizing waste.

Entrepreneurs in Central and Eastern Europe should capitalize on the growing demand for sustainability technologies and eco-innovations by adapting business models to changing EU regulations. Investing in digitalization, skills development, and international cooperation will be crucial to increasing competitiveness. Entrepreneurs should also monitor available EU funds to support green solutions. Financial and technical support should be targeted at regions lagging in implementing modern economic solutions, and a common legal system for the green economy is needed.

Entrepreneurship development supports innovation and job creation and increases the competitiveness of the economy. Supporting businesses in the technology, sustainability, and digital sectors helps to develop new industries and improve efficiency. Supporting start-ups and SMEs through funding, advice, and administrative simplification stimulates economic growth and labour market stability. However, there are clear differences in the development of entrepreneurship and the circular economy in EU countries, including the Eastern Bloc countries, which affect economic transformation processes. Noteworthy, these differences can influence economic transformation processes, including increased competitiveness of economies, efficient use of resources, and reduced environmental impact.

The survey was limited to the range of publicly available diagnostic changes available in public statistics (some possible dates are unavailable and incomplete for all years surveyed). It is also hampered by the lack of an unambiguous definition regarding the interpretation of the circular economy or the multidimensionality of entrepreneurship, making it difficult to conduct research and draw conclusions or to indicate diagnostic variables (*e.g.*, indicating sustainable entrepreneurship).

The clustering results may be the beginning of further in-depth research to determine which variables have had a decisive impact on the CE transition process and changes in the area of entrepreneurship. Further empirical research is needed on the implementation of CE, the relationship with variables of demographics, financial situation, environmental changes, and also their impact on changes in the area of entrepreneurship. It also seems reasonable to verify whether, and to what extent, the impact of entrepreneurship on development is lagged by time.

The study makes international comparisons between entrepreneurship and CE. The value of the article is the set of variables and the results of the analysis presenting the indicated relationship in the EU countries, with an indication of the Eastern Bloc countries in 2013 and 2020. It is an important stimulus in the discussion on strengthening the effectiveness of CE implementation in the conditions of a country and its impact on entrepreneurship changes. Most often, scholars analyse the areas of entrepreneurship and CE separately.

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The authors did not use artificial intelligence in the process of preparing the article.

**Conflict of Interest**

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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