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COMPARISON OF THE ENVIRONMENT OF EU COUNTRIES FOR SHARING ECONOMY STATE BY MODERN MULTIPLE CRITERIA METHODS

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Abstract
The rapid growth of the sharing economy attracts attention from scientists, businesses, and governments. The European Commission acknowledges the benefits of the sharing economy and emphasises that European countries should be open to the new opportunities that the sharing economy brings. The sharing economy makes an essential contribution to job creation and growth in the European Union. The sharing economy creates new markets and expands existing ones. It makes the use of resources more efficient due to the extensive sharing of assets. Sharing improves resource conservation and efficiency of use, reformats consumption patterns, raises the spirit of entrepreneurship and responsibility of every capital owner, and improves social trust among people worldwide. Despite the focus of researchers on the sharing economy, there is still a lack of research on conditions that stimulate the sharing economy's growth. The article lays the foundation for creating a more comprehensive methodology for assessing the growth of the sharing economy. The authors apply multi-criterion decision-making methods for research purposes, such as EDAS and PROMETHEE II, and recently developed CILOS and IDOCRIW for criteria weight calculation. A hierarchy structure of criteria for evaluating sharing economy growth was created and presented in the paper. The resulting weights of criteria of performance of sharing economy growth were obtained. The prominent features of hierarchy structures and the methodology for calculating ultimate weights are described and demonstrated. The results reveal that the environment is more favourable for sharing economy growth in the Netherlands, Germany, and Sweden among the chosen European countries.

Keywords: sharing economy, multicriteria evaluation, environment, factors, EDAS, PROMETHEE

JEL Classification: O30, O44, L26

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Introduction

According to Bloomberg, the turnover of the global sharing economy could reach $335 billion by 2025 (Bloomberg, 2020). Sharing improves resource conservation and efficiency, reshapes consumption patterns, and makes the spirit of capital owners more flexible and entrepreneurial while considerably increasing their responsibility and social trust among people. The USA and China are leaders in generating revenue of sharing, and they are noted in sustaining high rates of increase. The sharing phenomenon is not new, but the financial crisis of 2008-2009 boosted the growth of the sharing economy as it forced people to seek new ways of consumption and it made companies look for new business opportunities. The phenomenon considerably endangered traditional industries, such as hotels and accommodation vendors, the car and equipment rental, online media, book rental, and invented new industries, such as shared mobility, streaming media or on-demand staffing. Sharing is continuously expanding in every industry and is creating new sharing platforms: large companies-platforms such as Uber, Airbnb, Twitter, and Lime, which were established in the USA and Asia; Ola in India; Didi Chuxing in China, while the largest companies-platforms in Europe are Bolt (Estonia); Tubber, Bargo (The Netherlands); Cabify (Spain); and Grover (Germany) to name a few. According to World Bank estimates, China is the world leader in the sharing economy, with a turnover of more than 230 billion US dollars that makes 1.67% of its GDP (Daxueconsulting, 2020). In the EU, the largest sharing economy markets are in seven countries: France, the UK, Poland, Spain, Germany, Italy, and Denmark; in 2016, they comprised approximately 80% of the total collaborative revenues of the EU-28 member countries. At the same time, the level of development of the sharing economy in the EU varies significantly. In Estonia, Poland, Latvia, Luxembourg, the Czech Republic and Sweden, the collaborative economy makes a significant share of the total economy with its turnover above the average within the EU-28 (EC, 2018).

The name of sharing economy differs by various authors: collaborative consumption (Owyang et al., 2013), collaborative economy (European Commission, 2016), peer-to-peer e-commerce (Hawlitschek et al., 2018), on-demand economy (Cockayne, 2016). The Oxford English Dictionary covered a sharing economy as an economic system in which assets or services are shared between private individuals, either free or for a fee when transactions are typically performed via the Internet. The European Commission (2016) describes the collaborative/sharing economy as a new business model in which activities are facilitated by collaborative platforms and stresses that goods are not "sold" via digital platforms but that temporary access to them is allowed. According to Rinne (2019), the sharing economy focuses on sharing underutilised assets, monetised or not, in ways that improve efficiency, sustainability, and life. The sharing economy is an umbrella term for many organisational models that transform marketplaces and even cityscapes so that the goods and services, skills and spaces are shared, exchanged, rented, or leased (Mont et al., 2020). To summarise, it is an economy that involves individuals and businesses that are sharing the real estate, goods, services, transportation options, space, money, knowledge or skills (Mladenović and Krajina 2020), time, wi-fi network and similar by renting, lending, trading, bartering, or swapping through a shared marketplace (Grybaitė and Stankevičienė, 2016). The sharing economy involves the following participants: service providers, owners of underutilised physical assets or labour; customers who are willing to use the offered assets and services for a particular fee; providers of digital platforms (website or a mobile application). In this paper, the authors are inclined to adhere to the

following description of the sharing economy: it is the set of multi-sided digital platforms that supply various services and products to the open market and act as intermediaries between users and service providers for individuals and businesses.

This article aims to present and use the quantitative methodology to evaluate different countries in terms of their attractiveness for doing the sharing business. The methodology implies choosing a set of indicators that characterise particular conditions that make peer-to-peer services successful and ensure the sharing economy's future growth. The paper presents grounding for the chosen criteria. The authors used several multiple criteria methods in the proposed methodology as the most fitting for the quantitative evaluation of various multi-facet phenomena (Palevicius et al., 2016, 2018; Jakimavicius, 2016; Bielinskas et al., 2018), such as conditions for the sharing economy. The methods imply eliciting weights of criteria as well. The results of several multiple criteria methods and methods for eliciting weights were combined in order to increase precision. Several European countries were chosen from each sub-region to derive a snapshot of the current situation in the EU for further analysis.

The structure of the article is as follows: the literature review and grounding of the choice of criteria are provided in Section 1. Section 2 presents the research methodology and empirical results of the analysis. Finally, conclusions are provided in the last section.

1. Literature review

As the sharing economy has a considerable impact on society's welfare, it became essential to perform a comparative evaluation (Ginevicius et al., 2012) of countries in terms of their attractiveness for doing the sharing business there. The analysis of factors that influence the environment for the sharing economy in the literature usually consists of the following aspects: economic, political-legal, technological, socio-demographical, environmental, and international. The authors did not account for the international factor as the sharing economy became global: in the paper, we limit ourselves to large firms that can choose countries for their business. Contemporary technology allows online intermediation services across countries, even making cultural particularities or language unimportant. On the other hand, platform providers are registered in a particular country. As taxes are paid to a specific country's budget, the countries should be competing for a favourable environment for the sharing businesses.

Various researchers, e.g. Dervojeda et al., (2013), Demailly and Novel (2014), Daunorienė et al., (2015), Molenaar (2015), Hamari et al., (2016), Selloni (2017), Dabbous and Tarhini (2019), highlight rapid technological development as the most significant factor that influences the growth of the sharing economy. Baller et al., (2016) emphasise the importance of international trade centres, aligned with creating and sustaining connectivity between vendors, in making a sharing business accessible to a broader range of consumers. Huckle et al. (2016) point out the benefits of the Internet of Things with blockchain technology, as it opens opportunities for creating peer-to-peer secure automatic payment mechanisms and foreign exchange platforms (CIO review, 2016). Sundararajan (2016) emphasises wireless broadband, mass-market smartphones, and digitalised social networks while Owyang (2013) social networking technologies, mobile technologies and payment systems; and Baller et al. (2016), Stremousova and Buchinskaia (2019) the Internet as the most critical technology in the world. Criteria that represent the technological environment

are outlined in table no 1. First, they represent communication ability (Internet availability, infrastructure reliability, connection costs) and technological literacy. Second, they reveal how citizens use such technologies by such aspects as the Internet usage level, computers, tabs, and smartphones. Third, special technological features are also included in the list, such as digitalised social networking technologies, a number of sharing economy platforms, blockchain, secure automatic payments, and software quality.

Table no. 1. List of indicators that refer to the technological factors

Group of technological criteria	Criterion	Source	Ratios of the criteria
Infrastructure	Level of internet access.	Owyang et al., 2013; Baller et al., 2016; Huckle et al., 2016; Rowe, 2017; Apte and Davis, 2019.	Level of internet access (percentage of households).
Technological literacy	Individuals using the Internet; Computers, tabs and smartphones.	Owyang, 2013; Owyang et al., 2013; Rowe, 2017; Apte and Davis, 2019.	Availability of computers (% of households; Fixed broadband subscriptions (per 100 people); Number of smartphone users; Individuals using the Internet (% of population); Mobile-cellular subscriptions per 100 inhabitants.
Smartness of technologies	Digitalised social networking technologies; Blockchain, secure automatic payment; Quality and secure of information at various software.	Owyang, 2013; Huckle et al., 2016; Apte and Davis, 2019; Huckle et al., 2016; Hong and Lee, 2018; Dabbous and Tarhini, 2019.	Individuals using the Internet for selling goods or services (% of individuals); Sharing economy platforms (number).

Source: Created by authors using databases: Eurostat, International Telecommunication Union, Statista, The World Bank

Socio-demographical factors are essential, but it is difficult to gauge them as they are related to the level of trust, the particularities of culture, the level of sharing mentality, and the prevailing entrepreneurial spirit. Debarshi (2015) highlighted the development of sharing mentality, entrepreneurial spirit, aspiration, and other particularities of culture, induced by sharing. The level of trust among unacquainted people is essential in the sharing economy and trust in the information provided by different platforms (Trivett and Staf, 2013; Botsman, 2015; Debarshi, 2015; Dabbous and Tarhini, 2019). Furthermore, it is essential to note that consumers in the sharing economy have access to their peers' resources instead of being related to businesses. Consequently, Eckhardt and Bardhi (2020) define the sharing economy as "access-based consumption" because market-mediated transactions mostly occur without ownership change. That makes socio-demographic factors even more important as such type of access cannot be entirely regulated by the law.

Such factors could be gauged more easily: knowledge level of new IT services, population density; consumption habits of each generation; and intensity of participation in social

networks, such as Facebook. Furthermore, social networks allow some security checks on customers; thus, they deepen trust-building with unacquainted customers (Trivett and Staf, 2013) and consequently help to share idle assets with others by advertising and by promoting the attitude of customers who believe that products and services can be provided only by regular businesses.

Tussyadiah and Pesonen (2016) confirm that authentic experiences (enjoyment, social belongingness, perceived usefulness, and meaningful interactions with locals) are the most substantial factors that influence an individual's choice to stay at the P2P accommodation (Barnes and Mattsson, 2016). The authors indicate that an average guest who uses the P2P accommodation is educated and, as a result, may not prioritise cost as a deciding factor for making the accommodation choice. The authors noticed that technological knowledge influences trust and positively affects the choice of services and products of the sharing economy (Dabbous and Tarhini, 2019). The possibilities provided by the sharing economy allow individuals to enter the market for the first time and compete almost immediately with large, well-established companies on an equal basis (Apte and Davis, 2019).

To make the quantitative analysis, we had to choose such socio-demographic factors that can be gauged (table no. 2). First, general indicators of population growth and population density influence the style of consumption (Diamantopoulos et al., 2003; Owyang 2013; Hellwig et al., 2015; Dabbous and Tarhini, 2019). Second, sustainability, value-driven, and minimalistic mindset contain several positive drivers that positively affect the sharing economy. It intrinsically supports the feeling that the planet is for everyone and promotes sharing, trust, and the increasing entrepreneurial spirit; market participants with a sustainability mindset understand the importance of sharing economy's development. In addition, people spend more time on various social networks; thus, they actively participate in economic and social life. On the other hand, sharing can be viewed as a considerable augmentation to the capitalist market economy and even a protest against consumerism.

Table no. 2. List of indicators referring to the socio-demographical factors

Group | of socio-demographical criteria	**Criteria**	**Authors/year**	**Ratios referring the criteria**
Population structure	Population density; The number of women (Women are keener to share).	Diamantopoulos et al., 2003; Owyang, 2013; Hellwig et al., 2015; Dabbous and Tarhini 2019.	Population density (people per sq. km of land area); Number of women; (Women per 100 men).
Sustainability mindset	The generational shift in consumption habits: sustainability mindset – value-driven and minimalist; Trust factors; Entrepreneurial spirit and aspiration; An independent lifestyle.	Owyang, 2013; Debarshi, 2015; Botsman, 2015; Sundararajan, 2016; Böcker and Meelen, 2017; Ravenelle, 2017; Apte and Davis, 2019.	Ratio of young people in the total population on 1 January by sex and age (from 15 to 29) %; Entrepreneurial intention index; Motivational index; Cultural and Social Norms Index.

Group | of socio-demographical criteria	Criteria	Authors/year	Ratios referring the criteria
Dependence on technology	Knowledge level; Participation in social networks; enjoyable communication	Trivett and Staf, 2013; Barnes and Mattsson, 2016; Dabbous and Tarhini, 2019.	Individuals using the Internet for participating in social networks% of individuals.

Source: Created by authors using databases: Eurostat, The World Bank, Global entrepreneurship monitor (GEM)

Inclusion of the economic criteria category into the list of criteria of evaluation is obvious as they are considered uniformly among human beings in making economic decisions. For example, Guttentag (2015), Weng et al. (2020) find that low cost is one of the main reasons to stay at Airbnb. Interestingly, the very emergence of the sharing economy could be related to the financial and economic crisis (Dervojeda et al., 2013; Goudin, 2016; Rowe, 2017). The severe consequences of the crisis can be seen in the coherent rise of unemployment and the decline in consumer purchasing power. That leads to substantial changes in buyers' consumption behaviour: households faced a strong demand to find ways to save or earn money and shift to peer-to-peer business models. Financial sources for investment in sharing economy business became more accessible (Dervojeda et al., 2013); this helped the rapid development of sharing economy's platforms. Apte and Davis (2019), Parente et al. (2018) highlighted other drivers of sharing economy growth: lower transaction costs and extensive venture capital funding that the industry has received in the last decade, both interrelated factors. Thus, we created two categories of economic criteria to simplify the process of choosing: uncertainty of performance of country's economy; and new opportunities in the market for the development of the sharing economy.

Bounding ourselves to the first group of criteria (uncertainty of performance of country's economy), we note that the 2008 financial crisis was the major impetus fostering a change of economic life of a large part of households. The solutions proposed by sharing economy platforms became attractive for many consumers who had the motivation to reduce expenditures. Furthermore, the rising unemployment rate forced many people to offer their underutilised assets or services to the market. The lower GDP and the higher unemployment rate created economic uncertainty and a stimulus for market participants to find new ways to conduct their economic lives (Dervojeda et al., 2013; Goudin, 2016; Apte and Davis, 2019).

The second group of economic criteria (new opportunities in the market for the development of the sharing economy) is related to the sharp improvement in the IT business while making the sharing economy more attractive to smaller entrepreneurs. In addition, lower transaction and IT services costs and increasing dominance of the IT industry have boosted investment in sharing economy businesses. Therefore, opportunities for the sharing economy are better in a country with high R&D expenditures, significant investment rates, development and expansion of the IT sector. The economic criteria are presented in table no 3.

Table no. 3. List of indicators that refer to the economic factors

Group of economic criteria	Criteria	Authors/year	Ratios referring the criteria
Uncertainty of performance of country's economy	GDP per capita; Total unemployment rate.	Dervojeda et al., 2013; Goudin, 2016; Rowe, 2017.	GDP per capita, PPP; GDP per capita of IT industry; Total unemployment rate (% of the total population); Annual net earnings, Euro (per person); Labour costs (wages and salaries total); Productivity (GDP per hour worked).
		Apte and Davis, 2019.	
New opportunities	Lower transaction costs.	Parente et al., 2018; Apte and Davis, 2019.	R&D expenditure (% of GDP); Intramural R&D expenditure (GERD) by sectors of performance (all sectors); Rate of GDP growth (%).
	Investment into sharing economy business (R&D expenditure).	Sundararajan, 2016; Apte and Davis, 2019.	
	Economic benefit.	Guttentag, 2015; Dabbous and Tarhini, 2019; Weng et al., 2020.	

Source: Created by authors using databases: Eurostat, The World Bank, Organization for Economic Co-operation and Development (OECD)

Such regulatory, political, and legal factors that ensure the stable performance of businesses also naturally affect the growth of the sharing economy. Political stability, protected property rights, and ease of starting and operating a business are essential factors for any economic activity, including the sharing economy. It should be noted that the further development of the sharing economy largely depends on the 'government's approach. As Ohlhausen (2015) states, "misguided government regulation can be the barrier to innovation that never falls". Vitkovic (2016) acknowledges the need for an "effective regulatory framework for the sharing economy". The sharing economy serves as an excellent example of the internationalisation of business, allowing even novices to enter markets and compete almost immediately as equals with larger and well-established companies (Apte and Davis, 2019). The chosen political and legal factors are presented in table no. 4; the factors are placed in two categories: *regulatory environment* with five essential criteria and the *level of freedom* category with two indices of business and investment freedom. The latter category is especially attractive to the sharing small businesses because high freedom levels allow them to deal with shared assets.

The literature suggests that all factors impact the phenomenon of sharing economy, and at the same time, these factors are interrelated. Despite that, the task of empirical research is to clarify the most significant ones. The analysed literature, economic logic, and availability of statistical information summarise the particular list of variables chosen for a further stage of analysis (table no. 5).

Table no. 4. List of indicators referring to the political-legal factors

Group of political-legal criteria	Criteria	Authors/year	Ratios referring the criteria
Regulation environment	Rule of law; Regulatory quality; Government effectiveness; Property rights.	Vitkovic, 2016; Hong and Lee, 2018.	Rule of law index; Regulatory quality index; Government effectiveness index; Property rights index; Tax burden index.
Level of freedom	The waves of democratisation.	Apte and Davis, 2019; Gurău and Ranchhod, 2020.	Business freedom index; Investment freedom index.

Source: Created by authors using databases: The Heritage Foundation, Worldwide Governance Indicators

2. Methodology

As described above, the literature analysis allowed us to identify four categories of factors: technological, socio-demographical, economic and political-legal, in which the most critical indicators were gathered up. Due to limitations related to finding quality data and MCDM methods, the authors used thirteen indicators for further empirical investigation. Such categorisation makes searching for criteria much more effective, especially in complicated problems (Amiria et al., 2021). The imposing structured approach to reach a better trade-off between the comprehensiveness of the set of criteria and limitations of MCDM methods on the number of criteria to be relatively small to enable their processing by experts to be relatively small. In addition, the goal of comprehensiveness is achieved more efficiently by limiting the search of criteria to each particular category at a time. There are no formal methods to build a hierarchy structure (Brauers et al., 2012); the authors used the most popular literature analysis approach that provided an exhaustive set of categories. The most important criteria for evaluating the conditions for the sharing economy were identified. Several stages of reviewing the set of criteria resulted in the following set of criteria, as is presented in table no 5.

Table no. 5. Factors and criteria of evaluation of conditions for sharing

Category	Criterion	Ratio
Technological	Level of internet access	percentage of households
	Individuals using the Internet	percentage of population
	Individuals using the Internet for selling goods or services	percentage of individuals
Socio-demographical	Population density	people per sq. km of land area
Economic	GDP per capita, PPP	current international $
	R&D expenditure	% of GDP
	Total unemployment rate	percentage of the total population
Political	Rule of law	index
	Regulatory quality	index
	Government effectiveness	index
	Property rights	index
	Business freedom	index
	Investment freedom	index

Weights of the importance of criteria of evaluation that reflect conditions for the sharing economy are not found in the literature; the paper attempts to fill this gap. Grounding of the choice of criteria was provided in the literature review section (table no 1-4); weights were calculated using recently developed methods of objective allocation of weights that reflect the particularities of the data: CILOS, entropy, and the integrating method IDOCRIW. In the paper, we will use MCDM methods of evaluation; they integrate weights with normalised values of criteria.

The values of criteria are initially placed into the so-called decision matrix R:

$$R = \|r_{ij}\| \tag{1}$$

where *i* ($i = 1, \dots, m$) is the index of criteria while *j* ($i = 1, \dots, n$) is the index of alternatives to be evaluated, in our case countries.

The values of criteria are normalised depending on the method used. The ways of normalisation will be described in appropriate sections in the description of MCDM methods. For example, the EDAS method uses the normalisation that divides values by the maximal value, while PROMETHEE uses the chosen preference function. Normalised values are coupled with the weights to obtain the cumulative criterion of each method that represents the level of attractiveness of each alternative in quantitative terms.

Description of the CILOS method of objective allocation of weights

The CILOS method is a relatively new original method that belongs to the realm of objective methods of establishing weights brought to be ready-to-use by Zavadskas and Podvezko (2016). The method uses losses of impact by each criterion measured by distances to its best value. The following steps form the integral model of the method.

Step 1. The values of all minimising criteria are transformed to become the maximising ones. The following inverse transformation function can be used:

$$\bar{r}_{ij} = \frac{\min_j r_{ij}}{r_{ij}} \tag{2}$$

After the transformation, we denote the decision matrix where all criteria are maximising, as
$X = \|x_{ij}\|$.

Step 2. Maximal values are found in each row of the matrix. Such maximal values are denoted as x_i.

Step 3. The matrix $A = \|a_{ij}\|$ is formed from the columns where maximal values were found for each criterion. Naturally, the matrix is square, of the size *m* x *m*, where *m* is the number of criteria; maximal values for each criterion are now found on the main diagonal of the matrix.

Step 4. Relative losses are found for each entry of matrix A as follows:

$$p_{ij} = \frac{x_i - a_{ij}}{x_i} \quad (p_{ii} = 0; i, j = 1,2, \dots, m) \tag{3}$$

Step 5. The vector of weights q of the CILOS method is found by solving the following system of equations and by further normalisation:

$$F \cdot q = 0 \tag{4}$$

The matrix F has the sums of relative losses embedded to its main diagonal:

$$F = \begin{pmatrix} -\sum_{i=1}^{m} p_{i1} & p_{12} & \cdots & p_{1m} \\ p_{21} & -\sum_{i=1}^{m} p_{i1} & \cdots & p_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & -\sum_{i=1}^{m} p_{im} \end{pmatrix}. \tag{5}$$

Description of the entropy method of objective allocation of weights

The entropy method of the objective allocation of weights, and the CILOS method, reflects the structure of the data. The steps of finding weights using this method are as follows.

Step 1. Normalisation of criteria is carried out using the following formula:

$$\tilde{r}_{ij} = \frac{r_{ij}}{\sum_{j=1}^{n} r_{ij}} \tag{6}$$

Step 2. Calculation of the entropy level is carried out at this step as follows:

$$E_i = -\frac{1}{\ln n} \sum_{j=1}^{n} \tilde{r}_{ij} \cdot \ln \tilde{r}_{ij}, (i = 1,2, \dots, m; 0 \leq E_i \leq 1). \tag{7}$$

Step 3. Now, the variation level is calculated:

$$d_i = 1 - E_i, \tag{8}$$

Step 4. Finally, weights by normalisation are calculated:

$$\omega_i = \frac{d_i}{\sum_{i=1}^{m} d_i} \tag{9}$$

Description of the IDOCRIW method of integration of objective methods

The above objective methods have different logics. Integration of the two methods, the CILOS and the entropy, mitigates the shortcomings of each method (Zavadskas and Podvezko, 2016). The integration is created using the following formula:

$$\omega_i = \frac{q_i W_i}{\sum_{j=1}^{m} q_j W_j} \tag{10}$$

Based on the above idea of integration, the method is called Integrated Determination of Objective Criteria Weights (IDOCRIW).

Description of the EDAS method of MCDM evaluation

MCDM methods integrate the vector of weights with normalised values of the criteria. Normalisation in this method is a proprietary one. The method uses distances to the average solution; the method's name descends from this idea as the abbreviation of the method is "Evaluation Based on Distance from Average Solution". The following are the steps of the method.

Step 1. The average solution is calculated for each criterion *i*:

$$AV_i = \sum_{j=1}^{n} \frac{r_{ij}}{n} \quad (11)$$

Step 2. Both positive and negative distances (namely, PD and ND) to the average solutions are found for each criterion and alternative:

$$PD_{ij} = \frac{\max\left(0,(r_{ij}-AV_i)\right)}{AV_i}, \quad (12)$$

$$ND_{ij} = \frac{\max\left(0,(AV_i-r_{ij})\right)}{AV_i}. \quad (13)$$

The above formulae are used for the maximising criteria. For the minimising criteria, the following formulae are used:

$$PD_{ij} = \frac{\max\left(0,(AV_i-r_{ij})\right)}{AV_i}, \quad (14)$$

$$ND_{ij} = \frac{\max\left(0,(r_{ij}-AV_i)\right)}{AV_i}, \quad (15)$$

Formulae 12-15 fulfil the function of normalisation.

Step 3. At this step, the weights ω_j are coupled with the normalised values using the following formulae for the positive and negative distances separately:

$$SP_j = \sum_{i=1}^{m} \omega_i \cdot PD_{ij}, \quad (16)$$

$$SN_j = \sum_{i=1}^{m} \omega_i \cdot ND_{ij}, \quad (17)$$

Step 4. At this step, the resulting sums are normalised for each alternative by dividing them by the maximal value found among all alternatives:

$$NSP_j = \frac{SP_j}{\max\limits_j SP_j}, \quad (18)$$

$$NSN_j = 1 - \frac{SN_j}{\max\limits_j SN_j}. \quad (19)$$

Step 5. The average between normalised positive and negative normalised solutions is believed to represent the cumulative representative criterion of the EDAS method that reflects the attractiveness of each alternative *j*.

$$AS_j = \frac{1}{2}\left(NSP_j + NSN_j\right), \tag{20}$$

Obviously, $0 \leq \mathrm{AS}_i \leq 1$.

Description of the PROMETHEE II method of MCDM evaluation

The group of PROMETHEE methods belongs to the category of MCDM methods with a pairwise comparison of alternatives. Comparison is carried out for all pairs of alternatives with respect to all criteria involved in the evaluation. Preference functions serve the purpose of creating a normalisation, an essential part of the MCDM evaluation. Preference functions are chosen among the set of proposed functions in the original method or in subsequent studies (Brans and Mareschal, 2005; Podviezko et al., 2019). The function of linear preference (with indifferences) was chosen for all criteria as this function proportionally reflects differences between values of criteria for each pair of alternatives and also mitigates irregularities of data. The parameters of the function are found after the calculation of the minimal distance $\left|\min_{1\leq j,k\leq n} d_i\left(A_j, A_k\right)\right|$ and, correspondingly, the maximal distance $\left|\max_{1\leq j,k\leq n} d_i\left(A_j, A_k\right)\right|$. Then the algorithm of finding such parameters that are laid out in Podvezko and Podviezko (2010) is used. The sizes of the areas of indifference are determined by taking the 5% size of the largest difference within the set of all differences of values, among all pairs of alternatives, for each particular criterion. This is an increment of the indifference threshold from both sides.

For all pairs of alternatives (A_j, A_k) and, respectively, (A_k, A_j,), inward and backward aggregated preference indices are calculated. For the *j*-th alternative formulae of finding the indices will be the following:

$$\pi\left(A_j, A_k\right) = \sum_{i=1}^{m} \omega_i p_t \left(d_i\left(A_j, A_k\right)\right) \tag{21}$$

$$\pi\left(A_k, A_j\right) = \sum_{i=1}^{m} \omega_i p_t \left(d_i\left(A_k, A_j\right)\right) \tag{22}$$

Inward and backward aggregated preference indices are calculated:

$$F_j^+ = \sum_{k=1}^{n} \pi\left(A_j, A_k\right) (j = 1,2, \ldots, n) \tag{23}$$

$$F_j^- = \sum_{k=1}^{n} \pi\left(A_k, A_j\right) (j = 1,2, \ldots, n) \tag{24}$$

The cumulative criterion is found by taking the difference between the positive and the negative flows:

$$F_j = F_j^+ - F_j^- \tag{25}$$

Empirical analysis

For our analysis, we chose 12 representative countries, three from each EU region determined by the EuroVoc geographical classification as shown in table no. 6.

Table no. 6. List of countries

	Region	Country
1.	Northern Europe	Sweden
2.		Lithuania
3.		Estonia
4.	Western Europe	Germany
5.		France
6.		The Netherlands
7.	Central and Eastern Europe	Poland
8.		Hungary
9.		Czech Republic
10.	Southern Europe	Spain
11.		Italy
12.		Portugal

Data were obtained from various databases: Eurostat, The World Bank, The Heritage Foundation, Worldwide Governance Indicators.

To apply the PROMETHEE method, values of the thresholds and parameters of the preference functions were calculated using the algorithm described in (Podvezko and Podviezko, 2010) and applying 5% of the size of the most significant difference within the set of all differences of values, among all pairs of alternatives, for each particular criterion. The 5% increments, and the parameters of the indifference *q* and *s*, are provided in table no. 7.

Table no. 7. The 5% increments along with the parameters of the indifference q and s

	2011												
	1	2	3	4	5	6	7	8	9	10	11	12	13
5%	1.80	1.92	1189	0.06	0.08	2.00	1.68	1.75	23.60	1.30	1189	0.13	0.54
q	1.80	2.78	1215	0.07	0.10	2.00	1.78	1.75	27.67	1.30	1215	0.15	0.54
s	34.2	36.5	22586	1.21	1.51	38	31.9	33.3	448	25	22586	2.4	10.2
	2014												
	1	2	3	4	5	6	7	8	9	10	11	12	13
5%	1.55	1.84	1181	0.06	0.07	2.00	1.05	1.00	24	1.25	1181	0.11	0.63
q	1.55	2.34	1189	0.06	0.07	2.00	1.05	1.00	27	1.25	1189	0.12	0.63
s	29.5	35.0	22447	1.11	1.37	38.0	20.0	19.0	453	23.8	22447	2.10	12.0
	2017												
	1	2	3	4	5	6	7	8	9	10	11	12	13
5%	1.15	1.62	1267	0.07	0.07	1.43	1.34	1.00	24	1.50	1267	0.12	0.47
q	1.15	1.83	1444	0.07	0.08	1.73	1.54	1.00	26	1.50	1444	0.13	0.47
s	22	31	24077	1.33	1.28	27	25	19	460	29	24077	2.30	8.84

The results obtained using different MCDM methods are presented in table no 9. As was mentioned in the methodological part, weights form the essential part of the MCDM evaluation; weights obtained by the CILOS, entropy and IDOCRIW methods are presented in table no. 8.

Table no. 8. Weights of criteria

	Criteria, 2011												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Entropia	0.013	0.014	0.073	0.052	0.096	0.016	0.006	0.009	0.297	0.209	0.035	0.089	0.090
CILOS	0.039	0.092	0.041	0.051	0.032	0.298	0.044	0.329	0.003	0.020	0.027	0.016	0.007
IROCRIW	0.020	0.050	0.112	0.101	0.115	0.180	0.009	0.112	0.033	0.154	0.036	0.053	0.025
	Criteria, 2014												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Entropia	0.007	0.011	0.104	0.070	0.090	0.019	0.004	0.005	0.322	0.150	0.029	0.080	0.107
CILOS	0.021	0.150	0.086	0.054	0.038	0.270	0.152	0.135	0.002	0.044	0.025	0.016	0.006
IROCRIW	0.005	0.047	0.261	0.110	0.099	0.152	0.018	0.020	0.016	0.193	0.021	0.038	0.020
	Criteria, 2017												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Entropia	0.003	0.006	0.112	0.069	0.087	0.008	0.007	0.004	0.321	0.147	0.024	0.089	0.124
CILOS	0.087	0.142	0.051	0.029	0.040	0.159	0.051	0.336	0.006	0.011	0.038	0.016	0.033
IROCRIW	0.011	0.033	0.227	0.079	0.138	0.051	0.014	0.058	0.070	0.063	0.036	0.058	0.160

Finally, in table no. 9, the results of MCDM evaluation by the EDAS and PROMETHEE II methods are presented. The final results of each year's evaluation are found as averages of the ranks obtained using the EDAS and PROMETHEE II methods, while the final ranks for the three-year period are calculated as the weighted average of the ranks. The weights are proportional to the power of 2 placing greater emphasis on the later years. The weight for 2011 is 0.14 that is proportional to 2 of 14; for 2014, it is 0.29 that is proportional to 4 of 14; and for 2017 it is 0.57 that is proportional to 8 of 14; 14 is the sum of the corresponding powers. In table no 9, the values of the cumulative criteria of the MCDM methods EDAS and PROMETHEE II are presented, as well as the integral results obtained by taking averages of the ranks and the final ranking.

Table no. 9. Results of MCDM evaluation by the EDAS and PROMETHEE II methods

	Sweden	Lithuania	Estonia	Germany	France	The Netherlands	Poland	Czech Rep	Hungary	Spain	Italy	Portugal
	2011											
EDAS	0.870	0.026	0.505	0.917	0.655	1.0	0.103	0.364	0.248	0.283	0.024	0.130
EDAS	3	11	5	2	4	1	10	6	8	7	12	9
PROMETHEE $F+$	0.456	0.033	0.230	0.410	0.231	0.483	0.048	0.073	0.052	0.083	0.037	0.046
PROMETHEE $F-$	0.022	0.308	0.095	0.021	0.137	0.008	0.300	0.197	0.234	0.196	0.381	0.283
PROMETHEE F	0.434	-0.275	0.135	0.390	0.094	0.476	-0.252	-0.124	-0.182	-0.114	-0.345	-0.237
PROMETHEE	2	11	4	3	5	1	10	7	8	6	12	9
Final rank, 2011	2	11	4	2	4	1	10	6	8	6	12	9
	2014											
EDAS	0.805	0.193	0.664	0.942	0.725	1.0	0.244	0.433	0.199	0.253	0.008	0.257
EDAS	3	11	5	2	4	1	9	6	10	8	12	7
PROMETHEE $F+$	0.426	0.055	0.284	0.466	0.281	0.503	0.042	0.103	0.053	0.061	0.020	0.060

	Sweden	Lithuania	Estonia	Germany	France	The Netherlands	Poland	Czech Rep	Hungary	Spain	Italy	Portugal
PROMETHEE $F-$	0.045	0.305	0.075	0.004	0.085	0.004	0.298	0.184	0.344	0.260	0.475	0.274
PROMETHEE F	0.381	-0.250	0.209	0.462	0.196	0.499	-0.256	-0.081	-0.291	-0.199	-0.456	-0.214
PROMETHEE	3	9	4	2	5	1	10	6	11	7	12	8
Final rank, 2014	3	10	4	2	4	1	9	6	11	7	12	7
	2017											
EDAS	0.730	0.254	0.473	0.850	0.535	1.0	0.185	0.507	0.153	0.062	0.028	0.331
EDAS	3	8	6	2	4	1	9	5	10	11	12	7
PROMETHEE $F+$	0.446	0.0613	0.1976	0.3939	0.2406	0.5307	0.0303	0.0846	0.0147	0.0713	0.0316	0.0802
PROMETHEE $F-$	0.0226	0.2295	0.0926	0.022	0.078	0.0053	0.3588	0.1831	0.3948	0.2077	0.3805	0.208
PROMETHEE F	0.4235	-0.1682	0.105	0.3719	0.1626	0.5254	-0.3286	-0.0985	-0.38	-0.1364	-0.3489	-0.1278
PROMETHEE	2	9	5	3	4	1	10	6	12	8	11	7
Final rank, 2017	2	8	5	2	4	1	9	5	11	9	12	7
FINAL	3	9	5	2	4	1	10	6	11	8	12	7

Graphically, the dynamics of ranks of countries can be observed in figure no. 1. It becomes clear that the countries did not experience considerable fluctuations in rank over the period.

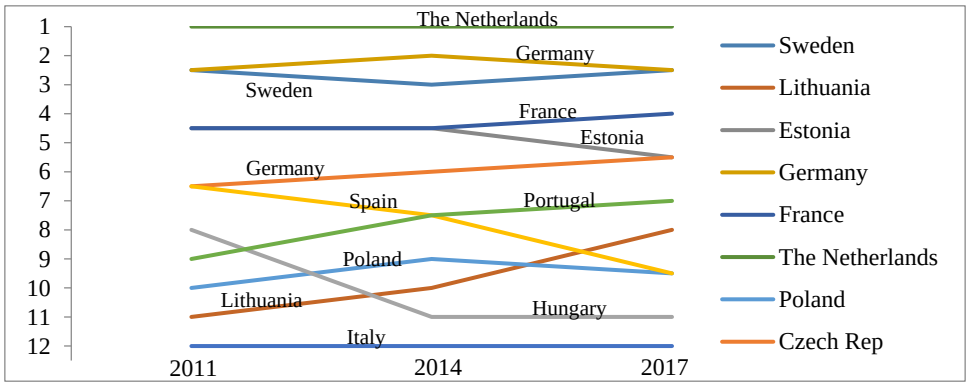

Figure no. 1. Dynamics of ranks of countries

The Netherlands, Germany, Sweden, France and Estonia are at the top of the proposed list. These countries are well-developed with a high level of Internet connectivity, rapid adoption of new technologies, and a high GDP. Generally, countries with mature Internet infrastructure and tourism fuelled economies have more significant proportions of the sharing economy. Therefore, according to the criteria chosen for the research, countries that achieved high ranks based on the values of such criteria should have high rates of sharing economy growth in the future.

Conclusions

Sharing economy is the ability to match the supply and demand of capital available for the sharing between different market players to increase the efficiency of its utilisation and thus expand free-market possibilities. An effective connection between suppliers and consumers can only be possible when tremendous digital networks' progress occurs while the social trust climate is favourable. The sharing economy is changing people's attitudes towards ownership. It emphasises that using rather than just owning, sharing economy can be related to liberalisation adjustment of regulations. However, on the other hand, it brings chaos and risk to the market.

The authors selected the main criteria that influence the growth of the sharing economy to create an instrument to monitor and control the progress of this phenomenon. Based on analysis of the literature, four categories of criteria were found: technological, socio-demographical, economic, and political.

From the initial observation of the sum of all final ranks in each of the four regions, it becomes clear that the leading region is Western Europe (with the sum equal to 21). The second region by attractiveness is Northern Europe (the sum of ranks equals 49), and the remaining two regions, Central and Eastern and Southern Europe, are similar and are least attractive (the sum of ranks being 75 and 81, respectively). Looking at the values of criteria, we can analyse both causes of success and failure. Three leading countries, The Netherlands, Germany, and Sweden, have excellent relative positions in terms of all criteria in all three years with the following exceptions. The Netherlands has a non-inspiring R&D expenditure, while Sweden has the lowest population density. Germany also has only half of the Netherlands' population density, even if it is found in the second-best position in terms of this criterion. France (rank 4) has most of the criteria above average even if it never reaches the best market position in 2017 by all criteria. However, it has the worst position in terms of investment freedom among selected countries. Estonia (rank 5) has especially good property rights and investment freedom but low population density. GDP per capita and R&D expenditure are lagging compared to the majority of other countries. The Czech Republic (rank 6) has an especially low level of unemployment, but especially low and even decreasing business freedom; low use of internet shops; and a relatively low population density. Portugal (rank 7) has a mediocre but increasing level of internet access; a relatively small part of the population uses Internet shops, and regulatory quality gradually increasing but still uninspiring. GDP per capita is low and even decreasing insignificantly, and investment freedom became the lowest among the set of chosen countries. On the other hand, variables such as business freedom, the rule of law, government effectiveness, property rights, and the unemployment rate create quite favourable conditions for the sharing economy. Spain (rank 8) has the highest unemployment rate permanently; relatively low population density, R&D expenditure, regulatory quality, increasing but still a mediocre level of Internet access, and the level of business freedom. On the other hand, favourable conditions are created by more influential positions in investment freedom, the percentage of the population that uses the Internet, property rights, fluctuating at a rather good level of government effectiveness. Lithuania (rank 9) has an uninspiring percentage of the population using the Internet for selling goods and services, R&D expenditure, population density, and sharply increasing but still a relatively low GDP per capita, slowly increasing the quality of property rights. On the other hand, good positions in business freedom, unemployment rates, and investment freedom improve conditions for sharing economy. Poland (rank 10) is lagging in areas such as GDP

per capita, R&D expenditure, business freedom, property rights, and investment freedom; while it has a low unemployment rate, a high percentage of individuals and households use the Internet, decreasing regulatory quality. Hungary (rank 11) has low positions in GDP per capita, government effectiveness, rule of law, regulatory quality, and population density. In contrast, Italy (rank 12) has low positions in the percentage of individuals and households using the Internet, the rule of law, government effectiveness, regulatory quality, property rights.

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