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# Assessment of the Sharing Economy in the Context of Smart Cities: Social Performance

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**Abstract:** The sharing economy (SE) provides new opportunities to solve social, economic, and environmental problems, as well as increasing resource efficiency and releasing underutilized assets. However, social aspects of the sharing economy remain to be fully appraised. The present study aims to develop and apply a technique for assessing the sharing economy in the context of improving the social performance of smart cities. When considering social performance, we examine the relationship between the development of SE services and the public goods sector, as well as the potential of the sharing economy for improving the quality of life of citizens. A comparative analysis of approaches used to evaluate the sharing economy concluded that the social and environmental significance of the sharing economy can be most appropriately considered at the level of cities. The proposed technique is based on the use of the Smart City Index and Sharing Economy Index databases, data on collaborative economy platforms presented by Eurostat. The methodology used to assess the sharing economy comprises three stages: substantiation of the selected indicators for assessing SE; calculation of the presented integral index of the sharing economy; and construction of a matrix of indices of the sharing economy. At the first stage, correlation analysis was used; at the second stage, the TOPSIS system analysis method was used; and at the third stage we used graphical analysis. As a result, a ranking of 31 European cities was compiled in terms of the level of development of the sharing economy. It is shown that the sharing economy has a greater impact on public goods in cities with lower rates of economic development. In addition, significant changes in the 2020 ranking occurred due to restrictions caused by the COVID-19 pandemic. It is hoped that the obtained results will contribute to the development both of sharing economy methodologies and the urban environment by supporting sharing services.

**Keywords:** sharing economy; social area; TOPSIS; cities; assessment; car sharing; platforms



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## 1. Introduction

Significant changes in the patterns of consumption and the exchange of resources as a result of global digitalisation trends [1] have led to the creation of new opportunities for the development of industry sectors and individual territories, through the formation and dissemination of the sharing economy [2]. On the one hand, the emerging resource sharing models are based on changing individual motivations, which determine the selection of new forms of consumption [3]. On the other hand, the introduced changes undermine the established behavioural norms of existing market participants, which can reduce the certainty and stability of this interaction and may have negative social consequences [4]. Against this background, increasingly widespread network and hybrid forms of interaction between economic agents regarding the consumption of resources or reproduction of goods and services are accompanied by the formation of both formal and informal norms, and rules that support their continuing development [5]. Representing a novel type of economic agent that intermediates between supplier and consumer, digital platforms make significant changes to the existing models of consumption and the exchange of resources. The new

type of consumption, based on digital technologies and the development of platform relationships, can be found in the sharing economy.

The sharing economy approach is characterized by transferring the right of access to resources along with the formation of communities united by common interests or values [6]. While the sharing economic concept does not imply a complete repudiation of property, there is a discernible shift in the choice of economic agents in favour of temporary access. The values and interests of the participants in the interaction may also not be identical, but the personal benefits that the business models of sharing can provide often exceed the benefits obtained by participating in market behaviours. This encourages economic agents to make a choice in favour of collaborative consumption. The main advantages of the sharing economy, to which its rapid development may be ascribed, are increased resource use efficiency [7], reduced transaction costs [8], and the released untapped potential of various types of resources. At the same time, different models of the sharing economy have attracted significant attention due to industry disruption, regulatory issues and the potential social, economic, and environmental impacts of these consumption practices [9].

On the one hand, the multifaceted nature of the concept referred to by the term "sharing economy" reveals its versatility. However, on the other hand, there is a risk of blurring boundaries. The term "collaborative consumption" was first used by M. Felson and Joe L. Spaeth. Noting that "the structure of daily activities creates the circumstances in which collaborative consumption occurs", they treat collaborative consumption as "a routine activity feeding upon other routine activities" [9]. At the same time, the authors rely on A. Hawley's human ecological theory of community structure, which provides a way of thinking about consumer activities [10,11].

A more contemporary meaning of the sharing economy concept is set out in the work of L. Lessig [12], who describes commercial and sharing economies in order to characterize a hybrid one. The spread of this term and the expansion of the sharing economy from the exchange of online content to other areas of activity is due to the work of R. Botsman and R. Rogers "*What's Mine Is Yours: The Rise of Collaborative Consumption*" [13]. In this work, the authors presented an historical excursion into developing a new model and demonstrated a systematization of collaborative consumption examples into three systems: product-service system; redistribution markets; and collaborative lifestyles. In addition, Botsman and Rogers highlighted four principles that this new model of consumer behaviour characterizes: critical mass; idling capacity; belief in the commons; and trust between strangers [13].

The novelty of this business model, and the transformation of consumption patterns it promises, have given rise to sharing economy supporters in research and practice. Proponents of the sharing economy point to the possibility to free up underutilized resources by supporting more efficient consumption and reducing transaction costs [8]. However, its opponents cite institutional voids contributing to the development of a shadow economy, tax evasion, and uncertainty in allocating responsibility and guarantees when conducting transactions [4].

At the same time, the market basis of this model and high potential for the self-regulation of the sharing economy platforms contributed to its spread on a reasonably large scale. According to a PricewaterhouseCoopers report, by 2025, it can reach USD 335 billion [14] with an average annual growth rate of 33%; while the share of GDP from sharing economy activities is rather low, annual growth rates can reach 100%. For example, in China, the value of this indicator in 2017 was 95.4% [15].

It should be noted that the sharing economy concept is closely intertwined with that of the circular economy (CE). Henry et al. present a comparative analysis of these concepts based on bibliometric analysis [16]. As well as revealing the existence of linkages between the areas of sustainable development, business models, sustainable consumption, and management, the authors also confirm the nesting of the sharing economy in the circular economy. Another detailed analysis of the circular economy and the sharing economy

shows that the goals of their respective digital platforms may differ [17] due to a gap between theoretical sharing economy principles and practical activities. In addition, if the circular economy is more focused on the analysis of large corporations, the sharing economy covers small and medium-sized businesses, as well as the activities of start-ups, which reflects the prospects for a comprehensive study of these concepts [16,18]. The presented aspects of the relationship between CE and SE in general allow us to conclude that there is a high potential for the joint development of these concepts [19]. However, for this to be possible, there would need to be greater consistency of the development directions of platforms and companies using these models. As a control centre at the current stage of the formation and consolidation of these business models, large municipalities can be considered as points for the concentration of sharing economy services. This allows us to consider the sharing economy in the context of smart cities, comprising safe, environmentally friendly, and efficient urban centres with developed infrastructure, whose main purpose is to ensure sustainable economic growth and a high quality of life. However, there is little research that explicitly links the sharing economy with urban studies [20,21].

A specific area of study of the sharing economy is its potential for developing the social environment. As is shown by the historical background of the phenomenon, the formation and development of the sharing economy responded to unresolved social problems and optimized existing resources [13]. At the same time, the development of the sharing economy faces many problems caused by the change of the consumption model, i.e., from a consumption economy to a cooperation economy [22,23], which threatens the traditional market and thus requires a corresponding transformation. In addition, some types of activity attributed to the sharing economy can contribute to the development of a shadow economy and reduce an employer's responsibility to its employees. In other words, while the sharing economy makes it possible to solve certain socially significant tasks concerning, for example, the development of public goods (car-sharing and bike rental reduces traffic jams and increases mobility), it also stimulates the creation of new problems associated with a decrease in the protection of citizens in matters of employment, and in the formation of a shadow market, etc. Harmonization of these aspects is possible when considering the sharing economy as a subsystem of smart city development. The prospect of such a coincidence of interest is confirmed by the implementation of the principle of cooperation, both in the sharing economy and in the design of smart cities [24].

The problem of measuring the sharing economy also raises many questions. The sharing economy is evaluated in academic research at various levels. While the Timbro Sharing Economy Index [25] might seem relevant, it only presents data for 2018, which does not permit sharing economy dynamics to be traced. The Sharing Economy Index calculated by the Center for Consumer Choice (Washington, DC, USA) [26] reflects a qualitative assessment of the sharing economy services in increments of five units, which suggests a possible margin of error in this assessment. Although researchers have assessed both individual projects of the sharing economy, such as Uber [27], Airbnb [28], and Zipcar, as well as focusing on particular aspects of the sharing economy, in particular, issues of trust [29], and values, etc., these assessments are based on private entities. The lack of a comprehensive assessment of the sharing economy and its social performance at the municipal level determined the purpose of this study.

Therefore, the present study aims to develop and apply a technique for assessing the sharing economy in the context of improving the social performance of smart cities. We set out to substantiate the possibility of using the assessments of citizens about sharing economy services in order to draw a conclusion about their contribution to the development of the urban economy. Approaches to measuring and assessing the sharing economy were analysed and indicators for the analysis of the sharing economy were determined. In developing the proposed technique for assessing the sharing economy in cities, the expediency of using these indicators directly considered the social significance of the considered business model. In conclusion, limitations as the potential for using the proposed integral index of the sharing economy are described.

## 2. Sharing Economy and the Potential of Its Application in the Social Sphere

### *2.1. Sharing Economy: The Origins of the Formation and Distribution*

The variety of interpretations of the definition of the sharing economy is due to distinctive features of the use of such terms as collaborative consumption [13], the Mesh [30], commercial product-service systems [31,32], and access-based consumption [33]. The variety of terms used to describe the phenomenon include the direct sharing economy, the collaborative economy, the sharing economy, the access economy, and the sharing economy, and is due both to the peculiarities of the translation and to the individual elements that make up the sharing economy. For example, A. Acquier shows that the sharing economy is made up of three foundational cores—the access economy, the platform economy, and the community-based economy [34].

As noted by K. Laurell and K. Sandström [35], the sharing economy concept arose as a result of the exchange of content in the Internet environment in the format of peer-to-peer relationships. The SE is increasingly associated with platform-based commercial activities, where profit-oriented firms create and monetize so-called two-sided markets [36]. H.Guyader and L.Piscicelli proved that the SE relies on six key resources (member community, platform technology, user data, customer support, local management teams, and partners) and three key capabilities (leverage of the community's assets, technological improvement, and user engagement) [37]. R. Belk also introduces the concept of pseudo-sharing, which is distinguished by profit motives, as well as the absence of a sense of community and the expectations of reciprocity [38].

The analysis of sharing economy research allowed us to conclude that phenomena that gave rise to the sharing economy were described and analysed in the works of Nobel Prize Winners E. Ostrom, O. Williamson and J. Tirole. E. Ostrom received the Nobel Prize for her analysis of economic governance, especially the commons. The community economy, in turn, is one of the components of the sharing economy; its effectiveness lies, among other things, in the formation of communities whose interaction efficiency exceeds other forms of interaction [39]. Additionally, O. Williamson's contribution to the development of the sharing economy consisted of studying hybrid models that serve as the base for platform design where economic agents operate [40]. In contrast, L. Lessig, the originator of the term "sharing economy", argues that hybrid shared savings arises from the contribution of the platform to the redistribution of transaction costs, leading to the transformation of the norms and rules of interaction between economic agents [12]. In addition, J.-C. Rochet and J.Tirole. constructed a mathematical model of the competition of platforms in two-sided markets [41]. These studies also precede the current stage of sharing economy development.

The crisis of 2008 became a point of growth for the sharing economy, since SE opened up opportunities to increase resource efficiency and reduce transaction costs, freeing up additional cash. However, the current stage of sharing economy development demonstrates the "growth" comparable with a traditional business. Companies, banks, and government organizations, are increasingly beginning to include services that can be classified as sharing services. This phenomenon confirms the demand for this type of consumption. In addition, this indicates a transformation of the consumption model as a whole, which leads to the need to transform current interaction models [42].

### *2.2. The Sharing Economy in Terms of Its Social Significance*

The work of T. Roh shows the potential of social enterprises in using the sharing economy models. The scientist notes that the use of innovative and proactive platforms collectively known as the "ICT-based sharing economy" can comprise a new business model for social entrepreneurship. In addition, the sharing economy can increase the quality of life as social enterprises have the potential to create both social and economic values from the sharing economy by connecting people and helping to make sharing more efficient [43].

The authors S. Battino and S. Lampreu [44] examine ways to strengthen competitiveness and potential attraction of marginal geographical areas, and reduce the risk of demographic collapse through programs and instruments of the sharing economy. Researchers say that experiences gathered so far from the already existing sharing economy platforms (like those of food sharing) show that it is possible to respond to people's needs with new supply forms and according to original models.

Indeed, A. Szymańska confirmed that the sharing economy serves as a form of social innovation having influences on quality-of-life metrics. It was discovered that the formation of online groups led to more integrated local communities, which significantly impacted the quality of life of city residents in Krakow [45].

Particular attention should be paid to studies on the potential of the sharing economy in meeting the goals of sustainable development and circular economy formation. Thus, from a resources perspective, Sposato et al. [46] demonstrate that collaborative models in the most strategic and critical sectors (such as mobility, agro-food, construction, and goods production and consumption) can contribute to a circular economy. Further, Y. Ma et al. [47] investigate the synergy between social-ecological innovation in the sharing economy and the sustainable development of urban systems using empirical data from three business cases in the emerging sharing mobility sector in Shanghai: ridesharing, EV-sharing, and bike-sharing.

When studying the impact of the sharing economy in terms of its social significance, it is possible to identify both positive and negative consequences of the development of this principle of interaction. Changing consumption patterns also stimulate social change, which is in turn driven by changing behaviour patterns. For example, I. Tussyadiah and J. Pesonen note that the reduction in accommodation fees, which became possible thanks to Airbnb, increased the frequency of tourists' trips and the length of stay at destinations, thus creating additional business opportunities [48]. Additionally, B. Greenwood and S.Wattal show that vehicle sharing services have reduced the incidence of alcohol-impaired driving accidents [49]. When evaluating smart cities, the MD-SUTD Smart City Index Report shows the impact of sharing economy services on road congestion.

When considering social aspects within the framework of this study, we consider the potential of using the services of the sharing economy to solve socially significant urban problems, as well as citizens' satisfaction with the public goods sector. In particular, carsharing and bicycle rental can reduce traffic congestion at the same time as increasing the mobility of citizens [50]. Platforms for the return of unnecessary things contribute to the formation of ethical consumption, as well as reducing the amount of rubbish to be recycled by other means. Digital platforms that facilitate the short-term rental of premises create additional sources of income, which can lead to improvements in the quality of life of citizens. The list of social aspects that need to be considered when analysing the sharing economy is not exhaustive and can be expanded if additional statistical data are available.

### *2.3. Approaches to Measuring the Sharing Economy*

The evaluation of social aspects of the sharing economy is presented very narrowly in scientific literature and analytical reports. This lack of a comprehensive assessment is due both to the heterogeneity of the various sharing economy models and the limited amount of data. In addition, sharing economy models are increasingly being subjected to market exchange, which creates limitations when trying to distinguish the effects of the platform economy, the circular economy, and the sharing economy.

Research on the sharing economy is increasingly dominated by qualitative evaluation methods. In particular, R. Laurenti et al. confirm that qualitative approaches are the most common (51.5% versus 24.9% of quantitative and 17.4% of mixed methods). These approaches include a literature review (22.9%), a survey (13.2%), case study (7.3%), and interviews (7%), etc [51]. However, in this study, we attempt to quantify the sharing economy.

The first global index of the sharing economy was developed by Timbro, a free-market think-tank based in Sweden, with a mission to shape public opinion in favour of free

enterprise, individual freedom, and to open society by publishing works on these topics and developing policy recommendations and organizing educational programs for young people. The sharing economy index was compiled from an analysis of 286 companies using the sharing economy models. The index value was formed based on data on the volume of traffic in the sale of these companies [25].

The Consumer Choice Centre (Washington, DC, USA), a non-governmental consumer protection organization that supports freedom of lifestyle, innovation, privacy, science, and consumer choice, also compiled an index of the sharing economy based on the data obtained for the year 2020. The authors of this study present the results of an analysis of 52 of the most dynamically developing cities in the world, forming their ranking precisely in the context of the sharing economy. During the formation of this index, a review of the most popular services of the sharing economy was conducted. The authors assess the degree of restrictions for projects and organizations implemented through the sharing economy, in particular, considering criteria such as the availability of permission for a particular service of the sharing economy, tax rates, and the need for special permits for the provision of services of the sharing economy. The study presents the results of an analysis of the urban environment regarding the availability of carsharing and car-pooling, electric scooters, rental housing, and services for sports training [26].

Separate data for 2019 to 2021 on the development of the sharing economy by city are presented in the MD-SUTD Smart City Index Report. Among the indicators used to evaluate smart cities are data showing the satisfaction of the citizens of cities in connection with car-sharing, bike rental, and the effectiveness of digital platforms used to exchange unnecessary things [52].

Another source of statistical data on short-stay accommodation booked via collaborative economy platforms based on countries, regions, and cities, is provided by Eurostat reports [53]. These reports also present data on the number of stays, number of nights, and guest-nights, which consider both domestic and international bookings. To additionally analyse the development of the sharing economy in the hospitality industry, we used the indicator of the total number of nights per capita booked through the collaborative economy platforms.

Various commercial agencies also collect databases on the development of the sharing economy. The verified market research (VMR) presents data by product (transportation, shared space, sharing financial, sharing food, shared health care, shared knowledge education, shared task service, shared items, and others), by end-user (traffic, electronic, accommodation, food and beverage, tourism, education, and others), by geography (North America, Europe, Asia Pacific, and others).

Scientific studies also use data on the development of specific companies (Uber, Airbnb, BlaBlaCar, Zipcar, and others) to measure the sharing economy. Surveys are also quite commonly used to assess the behaviour of platform users.

In the present work, the social significance of the sharing economy is established by determining the relationship between SE development indicators and the citizens' assessments of the quality of public goods.

## 3. Methodology

### *3.1. Data*

Data on the analysis of sharing economy services by the city are presented in the Sharing Economy Index, prepared by the US Consumer Choice Centre, and in Smart City Index reports.

The Smart City Index database was selected for use in our study due to the presence of data in sufficient detail for 2019–2021 in 102 cities. The following indicators were chosen to assess the sharing economy:

- indicator that characterises the degree of the consent of citizens with the fact that "bicycle hiring has reduced congestion" ($X_1$);

- an indicator that characterises the degree of the consent of citizens with the fact that "car-sharing Apps have reduced congestion" ($X_2$);
- an indicator that characterises the degree of the consent of citizens with the fact that "a website or App allows to give away unwanted items to other city residents" ($X_3$).

The first and second indicators were used to assess the sharing economy in the field of transport. The third indicator characterises the services of the sharing economy related to the exchange of material goods. To evaluate the sharing economy services in the hospitality industry, we additionally used data from European Statistical Office reports on the development of collaborative economy platforms. Here, we used the total number of nights per capita booked through the collaborative economy platforms ($X_4$). The presented indicators allow us to consider the main directions of the sharing economy, which can be used in the development of the urban environment.

In the study, we looked at cities in Europe for which data is available in both databases for 2019 and 2020. The final list included 31 cities, including Rome, Barcelona, Bilbao, Madrid, Zaragoza, Prague, Lisbon, Bratislava, Kraków, Warsaw, Budapest, Athens, Bucharest, Sofia, Geneva, Dublin, Oslo, Copenhagen, Amsterdam, Rotterdam, Vienna, Berlin, Hannover, Gothenburg, Stockholm, Helsinki, Lyon, Paris, Bologna, Zurich, and Milan.

### *3.2. Methodology for Assessing the Sharing Economy*

As a methodological basis for assessing cities according to the development level of the sharing economy in terms of its social significance, the TOPSIS method was used. This method was first described in detail by K. Paul Yoon and Won Kyung [54]. The method has also been applied for ranking energy, medical, environmental, or automotive technologies, etc. Katarzyna Halicka uses this technique to select the most suitable road surface [55]. Elena Lobkova shows the application of this approach to assess the sustainable development of territories [56]. The first and preparatory stage includes a justification of the choice of indicators for assessing the sharing economy. The second stage consists of directly evaluating and ranking cities according to the level of development of the sharing economy. The third stage consists of comparing the data obtained with other estimates presented in the scientific literature and analytical studies. Let us consider the content of these stages in more detail.

Stage 1. Justification of selected indicators

To confirm the expediency of using the above-mentioned indicators to assess the sharing economy, data from Smart City Index reports were used, which characterise the citizens' assessments of urban development priority areas, including affordable housing, fulfilling employment, unemployment, health services, road congestion, air pollution, green spaces, public transport, school education, recycling, basic amenities, citizen engagement, security, social mobility, and anti-corruption [52].

We used correlation analysis to substantiate that these indicators can be used to assess the sharing economy in the context of its social significance. Here, the assessment of the social significance of the sharing economy services follows from the wording of indicators $X_1$ and $X_2$. However, we also compared these indicators with the list of the most significant problems in the cities. These indicators characterise the share of citizens who believe that there are problems in such areas as affordable housing, road congestion, air pollution, and social mobility [52]. Therefore, we determined whether there is a correlation between indicators of the sharing economy and the citizens' actual assessment of these problems. In the course of the correlation analysis, we used data for 2019 and 2020.

Stage 2. Calculation of the authors' integral index of the sharing economy

Preliminarily, we normalised the available data according to the Equation (1):

$$R_{ij} = \frac{X_{ij} - X_j^{min}}{X_j^{max} - X_j^{min}} \quad (1)$$

where $R_{ij}$—the normalised value of the indicator $j$ in the city $i$; $X_{ij}$—the value of the indicator $j$ in the city $i$; $X_{maxj}$—the maximum value of the indicator $j$; $X_{minj}$—the minimum value of the indicator $j$; $j$ characterises the city; $i$—number of the indicator in question.

The TOPSIS method was used to calculate the integral index (I).

First of all, the weight coefficients were calculated using the entropy method. For this, the values of the matrix R were standardised to obtain the matrix Z (2):

$$Z = (z_{ij}) = \left( \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \right) \quad (2)$$

$z_{ij}$—standardised values of the matrix R; $m$—the number of cities in the sample.

The value of the entropy coefficients $w_j$ are calculated by the formula:

$$w_j = \frac{(1 - e_j)}{\sum_{j=1}^{n} (1 - e_j)} \quad (3)$$

where $n$—number of indicators;

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} z_{ij} ln z_{ij} \quad (4)$$

Based on the obtained weight coefficients, a normalised matrix was constructed:

$$V = (v_{ij}) \quad (5)$$

where

$$v_{ij} = r_{ij}\, w_j \quad (6)$$

Then the ideal value of indicators $A^+$ (7) (the maximum value among the considered cities) and the worst solution $A^-$ (8) (the minimum value among the considered cities) were determined.

$$A^+ = [v_1, v_2, ..., v_n] = [\max v_{i1}, \max v_{i2}, \max v_{i3}, \max v_{i4}] \quad (7)$$

$$A^- = [v_1, v_2, ..., v_n] = [\min v_{i1}, \min v_{i2}, \min v_{i3}, \min v_{i3}] \quad (8)$$

When determining these values, it is assumed that the higher the value of these indicators, the better the integral index value is; the lower—the worse. Thus, the proximity of each value of the sharing economy indicator characterising a particular city to the best and worst values was determined. In the last step, the integral index of the sharing economy was determined, calculated by the Equation (9):

$$I = \frac{S^-}{S^- + S^+} \quad (9)$$

where $I$—value of the integral index of the sharing economy; $S^-$—distance to the worst value; $S^+$—distance to the best value.

$S^+$ and $S^-$ are calculated by Equations (10) and (11).

$$S_j^+ = \sqrt{\sum_{j=1}^{n} \left(V_i^+ - v_{ij}\right)^2} \quad (10)$$

$$S_j^- = \sqrt{\sum_{j=1}^{n} \left(V_i^- - v_{ij}\right)^2} \quad (11)$$

Based on the obtained values, a rating of cities was set according to the development level of the sharing economy in terms of its social significance.

Stage 3. Building a matrix of indices of the sharing economy

The next step consisted in comparing the obtained data with the data from the Sharing Economy Index prepared by the Consumer Choice Centre (Washington, DC, USA). We constructed a matrix where the ordinate axis represents the values of the integral index calculated in this study, while the abscissa axis represents the values of the Sharing Economy Index (CCC). In addition, we compared the data obtained and the results of previous studies, taking GDP per capita into account.

## 4. Results

### *4.1. The Potential of Sharing Economy Services in Solving Social Problems*

When establishing a connection between the development of sharing economy platforms for short-term rental, the heterogeneity of the impact of this type of activity on the indicator "proportion of citizens who believe that housing affordability is one of the main tasks requiring a priority solution" was established. We found a need to separate countries by income level. Thus, for countries with GNI per capita up to USD 40 PPP, the value of the Pearson correlation coefficient (PCC) was r = 0.69. These cities included Prague, Lisbon, Bratislava, Kraków, Warsaw, Budapest, Athens, Bucharest, Sofia. For the second group of cities (GNI per capita is from USD 40 to 55 PPP) PCC = −0.61. This group of cities included Gothenburg, Stockholm, Helsinki, Lyon, Paris, Bologna, Milan, Rome, Barcelona, Bilbao, and Madrid, Zaragoza. No correlation was found for cities where GNI per capita is more than USD 55 PPP. From the findings, we can conclude that for a group with a lower level of GDI per capita, the sharing economy can serve as an additional source of income and therefore have a positive impact on citizens' standard of living. However, the impact on housing affordability remains low. A negative correlation for the second group of cities shows that the sharing economy can positively impact solving the problem of housing affordability. According to the data for 2020, a positive relationship was found for all the cities under consideration (r = −0.047).

The significance of the impact of car-sharing and bicycle hiring on traffic congestion follows from the formulation of the indicators. Based on the 2020 data, a correlation between the car-sharing development and the social mobility of citizens (r = 0.42) can be identified. However, as of 2019, no such relationship was found. In addition, bicycle hiring has also been found to positively affect the social mobility of citizens (r = 0.43 in 2019; r = 0.44 in 2020, or in cities where more than 13% of citizens noted a problem with social mobility).

According to 2020 data, a negative correlation between the citizens' assessment of air pollution and car-sharing was found for cities in which less than 50% of citizens noted this problem (r = –0.4). According to 2019 data, r = 0.41. The 2020 data also found a negative correlation between the citizen ratings of donation platforms and air pollution in cities with low air pollution. Here we find it plausible that the functioning of these platforms could indeed positively impact the citizens' assessment of the air pollution level.

Despite the heterogeneity of the data obtained, we can conclude that the development of the sharing economy has a positive impact on solving social problems. These results confirm the possibility of applying the proposed above approach to assessing the social significance of sharing economy development in cities.

### *4.2. Ranking of Sharing Economy Cities*

In applying the TOPSIS method, an integral index for assessing the sharing economy was calculated. Table 1 presents both the values of the integral index and the rank of the analysed cities.

**Table 1.** The values of the integral index and the rank of the cities.

| | **The Value of the Integral Index (I)** | | **The City's Position in the Ranking** | | **Deviation** | |
|---|---|---|---|---|---|---|
| City | 2019 | 2020 | 2019 | 2020 | I | Ranking |
| 1 | 2 | 3 | 4 | 5 | 3–2 | 5–4 |
| Krakow | 0.81 | 0.77 | 1 | 1 | –0.05 | 0 |
| Warsaw | 0.67 | 0.74 | 2 | 2 | 0.06 | 0 |
| Prague | 0.61 | 0.51 | 3 | 10 | –0.10 | 7 |
| Budapest | 0.61 | 0.50 | 4 | 11 | –0.10 | 7 |
| Lisbon | 0.57 | 0.57 | 5 | 4 | 0.00 | –1 |
| Bologna | 0.57 | 0.55 | 6 | 6 | –0.02 | 0 |
| Barcelona | 0.56 | 0.55 | 7 | 5 | –0.01 | –2 |
| Milan | 0.56 | 0.54 | 8 | 7 | –0.02 | –1 |
| Madrid | 0.54 | 0.62 | 9 | 3 | 0.07 | –6 |
| Helsinki | 0.52 | 0.41 | 10 | 17 | –0.11 | 7 |
| Copenhagen | 0.49 | 0.45 | 11 | 14 | –0.04 | 3 |
| Dublin | 0.49 | 0.36 | 12 | 20 | –0.13 | 8 |
| Oslo | 0.48 | 0.42 | 13 | 16 | –0.06 | 3 |
| Vienna | 0.47 | 0.44 | 14 | 15 | –0.03 | 1 |
| Bilbao | 0.47 | 0.48 | 15 | 12 | 0.01 | –3 |
| Lyon | 0.46 | 0.52 | 16 | 9 | 0.06 | –7 |
| Amsterdam | 0.46 | 0.37 | 17 | 19 | –0.09 | 2 |
| Bucharest | 0.46 | 0.52 | 18 | 8 | 0.07 | –10 |
| Paris | 0.43 | 0.45 | 19 | 13 | 0.02 | –6 |
| Geneva | 0.37 | 0.36 | 20 | 21 | –0.02 | 1 |
| Zaragoza | 0.34 | 0.34 | 21 | 22 | 0.00 | 1 |
| Bratislava | 0.34 | 0.41 | 22 | 18 | 0.07 | –4 |
| Zurich | 0.34 | 0.34 | 23 | 23 | 0.00 | 0 |
| Rome | 0.30 | 0.22 | 24 | 30 | –0.08 | 6 |
| Berlin | 0.30 | 0.30 | 25 | 25 | 0.01 | 0 |
| Hannover | 0.29 | 0.26 | 26 | 28 | –0.03 | 2 |
| Athens | 0.28 | 0.30 | 27 | 24 | 0.02 | –3 |
| Gothenburg | 0.27 | 0.16 | 28 | 31 | –0.10 | 3 |
| Stockholm | 0.26 | 0.28 | 29 | 27 | 0.02 | –2 |
| Rotterdam | 0.22 | 0.22 | 30 | 29 | 0.00 | –1 |
| Sofia | 0.17 | 0.30 | 31 | 26 | 0.12 | –5 |

From Table 1, the social significance of the sharing economy in Poland becomes apparent. Warsaw and Krakow occupy the first positions in the ranking in 2019 and 2020. The positions of Prague, Budapest, Dublin, Helsinki, and Rome decreased by more than six points in the ranking, which was due to the introduction of restrictions due to the COVID-19 pandemic, which had a significant impact on both the demand for sharing economy services and the ability to use them. Another reason for the results obtained is the peculiarity of the indicators used, since three of them are inherently based not on

objective values of the sharing economy development, but rather the subjective assessments of citizens.

The correspondence of the values of the considered indicators to the integral index is presented in Table 2.

**Table 2.** Pearson correlation coefficient between the indicators and the integral index.

| Indicators | 2019 | 2020 |
|---|---|---|
| Number of nights per capita booked through the collaborative economy platform($X_4$) | 0.68 | 0.61 |
| Indicator characterising the degree of the consent of citizens with the statement that "car-sharing Apps have reduced congestion" ($X_2$) | 0.73 | 0.84 |
| Indicator characterising the degree of the consent of citizens with the statement that "bicycle hiring has reduced congestion" ($X_1$) | 0.65 | 0.52 |
| The indicator that characterises the degree of the consent of citizens with the statement that "a website or App allows unwanted items to be given away other city residents ($X_3$)" | 0.36 | 0.27 |

From Table 2 it follows that the integral index reflects an indicator characterising the degree of the consent of citizens with the fact that "a website or App allows unwanted items to be given away to other city residents ($X_3$)" to a lesser extent. This is caused by the method used to calculate the weight coefficients and the homogeneity of the indicator's values.

## 5. Discussion

In order to compare the obtained results with the data presented in similar studies, a matrix (Figure 1) was constructed. This shows the ratio of the author's integral index indicators, which is presented along the Y–axis and the values of the Shared Economy Index, which is calculated by the Consumer Choice Centre for 2020. The figure considers cities' data presented in the SEI (CCC, USA).

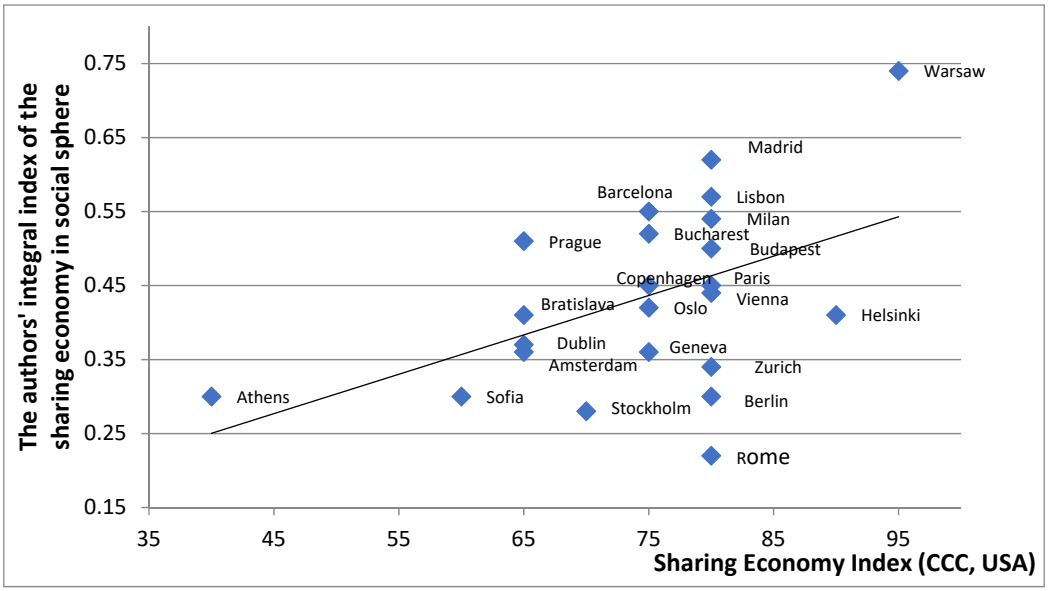


**Figure 1.** Comparison of the values of the authors' results and SEI (CCC, the USA).

In general, Figure 1 demonstrates the comparability of the presented data. In particular, this is confirmed for cities such as Warsaw, which received the highest ratings, as well as Milan, Bucharest, Copenhagen, Bratislava, Dublin, Athens, and others. The reason for the differences is that the index proposed in this study focuses specifically on assessing the social significance of the sharing economy services. The presented graph shows how the author's results correlate with the obtained data from similar studies.

Figure 2 shows the data obtained considering GDI per capita.

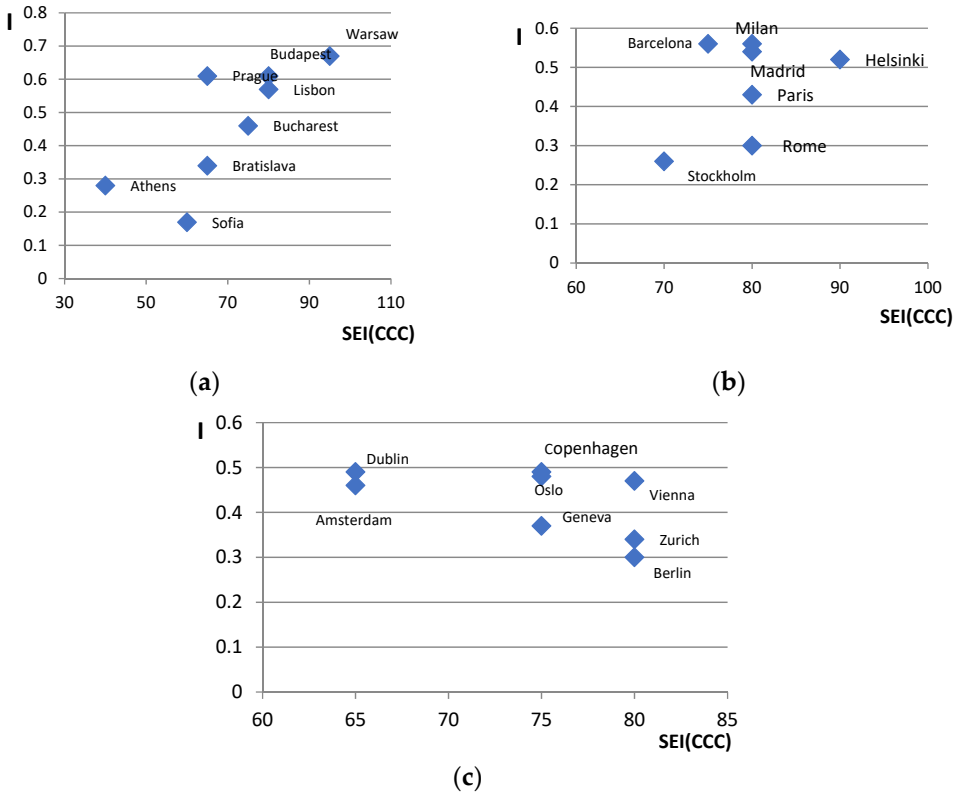


**Figure 2.** Comparison of the values of the authors' results and SEI (CCC, the USA) taking GDI per capita values into account: (**a**) cities, where GDI per capita USD <40 PPP, (**b**) cities, where GDI per capita from USD 40 PPP to 55 PPP, (**c**) cities, where GDI per capita more then USD 55 PPP.

From the analysis of Figure 2, it follows that the relationship between SEI values and the assessment of the social aspects of the SE is more traceable for countries with a lower level of economic development. For territories with high GDI values per capita, this conclusion is not confirmed. This is due to both the peculiarities of the methodology used and the higher level of social well-being characteristic of the territories under consideration.

The limitations of this study are primarily related to both the fragmented and heterogeneous nature of the indicators used and the uneven development of SE in practice. In particular, the rapid pace of sharing economy platform development in accommodations was affected by the COVID-19 pandemic, which limited people traveling and led to the rapid drop in sales of collaborative economy platforms. At the same time, the heterogeneous impact of COVID-19 is due to the restrictions imposed, the influence of state policy both during the pandemic and in relation to the development of the sharing economy, the impact of the sharing economy on GDI, as well as the existing social capital, which characterises the possible behaviour of citizens under crisis conditions.

Although we only considered the sharing economy development in the service sector and for P2P services, the development of this business model in the B2B sector is no less significant. One striking example of a socially oriented sharing economy project is given

in the organization of the production of pallets. Similar projects are not included in the presented technique [57].

The use of the sharing economy in the finance sector also has a high economic and social significance, requiring consideration in further research. The release of under-utilized financial resources and the attraction of financial resources for implementing social and environmental projects discover the high potential for sharing economy development.

Therefore, confirming the significance of the findings, the potential of the sharing economy is increasingly attracting the attention of researchers. For example, Acquier and Carbone (2018) note that "the sharing economy offers opportunities and organizational models that may be used to promote social innovation projects" [58]. Schor suggests that such innovative technologies of peer-to-peer economic activity are potentially powerful tools for building a social movement centred on genuine practices of sharing and cooperation in the production and consumption of goods and services [59]. At the same time, the study of the sharing economy also raises the question of what initiated the solution to social problems, whether the use of an online platform or, directly, the principles of shared consumption and access that underlie sharing economy projects [60]. Despite existing controversies about the risks generated by the sharing economy, in general, researchers recognize the social and environmental aspects in this consumption model, which confirms the appropriateness of its use in the development of the urban environment.

In general, the results obtained during the study are significant for the development of the urban environment per se, as well as demonstrating the high potential of the sharing economy in the development of urban services. This creates an opportunity for cooperation between public authorities and private enterprises, including digital platform operators, in terms of public good production in transport, air pollution, and housing affordability, etc.

## 6. Conclusions

In this study, we have shown that sharing economy projects can contribute to the development of the urban environment. The proposed approach to assessing the sharing economy in terms of its social significance allowed us to form a rating of cities in terms of the level of sharing economy development and track the dynamics of its development. The proposed approach can be modified in the light of new statistical data on the development of equity economy projects concerning the development of crowdfunding and crowdsourcing. These equity economy tools can also be used to increase the efficiency of underutilised resources to positively impact on the level of economic life in the city, increasing employment and stimulating civic initiatives. In addition, we have shown that the social significance of the sharing economy is most clearly traceable for countries with a lower level of economic development, which indicates the potential of its use for the development of the urban economy, including the public goods sector. Therefore, the practical significance of the results consists in determining the potential of this model development for urban economy improvement. At the same time, in the present work we did not analyse the negative social consequences of the sharing economy, which are observed to be especially problematic in the most developed territories. The potential for solving this problem and developing the sharing economy is seen in the design of supporting institutions aimed at emphasizing the positive effects of the sharing economy, at the same time as reducing the negative effects by revising the possibilities of using the sharing economy specifically for the public goods sector.

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