Digital Business system of sharing economy: How can European countries be segmented?

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Abstract—**Sharing economy, sometimes called collaborative consumption, is a concept, business model, and market in which individuals offer or rent their own assets which are not in use. Different types of sharing economy emerged from shared accommodation to sharing fashion items. No matter what is shared, the agreement on what is shared and under what circumstances is usually made via a website or platform within a digital ecosystem. The research question is how European countries can be segmented based on the characteristics of users of shared accommodation. The analysis was done on the Eurostat data from the ICT usage in households survey for 2019, while the applied segmentation (clustering) algorithm was k-means. The obtained results can be helpful in shedding light on how European countries can be grouped based on the characteristics of users of shared accommodation. It is believed that the research conducted in this study could act as a driver of further research on the topic of segmentation analysis of individuals and countries based on sharing economy activities.**

Keywords: Sharing economy, Shared accommodation, segmentation analysis, clustering, Digital business ecosystem.

I. INTRODUCTION

New communication tools (primarily Web 2.0 technologies) have opened up the possibility of mass sharing and dissemination of information and introduced the practice of contacting unknown and physically distant people [1]. The given ability inspired people to offer, share and use other person's resources, especially as the new technologies allowed for a simple and secure arrangement. Therefore, peer-to-peer activity through which access to goods and services can be given, obtained, and shared by coordinating the acquisition and distribution of a resource is defined as sharing economy [2].

The idea of "sharing" is nothing new, but how the "sharing" is organised and perceived is new. Literature suggests that the first forms of what we now call sharing economy appeared in the 2010s when companies like Uber and Airbnb started operating [1], [3]. What makes sharing in the sharing economy different from usual sharing is the presence of a platform and the Internet as mediators [4].

The main participants in the sharing economy are the platform provider, the service provider, and the customer [5]. In addition, it is essential to mention that politicians, local governments, and NGOs are also part of the sharing economy ecosystem and that their impact on the way sharing economy is organised and regulated is omnipresent [6].

The available data on the level of the European Union (hereinafter referred to as EU) on the level of usage of shared accommodation provided by Eurostat indicates that at the EU-27 level, there are visible differences [7]. According to the data for 2019, the country that had the lowest percentage of individuals who used any website or application for booking accommodation from another person is Cyprus (5%), while this type of hospitality is most represented in Luxembourg (46%). The average usage at the EU-27 level is 21%. Intercountry differences at the EU level related to the openness and proneness to using shared accommodation visibly exist.

The main research question of this study is how European countries can be segmented based on the characteristics of users of shared accommodation. The analysis was done on the Eurostat data from the ICT usage in households survey for the year 2019, while the applied segmentation (clustering) algorithm was k-means.

The obtained results can be helpful in shedding light on two aspects. First, the results could unveil how European countries can be grouped based on the characteristics of users of shared accommodation. Second, the results could indicate consumer behaviour patterns when using any website or application to arrange accommodation from another individual. Policy-makers at the micro and macro level could be provided with valuable insights which can assist them in developing new policies or modifying current ones, which will act as an impetus towards individuals to share their accommodation and for others to turn to shared accommodation. Also, the segmentation analysis results could be used for benchmarking purposes as well.

The paper has the following structure. After the introductory part, we will provide insights into the digital business system of sharing economy. In section three, the indicators provided by Eurostat, which were used for seg-

mentation, are presented. Besides presenting the indicators, the methodological aspects of the data collection process are outlined as well. In the next section, we outline the methodological aspects of the conducted research as well as the research results. Discussion and concluding remarks are given in the last section.

II. DIGITAL BUSINESS SYSTEM OF SHARING ECONOMY

Digital sharing economy (DSE) is defined as "*A class of resource allocation systems based on sharing practices which are coordinated by digital online platforms and performed by individuals and possibly (non)commercial organisations with the aim to provide access to material and immaterial resources. Digital sharing systems operate in the space between traditional sharing and the formal economy*" [8].

According to the report of the PANACEA project related to setting foundation for capacity building of sharing community in Serbia, there are two main business models in sharing economy [1].

The first model encompasses the model in which a company (provider) owns the specific resources and "shares" them via platform. Using the platform the provider achieves a bilateral relationship with the customer [9]. In this case, the provider provides the user with a resource for a limited amount of time for a predetermined price. This model is a B2C model, a business-to-consumer model. Examples of companies operating on this model are Car2Go and ZipCar.

The other model, a more decentralised one, is the model in which the transaction happens between two individuals, thus creating a peer-to-peer (P2P) (or even customer-to-customer C2C) sharing network [10]. Again, all communication and transactions take place on the platform. Examples of companies operating on this model are AirBnb and BlaBlaCar.

As we can see in both models, one of the prerequisites is the technology. Technologies which enable the function of sharing economy are digital platforms, mobile applications, big data, cloud solutions, Internet of Things (IoT), artificial intelligence (AI), machine learning (ML) and blockchain [11].

According to Wirtz et al. [12], sharing economy platforms are a specific type of platform alongside platforms for communication, content and review, social media, booking aggregator, retail, payment, and others. The platforms act as matchmakers, enabling interaction between service seekers and providers. Mobile applications allow providers to offer assets and customers to search for assets 24/7 from every corner of the world. Using big data and cloud solutions, the number of participants in the sharing economy and the number of transactions is unlimited. Internet of Things (IoT) allows to constantly monitor asset location, among other parameters, while AI and ML assist in predictions and personalisation. Finally, blockchain technology is used to build trust in the sharing economy system [11].

III. INDICATORS OF SHARING ECONOMY AVAILABLE FROM EUROSTAT

The data available in the Eurostat database, which refers to the sharing economy, is the data collected within the cycle of surveys on the use of information and communication technologies (ICT) in households and by individuals (ICT usage in households and by individuals (isoc_i)). This survey was conducted for the first time in 2002, and every year it is improved, modified, and new questions and groups of questions are included in the questionnaire to describe the use of ICT [7] more precisely.

The statistical unit of the survey are households and individuals. Households are defined as all private households having at least one member in the age group 16 to 74 years, while individuals are those aged 16 to 74. In some countries there are data for participants who are younger than 16 and older than 74, but that does not account for the majority of EU countries.

Regarding the country coverage, the annual ICT survey is conducted in all EU member states, United Kingdom (UK), Iceland, Norway, Switzerland, candidate countries and potential candidate countries. Here we should point out that for candidate countries and potential candidate countries, there are missing or imputed data for multiple indicators. Therefore, in our analysis, we observed the EU member states, UK, Iceland, Norway, and Switzerland.

In order to better understand and interpret the results, it is important to present how was the question related to shared accommodation defined and what was the precondition to answering it.

The precondition for the respondent to answer the question related to the usage of the shared accommodation is that he/she has used the Internet in the last year. In the question related to the usage of shared accommodation, the respondents were asked to indicate whether they had used a website or application to purchase accommodation services from another individual in the past twelve months. In order to include only P2P and exclude the B2P segment, the use of websites and applications of hotels, motels, campsites, travel agencies, tour operators and alike was not taken into account. The focus was on the accommodation reserved for vacations, as well as private purposes trips. It is important to note that the transaction and contracting are supposed to have been made through a website or application, while the payment methods were not the focus [13].

The question is defined as a multiple-choice question. The three answers offered were: a) Yes, through a specific website or application that allows the purchase of accom-

modation services from others, b) Yes, through any web-site or application that allows the purchase of accommo-dation services from others (e.g. social networks) and c) No, I have not [13]. The first answer offered involves the use of a specific website or application that allows book-ing and renting accommodation. An example of a company mentioned in this question to help respondents understand the question is Airbnb or examples of similar companies operating nationally. The second answer offered is about using any website or application. An example would be that through a certain Facebook group, an individual found accommodation and made a reservation.

An aspect important for the conducted study is the format in which the data is available. The main indicator provided is the percentage of individuals that used shared accommodation. However, Eurostat provides categorised data as it provides the percentage of individuals that used shared accommodation per gender, educational attainment, age group, income group, and their combinations.

IV. CONDUCTED RESEARCH

A. Research methodology

To answer the research question which is how European countries can be segmented based on the characteristics of users of shared accommodation, we first collected the data on sharing accommodation available from the Eurostat. We collected the data for the year 2019 for the following 13 indicators: All Individuals [all_individ], Individuals 16 to 24 years old [age16-24], Individuals 25 to 34 years old [age25-34], Individuals 35 to 44 years old [age35-44], In-dividuals 45 to 54 years old [age45-54], Individuals with no or low formal education [no_low_edu], Individuals with medium formal education [med_edu], Individuals with high formal education [high_edu], Individual living in a household with income in first quartile [LHW_1Q], Individual living in a household with income in second quartile [LHW_2Q], Individual living in a household with income in third quartile [LHW_3Q], Individual living in a household with income in fourth quartile [LHW_4Q], and Students [students]. We considered the effect of age, edu-cational attainment, and household income. The data used in this research is publicly available on user demand. We collected the data for EU-27, Norway, Iceland, Switzer-land, and the UK. The link to the dataset is provided in the reference list [14].

After the data was collected, in the next step, a cluster-ing algorithm was applied. We opted for k-means cluster-ing [15]. Literature suggests that k-means clustering effec-tively produces good clustering results in various fields of study [16], [17]. This clustering algorithm partitions the observed entities into a predefined k number of clusters. Each observation belongs to the cluster with the nearest mean, serving as the centre of the cluster [18]. The objec-tive function is to minimise the sum of squares between the entities and the cluster centre. Although the algorithm has many benefits, one of its drawbacks is that the number of clusters should be predefined and that the presence of outliers can distort its results [18]. Clustering has been pre-viously applied with success in segmenting users of shared transport [19], shared accommodation [20], micro-mobili-ty and shared scooters [21], so we as well applied it in our study.

B. Descriptive analysis results

The first step in the analysis was the descriptive analysis of the collected data. The results are presented in Table I.

Table I. Descriptive statistics of the collected data

Indicator	Min	Max	Mean	Std	IQR
all_individ	5.250	33.890	18.524	7.453	10.677
age16_24	5.730	42.990	20.711	9.196	14.435
age25_34	9.350	45.400	28.232	9.867	17.535
age35_44	6.140	41.530	23.861	9.216	13.566
age45_54	3.560	33.880	18.441	8.232	15.122
no_low_edu	0.480	16.840	7.468	5.096	9.050
med_edu	3.130	35.630	16.375	7.999	13.525
high_edu	9.110	56.880	31.637	11.537	18.650
LHW_1Q	1.680	20.440	10.243	5.653	9.852
LHW_2Q	2.820	20.410	11.548	5.024	9.428
LHW_3Q	5.440	35.620	16.697	7.500	12.910
LHW_4Q	6.440	47.210	24.240	10.153	16.775
students	6.060	37.000	20.750	8.670	15.345

To perform the descriptive analysis, we obtained the minimum (Min), maximum (Max), mean (Mean), standard deviation (Std), and interquartile range (IQR) for each of the 13 indicators. Observing the means, we can say that they range from 7.468% (no_low_edu) to 31.637% (high_edu). Interestingly, the indicators with the highest and the lowest mean are those related to the usage of shared ac-commodation based on educational attainment. Standard deviations are high and range from 5.024% (LHW_2Q) to 11.537% (high_edu). High standard deviation and high mean of the indicator high_edu indicate that in some coun-tries, the usage of shared accommodation among those with higher education is high, while in some, it is extreme-ly low. The results of the IQR point out that there is a vis-ible level of variability in the usage of shared accommo-dation among European countries according to different socio-demographic groups and characteristics.

The next step in the descriptive analysis was to explore whether there are multivariate outliers, as it is known that they can distort the results of clustering algorithms [22]. The presence of outliers was inspected using Mahalanobis distance [23]. This analysis was done in SPSS 29. The pro-cedure is such that if a value of Mahalanobis distance has a p-value less than 0.001 for the Chi-square distribution with, in our case, 12 degrees of freedom, a country would be considered an outlier. Our initial analysis pointed out

that Luxembourg was the closest to be an outlier with the p value of 0.025. According to the suggested threshold, Luxembourg is not an outlier, but as further clustering results indicated it distorted the results, we decided to exclude Luxembourg from further analysis.

C. Segmentation results

The k-means clustering was performed in R using the "cluster" package [24]. As mentioned above, when conducting k-means clustering, the number of clusters should be predefined. To decide on the number of clusters to retain, we used the between sum of squares and total sum of squares ratio. We calculated the ratio for four cluster structures; for two, three, four, and five retained clusters and noted the cluster structures (Table II). The ratio ranges from 56.8% to 79.4%. The increase in the number of clusters retained leads to a higher ratio, which is expected. However, the cluster structure should be taken into account. We opted for a three-cluster structure as the ratio is 67.4% and the three clusters are relatively similar in size.

Table II. Evaluation of different cluster structures

No. of clusters retained	2	3	4	5
between_SS / total_SS	56.8%	67.4%	75.3 %	79.4 %
Cluster sizes	17, 13	13, 10, 7	8, 7, 3, 12	6, 7, 7, 3, 7

The list of countries within each of the three retained clusters is provided in Table III. The first cluster is named *Advanced users* and within it we can find countries like France, Belgium, Italy, and Spain. The second cluster is named *Intermediate users* and countries like Greece, Norway, and the UK are in it. The final cluster is named *Beginners* and encompasses countries like Slovenia, Bulgaria, Denmark and the Czech Republic.

Table III. Segmentation of european countries based on the users of shared accommodation

Cluster 1 – Advanced users	Cluster 2 – Intermediate	Cluster 3 - Beginners
Belgium	users	Bulgaria
Croatia	Austria	Cyprus
Estonia	Finland	Czech Republic
France	Greece	Denmark
Germany	Hungary	Latvia
Ireland	Iceland	Romania
Italy	Lithuania	Slovenia
Malta	Norway	
Netherlands	Poland	
Slovakia	Portugal	
Spain	United Kingdom	
Sweden		
Switzerland		

To better understand the cluster structures and the behaviour of consumers in them, in Table IV, we present the mean values of each indicator per cluster.

cluster	all_individ	age 16_24	age 25_34	age 35_44	age 45_54
1	24.658	28.374	36.819	31.218	24.767
2	17.816	18.695	26.325	23.343	17.889
3	8.144	9.360	15.010	10.939	7.484
cluster	no_low_edu	med_edu	high_edu	LH-W_1Q	LH-W_2Q
1	10.498	23.165	40.512	13.633	14.811
2	7.262	14.695	29.901	10.344	11.895
3	2.139	6.164	17.637	3.713	4.993
cluster	LH-W_3Q	LH-W_4Q	students		
1	21.979	31.615	28.451		
2	16.218	22.830	18.341		
3	7.573	12.559	9.893		

Considering the coordinates of cluster centres, which are the mean values per cluster, visible differences could be noticed among the clusters. Firstly, cluster number one, *Advanced users*, is the cluster with the highest centre scores per each variable. Therefore, it is notable that countries within it are the ones where citizens with different socio-economical backgrounds are engaged in using shared accommodation. Particularly, this cluster excels mostly in the population aged 16-24, 35-44 and through medium level of education. Cluster two pointed out countries in which citizens are using shared accommodation in a certain percentage, but that percentage can be improved. For example, in these countries, only 18.341% of students, on average, use shared accommodation. The third cluster, the *Beginners*, showed in which countries the concept of shared accommodation is or not popularised or is slowly emerging or countries in which the citizens do not trust or do not have sufficient knowledge to use sharing accommodation platforms.

The four non-EU countries (Iceland, UK, Norway and Switzerland) have found their places in the first and second clusters, respectively. This means that non-EU countries are on the advanced and intermediate level of shared accommodation usage even if not in the EU.

Additional visualisation of the clustering results is given in Fig. 1. Countries within Cluster 1 are marked in red, those in Cluster 2 in green, and those in Cluster 3 in blue.
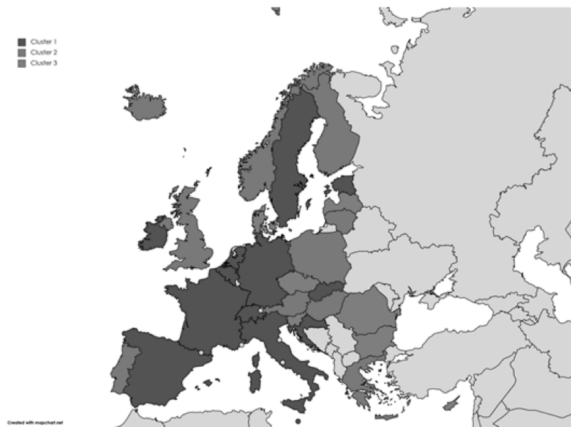
Fig. 1. Visualisation of clustering results on the map of Europe

V. DISCUSSION AND CONCLUSION

The level of participation in the sharing economy is expected to flourish as it provides personalised customer experiences [25]. Nevertheless, significant differences between european countries exist related to the usage of shared accommodation.

The survey conducted by Eurobarometer in 2016 showed that the majority of Europeans are aware of the sharing platforms, whereas only 17% of them actually use them [26]. The same survey indicated that there are visible country-level differences. According to the results, respondents in Greece and Portugal are more trustworthy towards the provider compared to respondents in Slovenia. Expectations of respondents from Latvia and Bulgaria who used sharing economy have not been mostly met, while the respondents in Romania, the Czech Republic and Cyprus need more information on the provider than it is currently offered [26].

The results from the newer wave of Eurobarometer survey are from 2018. The updated results indicate that 23% of Europeans use sharing economy platforms, pointing out an increase from 2016 [27]. However, the report also states that the differences in usage among countries are still significant.

According to Munkøe [28] by who states that "differences in the use of and the rules governing sharing economy services may well result in different approaches by national regulators". It is clearly evident that the signals from policy-makers and governing bodies are detrimental for the (non)participation in the sharing economy. To better understand and unlock the results of this study country-level policy analysis should be conducted.

The results of the study indicate that there are differences in consumer behaviour on the European level based on their socio-economic background when it comes to using shared accommodation. Most countries in Western Europe are advanced users of shared accommodation, countries in central Europe are intermediate, while countries in Eastern Europe are discovering shared accommodation services.

Although the presented study is promising, its results should be interpreted in light of its limitations. The first limitation of the study is the data used. The Eurostat data is reliable and reputable, but the latest available data is for the year 2019, which is four years ago from the current moment. Since 2019 COVID pandemic happened, as well as significant economic and political turmoil which have impacted sharing economy and sharing accommodation patterns [29], [30]. It would be interesting to conduct the analysis on more recent data, compare the segmentation results, and inspect how the sharing accommodation patterns changed in the previous period. Again, a limitation to the data can be discussed. The data provided by the Eurostat is on a country level. Data on the country level can provide valuable insights, but city data could be used to detect prominent tourist destinations, point out cities in which tourism is evolving, or tourist destinations which are losing attractiveness among tourists. Data on the individual level would allow us to even better understand the sharing economy user and provider.

Having in mind the type of available data, two future directions of the study emerge. The first is related to the application of more advanced segmentation techniques. In this study, clustering and k-means algorithm was applied. Clustering groups entities which behave in the same way taking into account all chosen variables. However, it would be interesting to go further and segment entities based on the specific pattern behaviours [31]. The analysis that allows for creating more coherent and precise segments is biclustering first emerged with the study of J.A. Hartigan, a professor of statistics at Yale University [32]. Since then, the application of biclustering has expanded. Biclustering is now used in different fields, such as marketing [33] and tourism research [34]. The second future direction of the study might be a longitudinal study. At the moment, Eurostat provides data for 2017, 2018, and 2019. It would be of interest to conduct related samples analysis [35] and simulation analysis [36]. Related samples analysis would reveal did and how the usage of shared accommodation changed in the three-year period. This analysis could be done for different types of data available and could reveal whether the behaviour of a particular socio-demographic group changed. These results could be beneficial to various stakeholders involved in the sharing economy.

Having in mind the presented results, observed limitations and defined future directions of the study, we can conclude that the ecosystem of sharing economy is developing, that there is interest in participating in the sharing economy, but that more research should be done to better understand the motivation, drivers, and perception of all the participants in the business model. It is believed that this research might trigger more in-depth segmentation analysis on the users of shared accommodation not only on the level of EU area, whereas on the national level as well.

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