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The Sharing Economy in the Framework of Sustainable Development Goals: Case of European Union Countries

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Abstract: The aim of this research study was to establish a framework for the relationships between the sharing economy and the Sustainable Development Goals (hereinafter, SDGs) set by the United Nations. There are 17 SDGs with 169 targets, which, in the scientific literature, are classified into sustainability dimensions: economic, social, and environmental. Thus, the objective of the current research was to perform an economic assessment of the sharing economy in the context of SDGs by analyzing European Union countries with a particular emphasis on their economic growth. Although the sharing economy has been analyzed from different aspects in recent scientific articles, the impact of this phenomenon on national economies in the framework of SDGs is lacking. Firstly, based on the latest research on the sharing economy from the perspective of sustainable development, a theoretical model of the sharing economy was developed in this study. Secondly, SDG indicators in the economic dimension and other key economic growth variables for European Union countries were collected. Thirdly, a cluster analysis was performed to determine the impact of the sharing economy on European Union countries in terms of SDGs in the economic dimension. The current study contributes to the existing research by analyzing the sharing economy from the perspective of sustainable economic development and highlights that this business model positively impacts countries' economic sustainability in terms of SDGs.

Keywords: sharing economy; Sustainable Development Goals; economic development; sustainability

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1. Introduction

The growth of the sharing economy and the notable attention that it has received from researchers, entrepreneurs, practitioners, policymakers, citizens, and other users illustrate the worldwide socio-economic importance of this phenomenon. Over the past decade, the sharing economy has been defined with various terms, such as "the mech" [1], "collaborative consumption" [2], "access-based consumption" [3], "crowd-based capitalism" [4], "in web platforms facilitated peer-to-peer exchanges" [5], and "access-based consumption of products and services that can be online and offline" [6]. In several research studies, the sharing economy has been characterized as an economic business model facilitated by the internet and based on digital platforms and/or applications, with an emphasis on access to underutilized goods or services instead of ownership [7–9]. The current study contributes to the above-mentioned definition of the sharing economy and demonstrates its importance in countries' sustainable development.

Some authors have argued for the importance of the sharing economy as a phenomenon that generates sustainable value creation [10]. This highlights the relevance of the sharing economy from the perspective of reducing consumption and resource and energy usage, thus potentially supporting the achievement and improvement of Sustainable Development Goals (hereinafter, SDGs) [11,12]. The activities of this economic model generate enormous value in national economies worldwide: the annual value of the sharing economy is estimated to rise from 14 billion in 2014 to 335 billion in 2025 [13]. The

above-mentioned numbers imply the potential scope of the sharing economy's impact on countries' economic development and highlight the need for scientific insights into this issue. Furthermore, the sharing economy has become even more essential for countries' sustainable development in the era of climate change [14].

However, although the sharing economy has been studied in the context of sustainability and characterized as "an opportunity for sustainability" [15], a research gap remains due to the lack of a clear set of measurable variables of the sharing economy's impact on countries' sustainable development in the framework of SDGs. Furthermore, the analysis of statistical data regarding the sharing economy in the framework of SDGs is virtually absent from the economic literature.

Previous researchers [14,16] have studied the sharing economy with a focus on high-income countries and, thus, significantly less research has analyzed this issue in the context of sustainable development in low-income countries. Considering the given context, this is also a pertinent aspect and should be included in the scope of the current research.

Thus, considering the above-described context, the aims of this article is to analyze the sharing economy in the context of SDGs; to develop a conceptual model to compare the impact of the sharing economy on sustainable development based on SDGs among countries; to group and compare the statistical data of European Union (hereinafter, EU) countries from the perspective of the sharing economy in the framework of sustainable development in order to present the most significant variables; and to analyze the generated groups and determine whether the sharing economy is more relevant and active in high-income countries by measuring the sustainable economic development progress based on statistical data of EU countries in 2018.

Therefore, this study contributes to the existing literature by analyzing the potential sustainable value creation of the sharing economy and its impact on countries' economies, presents an assessment of the sharing economy in the framework of SDGs, and provides an overview of European Union countries based on statistical data from 2018.

This research makes several relevant contributions: for academics, a theoretical overview of the sharing economy's impact on countries' sustainable development is provided in the framework of SDGs; for researchers, prospective lines of future investigation are revealed; for entrepreneurs, a scientifically supported opportunity to innovate using the sharing economy business model [17] and, moreover, to complement the achievement of SDGs is offered; and for policymakers, evidence of the sharing economy's effects and sustainability performance is provided by an analysis based on statistical data of EU countries.

The remainder of this paper is structured as follows. Section 2 provides the theoretical background and literature review of the sharing economy and its relationship with sustainability and SDGs. The section also presents the conceptual model of the sharing economy's impact from the perspective of countries' sustainable development based on SDGs. The data and methodology of the implemented research are presented in Section 3. Subsequently, Section 4 provides descriptive statistics and cluster analysis results of 27 EU countries based on 24 variables that measure the sharing economy in the framework of SDGs and sustainable economic development. Finally, Sections 5 and 6 present the discussion and conclusions of the paper.

2. Literature Review

2.1. Definition of the Sharing Economy

Over the past decade, a considerable number of definitions have been provided for the sharing economy in the research literature on this phenomenon. In the academic discourse [3,18–21], the sharing economy is mainly described as an economic ecosystem that is typically based on temporary access to goods or services using internet-based platforms that connect different members of communities (buyers and sellers, or users and providers). Some literature of the sharing economy [21] points out that the sharing

economy reduces transaction expenses and fosters trust to share items among unknown persons enabling this phenomenon to compete with traditional business.

Several recent studies on the sharing economy [8,10,21–27] have argued that the sharing economy increases the usage of underutilized items, usually for money but sometimes for free (for instance, couch surfing (free home sharing) and freecycle (providing free underutilized items to peers)), avoiding overconsumption. Thus, this study maintains that the sharing economy can be described as a business model that operates on these essential bases: (1) access economy, (2) platform economy, and (3) community-based economy, where underutilized assets are shared. Therefore, the main performers of the sharing economy are the providers of the shared items, the users/consumers, and information technology (hereinafter, IT) platforms.

Following the above-mentioned reasoning, the theoretical overview of the sharing economy is presented in Figure 1. The sharing economy is defined as the interaction between the providers of shared items and users mediated by IT platforms, facilitating access to items instead of ownership [28]. The access economy arguably demonstrates the initiative of sharing underutilized resources to improve their effective use, leading to resource optimization. Recently, companies have offered services to users instead of selling products; in the economic literature, this phenomenon is called the "product-service system" or "servitization" [18], for instance, car-riding services, accommodation, luxury clothes, and expensive tools and equipment. The second basis of the sharing economy, the platform economy, accurately maintains that the activities of the sharing economy are supported by digital solutions, where providers and users act to generate expected value according to the needs of the involved party. Therefore, this opportunity provides a comprehensive and secure transaction system of the sharing economy, generating economic, social, and environmental value for the actors of this business model. Research conducted by [8] indicates that the main function of the sharing platform is to moderate and facilitate social interactions and economic transactions among the actors of the sharing economy. The third basis of the analyzed phenomenon, the community-based economy, represents activities regulated with the help of "non-contractual, non-hierarchical, or non-monetized forms of interactions" [18]. Researchers indicate that building solidary communities, achieving social missions, and having common aims are the primary purposes rather than the creation of economic value.

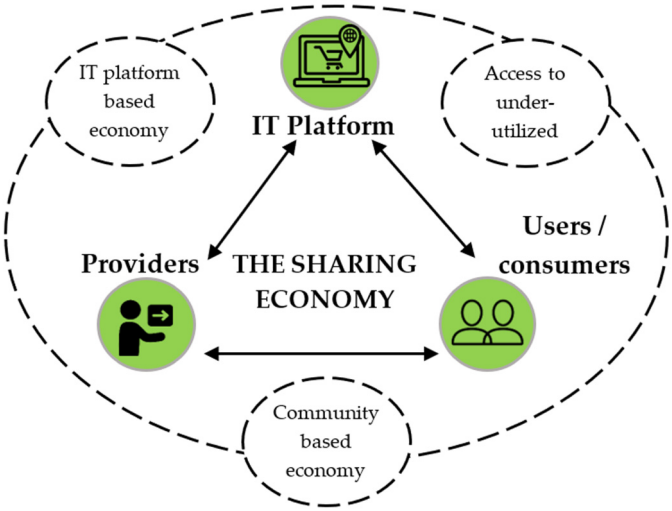

Figure 1. Theoretical overview of the sharing economy. Source: created by the authors.

Currently, the sharing economy involves different types of shared items with varying degrees of tangibility (products, space, money, services, workforce, data and knowledge, etc.). This phenomenon achieved popularity with the prosperity of startups, such as Uber, Airbnb, Lyft, and Zipcar [9]. Thus, the operations of the sharing economy have a significant

effect on the economies of countries all around the world. For instance, Statista predicts that the value of the global sharing economy will reach USD 335 billion by 2025, while it was USD 14 billion in 2014 [13]. However, these estimations were made before the beginning of the coronavirus pandemic, which has had an unfavorable impact on global economies. Notably, Uber had a market value of USD 71 billion at the beginning of 2020, which had dropped to USD 37 billion by spring of 2020, and GrubHub (food-delivery service), respectively, dropped from USD 5.35 billion to USD 2.92 billion [13].

Overall, economic research indicates that the sharing economy redirects profits from business, industry sectors and firms; for instance, in February 2019, Airbnb managed to achieve greater prosperity in the accommodation market than global hotel chains, such as Marriott [13].

The above studies highlight the importance of the sharing economy in providing opportunities for the sustainable economic development of countries.

2.2. The Sharing Economy in the Context of Sustainable Development and SDGs

This research supports the arguments provided in previous studies, e.g., [11,28–30], that the sharing economy acts based on access to underutilized goods or services. This statement indicates that the sharing economy shifts markets towards a sustainable ecosystem by impacting it from the perspective of economic, social, and environmental development. Further, the research conducted by [8] explains that the sharing economy is not sustainable by default; the authors define this phenomenon as a socio-economic system that leverages a technology-based market and contributes to more sustainable consumption by using underutilized assets.

In recent research, "access over ownership" is stated as an essential factor in conceptualizing business improvement for sustainability [5,8,26,27]. However, "access over ownership" by itself is not sufficient to ensure economic sustainability, especially in cases of hyper-competition (for instance, bike-sharing boomed, and then the bike-sharing platform flooded the market and generated overcapacity, resulting in underutilized goods in China in 2016) [10]. Thus, the sharing economy has the advantage of increased sustainability compared with traditional business systems. In the context of sustainability, the stakeholders of this system are the owners and users of the shared items, enterprises, and public authorities or governments (Figure 2).

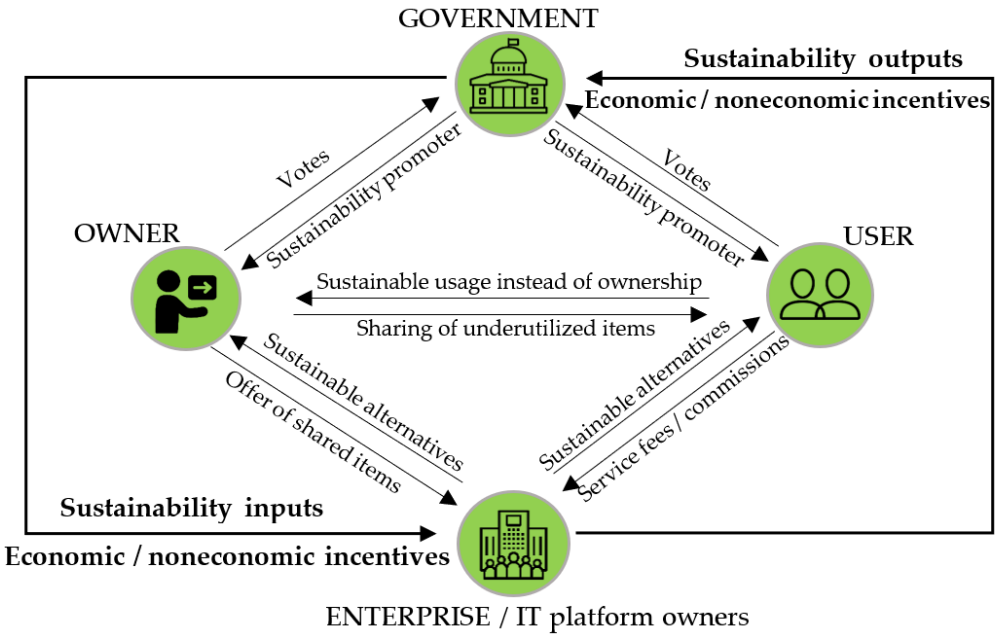

Figure 2. The framework of the sharing economy in the context of sustainability (according to [11]).

Governments potentially have the greatest ability to promote the growth of sharing models by offering economic (for example, reduced taxes and subsidies) or non-economic incentives. Therefore, even non-economic incentives (for instance, communication campaigns and referencing) can be transformed into economic benefits for enterprises. Enterprises highlight sustainability as one of the main objectives of the sharing economy instead of utilizing it as a business development tool [11]. Finally, the owners and users of shared items play crucial roles in the framework of the sharing economy by selecting to share or use underutilized goods or services rather than purchasing or selling items, and sustainability is potentially a key aspect of these decisions.

Furthermore, in several studies [15,28], the sharing economy is framed as an economic advantage that enables more sustainable consumption of shared items and thus serves as a pathway to a healthy and sustainable economy. These considerations [8,11,13,30] highlight the links of the sharing economy to the sustainable performance and development of countries' economies, as well as its effects on SDGs.

SDGs are a blueprint for achieving global sustainable development by 2030 and were adopted by the General Assembly of the United Nations in 2015 [31]. There are 17 SDGs, which have 169 targets with indicators to monitor the global progress of economic, social, and environmental development.

A systematic literature review analyzing the links between the sharing economy, sustainability, and SDGs was performed by [15] for the period from 2010 to May 2020, and the results show that the sharing economy is an opportunity for the sustainable development of countries. Recently, researchers [15] analyzed 61 papers on the sharing economy and sustainability aspects and 13 papers related to the theme of the sharing economy and SDGs. In this systematic review, the sharing economy was observed to influence the sustainable development of countries and to relate to the SDGs. The Stockholm Resilience Centre classifies the targets of the SDGs into three dimensions: economic, social, and environmental [32]:

- Economic dimension: SDGs 8, 9, 10, and 12;
- Social dimension: SDGs 1, 2, 3, 4, 5, 7, 11, and 16; and
- Environmental dimension: SDGs 6, 13, 14, and 15.

This study focuses on the economic dimension of countries' sustainable development in the framework of SDGs [32]. Thus, the SDGs "Decent Work and Economic Growth" (SDG 8), "Industry, Innovation and Infrastructure" (SDG 9), "Reduced Inequalities" (SDG 10), and "Responsible Consumption and Production" (SDG 12) [33] were used as part of the basis of the conceptual model in this research (Figure 3). Economic variables of business development, such as the new business density registrations and venture capital percentage of countries' GDPs, were added to the conceptual model as important aspects reported in the analyzed research studies [13,20]. New business development opportunities and their importance for sustainable development are highlighted in various research studies [10,25], and venture capital investments are reported to be a significant element in the emergence of the sharing economy [24–26,34].

As in the sharing economy, IT-based platforms are arguably an essential element of the sustainable business model. Thus, the technology and innovation factor appears to play a relevant role in the above-listed conceptual model based on the research analysis [35].

Although previous studies have been conducted on the sharing economy and its importance for the economic performance of countries, a complete comparative analysis on the impact of this phenomenon on countries' sustainability and especially its relationship with SDGs is still lacking. The proposed conceptual model may be a step toward filling this gap.

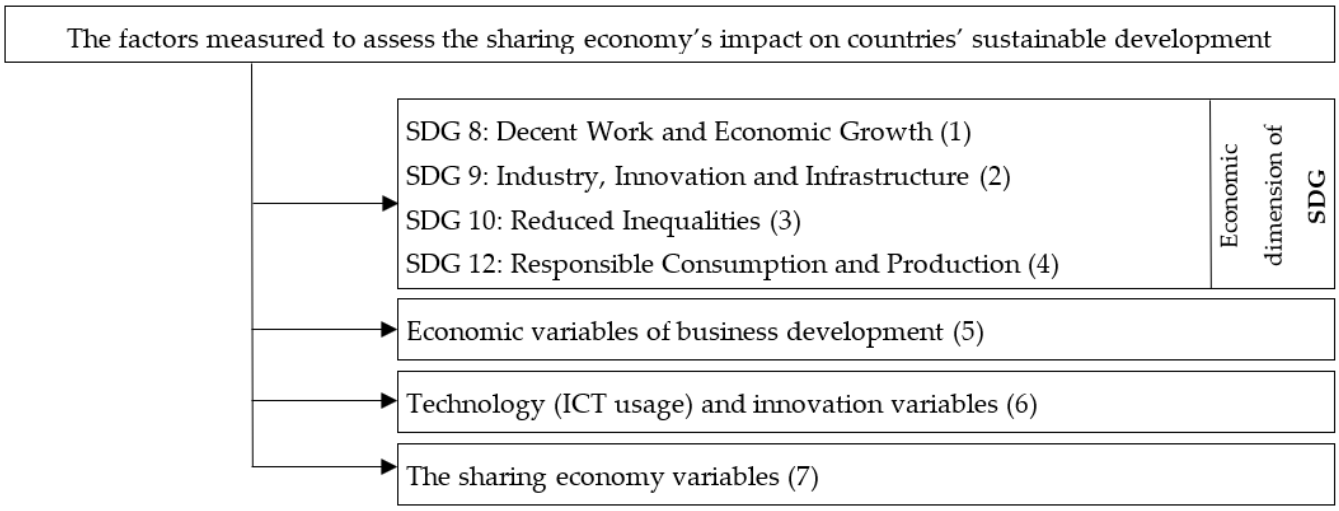

Figure 3. The conceptual model for comparative analysis of the impact of the sharing economy on countries' sustainable development based on SDGs.

3. Data and Research Methodology

This section presents the data and methodology used to analyze the sharing economy in the framework of SDGs in the economic dimension and other economic variables: measuring new business development, information, and communication technology (hereinafter, ICT) usage and innovation, and e-commerce measurement in the context of the collaboration economy (a synonym for the sharing economy) [2]. The below-described technique was used to group and compare statistical data on the sharing economy in EU countries in the framework of sustainable development in order to identify the most significant variables and to analyze the generated groups. Furthermore, the resulting groups were analyzed to determine whether the sharing economy was more active and relevant to the progress of sustainable economic development in high-income countries based on statistical data for EU countries in 2018. Following the theoretical analysis presented in Section 2, 24 variables measuring the sharing economy in the framework of SDGs and sustainable economic development were grouped into seven factors (Table 1).

The data sample used in this research is based on European Union countries (27 countries, excluding the United Kingdom), and the statistical data of 2018 were obtained from the open data available from World Bank datasets, Eurostat, and the European Innovation Scoreboard. The indicators measuring progress towards SDGs 8, 9, 10, and 12 were collected, and then some ("Share of rail and inland waterways in total freight transport" (related to SDG 9), "Manufacturing, value added" (related to SDG 9), and "Adjusted gross disposable income of households per capita" (related to SDG 10)) were eliminated because of missing information for some of the countries. The calculations in this research were performed using R software.

Descriptive statistics (Table 2) of the research data reveal remarkable asymmetry among the researched countries in 2018. Visualization of the main variables of descriptive statistics is presented in the figures of Appendix (see Appendix A, Figures A8–A28) presenting the distribution of variables in 2018.

The significant disparities are in the ratio of gross domestic product (hereinafter, GDP) to the average population, which corresponds to SDG 8. The statistics show that the standard deviation for this variable is 17,427.91, and it varies from 6550.00 euro per capita (in Bulgaria) to 83,470.00 euro per capita (in Luxemburg). The rates of youth neither employed nor involved in education or training activities significantly differ among EU countries: the maximum values, signaling a worse situation, are in Italy (23.4%), Greece (19.5%), Bulgaria (18.1%), and Romania (17%), while the minimum values are observed in the Netherlands (5.7%), Sweden (6.9%), Malta (7.3%), and Luxemburg (7.5%).

Table 1. Variables considered in the study.

Code of the Variable	Main Factors and Variables	Data Source
	SDGs in the Economic Dimension	
	SDG 8: *Decent Work and Economic Growth (1)*	
SDG_08_10	The ratio of real GDP to the average population of a specific year (euro per capita)	Eurostat
SDG_08_11	The investment share of GDP (% of GDP)	Eurostat
SDG_08_20	Young people neither in employment nor in education and training (NEET) (total men and women) (% of population aged 15–29)	Eurostat
SDG_08_30	The employment rate (% of population aged 20 to 64)	Eurostat
	SDG 9: *Industry, Innovation and Infrastructure (2)*	
SDG_09_10	Gross domestic expenditure on R&D by sector (% of GDP)	Eurostat
SDG_09_21	Human resources in science and technology (% of active population aged 25–64)	Eurostat
SDG_09_30	R&D personnel (in all sectors) (% of active population)	Eurostat
SDG_09_40	Patent applications to the European Patent Office (number)	Eurostat
SDG_09_50	Share of buses and trains in total passenger transport (% of total inland passenger-km)	Eurostat
Medium&HT_ind	Medium- and high-tech industry (including construction) (% manufacturing value added)	The World Bank
	SDG 10: *Reduced Inequalities (3)*	
SDG_10_10	Purchasing power adjusted GDP per capita (real expenditure per capita)	Eurostat
SDG_10_41	Income distribution (quintile share ratio)	Eurostat
	SDG 12: *Responsible Consumption and Production (4)*	
SDG_12_20	Resource productivity and domestic material consumption (DMC) (euro per kilogram)	Eurostat
SDG_12_30	Average CO_2 emissions per km from new passenger cars (g CO_2 per km)	Eurostat
SDG_12_41	Circular material use rate (% of material input for domestic use)	Eurostat
	Economic variables of business development (5)	
New_business	New business density (new registrations per 1000 people ages 15–64)	The World Bank
Venture_cap	Venture capital (% of GDP)	European Innovation Scoreboard
	Technology (ICT usage) and innovation variables (6)	
Enterpr_with_internet	Enterprises with internet access (% of enterprises)	Eurostat
Household_with_internet	Households with connection to the internet (% of households in the cities)	Eurostat
Inno_index	Country's innovation index (index)	European Innovation Scoreboard
	The sharing economy variables (7)	
Collab_econ_transport	Individuals used dedicated websites or apps to arrange a transport service from another individual (% of individuals)	Eurostat
Collab_econ_accomod	Individuals used dedicated websites or apps to arrange accommodation from another individual (% of individuals)	Eurostat
Last_online_purchase	Last online purchase: in the last 12 months (% of individuals living in the cities)	Eurostat
Selling_goods_or_serv	Internet use: selling goods or services (% of individuals living in the cities)	Eurostat

Table 2. Descriptive statistics of research data.

Variables	Mean	Std. Dev.	Min	Max
SDGs in the Economic Dimension Aspect				
SDG 8: *Decent Work and Economic Growth (1)*				
The ratio of real GDP to the average population of a specific year (euro per capita)	27,161.11	17,427.91	6550.00	83,470.00
The investment share of GDP (% of GDP)	21.09	3.56	10.84	28.35
Young people neither in employment nor in education and training (NEET) (total men and women) (% of population aged 15–29)	12.02	4.24	5.70	23.40
The employment rate (% of population aged 20–64)	73.66	5.40	59.50	82.40
SDG 9: *Industry, Innovation and Infrastructure* (2)				
Gross domestic expenditure on R&D by sector (% of GDP)	1.62	0.88	0.50	3.32
Human resources in science and technology (% of act. pop. aged 25–64)	47.14	8.78	27.90	61.20
R&D personnel (in all sectors) (% of active population)	1.25	0.51	0.36	2.23
Patent applications to the European Patent Office (number)	2451.15	5438.41	13.00	26,663.00
Share of buses and trains in total passenger transport (% of total inland passenger-km)	17.91	4.40	9.60	29.40
Medium- and high-tech industry (including construction) (% manufacturing value added)	40.35	12.57	19.65	61.70
SDG 10: *Reduced Inequalities (3)*				
Purchasing power adjusted GDP per capita (real expenditure per capita)	30,722.22	13,139.53	15,500.00	79,000.00
Income distribution (quintile share ratio)	4.85	1.25	3.03	7.66
SDG 12: *Responsible Consumption and Production (4)*				
Resource productivity and domestic material consumption (DMC) (€/kg)	1.71	1.07	0.32	4.42
Average CO_2 emissions per km from new passenger cars (g CO_2 per km)	120.30	8.32	105.50	132.50
Circular material use rate (% of material input for domestic use)	9.00	6.74	1.50	29.00
Economic variables of business development (5)				
New business density (new registrations per 1000 people ages 15–64)	7.03	5.77	0.65	23.59
Venture capital (% of GDP)	0.11	0.09	0.01	0.38
Technology (ICT usage) and innovation (6)				
Enterprises with internet access (% of enterprises)	97.07	3.80	86.00	100.00
Households with connection to the internet (% of households in the cities)	87.81	4.48	80.00	97.00
Country's innovation index (index)	98.22	32.01	32.89	150.50
The sharing economy variables (7)				
Individuals used dedicated websites or apps to arrange a transport service from another individual (% of individuals)	6.33	4.92	0.00	22.00
Individuals used dedicated websites or apps to arrange accommodation from another individual (% of individuals)	12.81	7.71	2.00	37.00
Last online purchase: in the last 12 months (% of individuals living in the cities)	57.37	16.95	27.00	87.00
Internet use: selling goods or services (% of individuals living in the cities)	17.04	10.04	1.00	35.00

As presented in Table 2, the variable under SDG 9 indicating the number of patent applications to the European Patent Office is highly variable among EU countries, and the values of the indicator have large deviations from the mean (2.451.15). The lowest number of patent applications is in Latvia (13) and Croatia (14), and the highest number is in Germany (26.663).

It is important to highlight the indicator of human resources in science and technology, which ranges from 27.90% (in Romania) to 61.20% (in Luxemburg). For SDG 10, descriptive statistics show a gap between the purchasing power adjusted GDP per capita, which has a standard deviation of 13,139.53. The lowest purchasing power is in Bulgaria (15,500.00), and the highest is in Luxemburg (79,000.00) and Ireland (57,600.00). The circular material use rate (% of material input for domestic use) under SDG 12 has crucial differences among EU countries: Romania (1.5%) and Ireland (1.6%) have the lowest values of this indicator, and the highest values are observed in the Netherlands (29%), Belgium (21.8%), and France (19.6%). For the average CO_2 emission per km for new passenger cars (g CO_2 per km) under SDG 12, the highest values are in Estonia (132.50), Luxembourg (131.40), and Hungary (129.00), and the lowest ones are in the Netherlands (105.50), Malta (105.90), and Portugal (106.10). New business density (new registrations per 1.000 people ages 15–64) shows disparities among countries, and the deviation from the mean (7,03) is immense: the lowest values are in Austria (0.64), Germany (1.35), and Greece (1.42), and the highest values are in Estonia (23.59), Cyprus (17.58), and Luxemburg (17.20). The innovation index also notably deviates; i.e., the mean is 98.22 with a standard deviation of 32,01, and the minimum values are in Romania (32.89) and Bulgaria (48.80). Among the variables measuring the sharing economy in the Eurostat database, the percentage of individuals using sharing economy platforms to arrange transport services or accommodation differs substantially among countries. According to official statistical data, no individuals used sharing economy platforms to arrange transport services in Cyprus, and only 1% of individuals used this opportunity in Czechia and Bulgaria, while the maximum mean values are observed in Estonia (22%), Malta (13%), Luxemburg, Ireland, Croatia, and France (12%). The mean of this variable is 6.33, while the mean percentage of individuals using sharing economy platforms to arrange accommodation is two times higher (12.81). The highest values of this variable are in Luxemburg (37%), Ireland (23%), Malta (21%), and the Netherlands (20%), and the lowest values are in Cyprus (2%), Czechia (3%), Latvia (5%), and Bulgaria (5%).

A clustering data mining technique was used to analyze the data variation and the number of clusters (Table 3). In this study, two clustering algorithms were used, hierarchical cluster analysis and K-means clustering, to obtain more significant results with better visualization [36]. In the presented research, the R software library "factoextra" was used to extract and visualize the results of multivariate data analyses.

Table 3. The scheme of the cluster analysis procedure.

Cluster Analysis
Hierarchical cluster analysis → Ward's method → K-means cluster analysis → Model-based clustering → Optimal cluster number based on Elbow and Silhouette methods → K-means cluster centroid analysis

All the variables considered in this study were normalized using the Z-score standardization method, which is one of the most popular methods for data normalization [37]. In the Z-score method, the standardized values (Z) have normal distributions; they are similar in shape to the normal curve, and the measurement units of the variables (%, euro, numbers, etc.) do not affect the calculations. Data normalization was performed with the R software using the "scale" function.

Dendrograms were prepared and analyzed with the hierarchical clustering approach using the Ward method (see Appendix A, Figure A1), and K-means clustering was performed. Traditional clustering methods, such as hierarchical and K-means algorithms, are heuristic-based methods that obtain clusters directly from the data instead of assigning a

measure of probability to the cluster assignments [38]. Among the several algorithms of cluster analysis, a popular hierarchical clustering approach known as the Ward method, also called the minimum variance method [39,40], and the K-means method, another popular algorithm of cluster analysis, were selected [36,37]. The results of the selected cluster analysis were compared with those of model-based cluster analysis (see Appendix A, Figure A2). The model-based algorithm aims to arrange "soft assignments", where observations can be assigned to each cluster [38]. Additionally, the model-based method presents an added-value solution by computing the optimal number of clusters. However, the final results of cluster analysis were assessed based on K-means cluster analysis, as this method is one of the most commonly used clustering techniques based on several research studies [36]. K-means clustering classifies the research observations into mainly exclusive clusters, with the purpose of producing clusters with the most similar observations possible [38].

The clusters were compared according to their connection to the research query. The clustering results differ depending on the number of the clusters [36], and the optimal number of the clusters was determined and visualized using the Elbow, Silhouette, and model-based (using Bayesian information criterion, BIC) [38,41] methods (see Appendix A, Figures A3–A5). The result for the optimal K clusters was used as a basis for clustering in further research. The combination of the K-means algorithm with Elbow, Silhouette and model-based methods improves the sufficiency of K-means assignment [36]. Furthermore, the K-means cluster centroids were analyzed in this research.

4. Results

The sharing economy encourages economic growth, entrepreneurship, and job creation, contributes to the GDP and impacts other economic criteria associated with sustainable development [25]; thus, the sharing economy has a relationship with SDGs [15]. The results of this research support previous studies stating that the sharing economy is stronger in high-income countries and contributes more to their SDGs [14] and that the sharing economy is significant in economically and digitally developed small countries [42], for instance, Estonia, Malta, and Luxembourg.

The first method of cluster analysis used in this research study was hierarchical clustering based on the Ward method, which indicated three clusters of EU countries based on SDGs 8, 9, 10, and 12 and other variables of sustainable economic development related to the sharing economy. The degree of homogeneity was assessed for the year 2018, and all 24 variables were scaled. Hierarchical cluster analysis identified three clusters (see Appendix A, Figure A1) containing countries with similarities in variables. The first cluster identifies similarities between 16 countries: Southern Central and Eastern European countries: Latvia, Lithuania, Cyprus, Portugal, Greece, Bulgaria, Romania, Czechia, Hungary, Austria, Slovenia, Italy, Spain, Croatia, Poland, and Slovakia. Conceivably, this cluster could also be divided into two separate clusters, but further analysis of the optimal number of clusters based on Elbow and Silhouette methods (see Appendix A, Figures A2 and A3) indicated that the reasonable number of clusters is three in this case. The second homogenous group contains eight of the most developed EU countries: France, Belgium, the Netherlands, Germany, Sweden, Finland, Denmark, and Ireland. The third group consists of Luxemburg, Estonia, and Malta, which are three outliers in this study, because the data of these economies are quite different from those of other clusters.

The result of hierarchical cluster analysis was ambiguous as to whether Austria should be included in the cluster with the most developed countries. However, further analysis with K-means clustering offered clarification. Using hierarchical methods, an object persists in a cluster once it is assigned to it, but with the K-means algorithm, the cluster affiliation varies during the clustering process. Notably, the results of K-means cluster analysis (see Figure 4) correspond to those of hierarchical cluster analysis; however, based on the K-means cluster algorithm, Austria was assigned to Cluster 1 (red) with other highly-developed countries of the EU, so this cluster consists of nine countries: France,

Belgium, the Netherlands, Germany, Sweden, Finland, Denmark, Ireland, and Austria. Cluster 2 (green) identifies three countries: Estonia, Malta, and Luxembourg, which could be labeled "top performance" countries in terms of the collaborative economy based on the data of 2018 from Eurostat. The highest percentage of individuals using dedicated websites or apps to arrange transport from another individual (% of individuals) is in Estonia (22%), and the highest percentage of individuals using dedicated websites or apps to arrange accommodation from another individual (% of individuals) is in Luxembourg (37%); additionally, these variables have high values in Malta (13% and 21%, respectively). Cluster 3 (blue) identifies the remaining 15 EU countries. Hereinafter, the focus is mainly on this three-cluster solution.

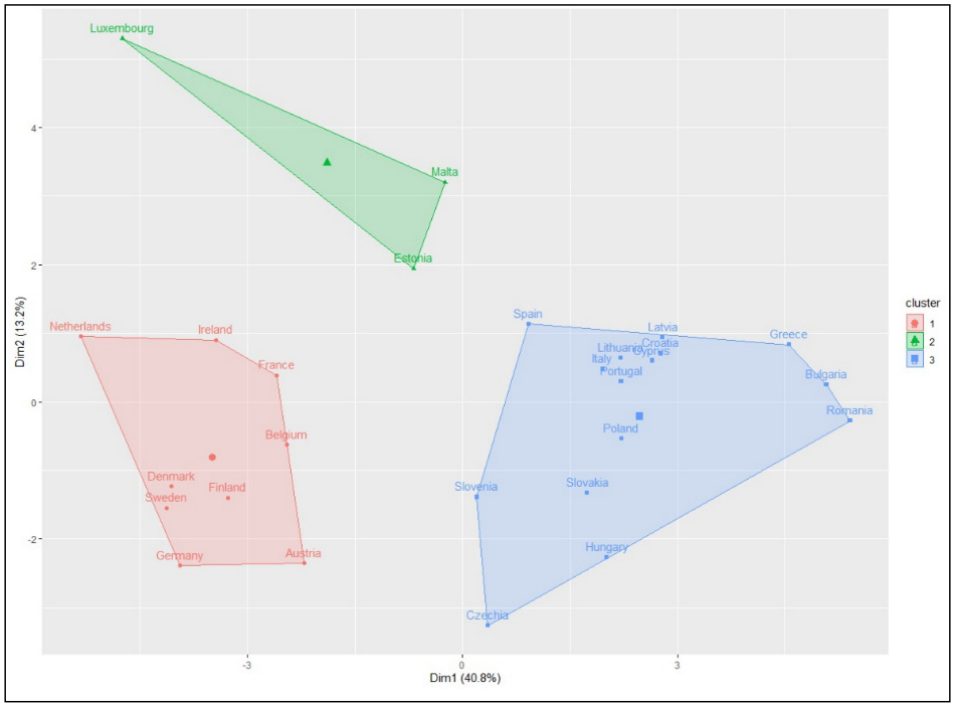

Figure 4. The cluster analysis based on the K-means algorithm.

Table 4 presents the cluster centroids, meaning the middle of the clusters, for the impact of the sharing economy on sustainable economic development in EU countries.

The results obtained in the empirical study present the average scores of the seven factors used to evaluate the sharing economy in the context of countries' sustainable economic development (see Table 5).

According to the locations of the cluster centroids, a key difference between Cluster 1 (the nine most developed EU countries: Belgium, France, Ireland, The Netherlands, Denmark, Sweden, Finland, Germany, and Austria) and the other clusters is that the variables corresponding to SDG 9 are the highest in Cluster 1, with significantly high gross domestic expenditure on R&D and R&D personnel in all sectors, as well as a high percentage of human resources in science and technology and a high value of the medium and high-tech industry indicator. Another notable difference between this cluster and other clusters is that it has the highest number of patent applications submitted to the European Patent Office in 2018. As a result of all of these variables, Cluster 1 has the highest average centroid for SDG 9. For variables related to SDG 8, Clusters 1 and 2 are similar, with high ratios of real GDP per capita, high employment rates and low rates of young people neither in employment nor in education and training. Cluster 1 has a significantly high centroid for the innovation index of countries. Thus, these results explain why Cluster 1 has the highest average centroid (see Table 5) of the technology (ICT usage) and innovation factor.

Table 4. K-means cluster centroids, 2018.

Main Factors and Variables	Clust. 1	Clust. 2	Clust. 3
SDG 8: *Decent Work and Economic Growth (1)*			
The ratio of real GDP to the average population of a specific year (euro per capita)	0.80	0.74	−0.63
The investment share of GDP (% of GDP)	0.69	−0.28	−0.36
Young people neither in employment nor in education and training (NEET), (total men and women) (% of population aged 15–29)	−0.59	−0.75	0.50
The employment rate (% of population aged 20–64)	0.49	0.38	−0.37
SDG 9: *Industry, Innovation and Infrastructure (2)*			
Gross domestic expenditure on R&D by sector (% of GDP)	1.13	−0.64	−0.55
Human resources in science and technology (% of active population aged 25–64)	0.91	0.68	−0.68
R&D personnel (in all sectors) (% of active population)	1.04	−0.22	−0.58
Patent applications to the European Patent Office (number)	0.73	−0.42	−0.36
Share of buses and trains in total passenger transport (% of total inland passenger-km)	−0.13	0.02	0.07
Medium and high-tech industry (including construction) (% manufacturing value added)	0.81	−1.00	−0.29
SDG 10: *Reduced Inequalities (3)*			
Purchasing power adjusted GDP per capita (real expenditure per capita)	0.61	1.05	−0.58
Income distribution (quintile share ratio)	−0.57	−0.01	0.34
SDG 12:*Responsible Consumption and Production (4)*			
Resource productivity and domestic material consumption (DMC) (euro per kilogram)	0.67	0.20	−0.44
Average CO_2 emissions per km from new passenger cars (g CO_2 per km)	−0.42	0.36	0.18
Circular material use rate (% of material input for domestic use)	0.58	0.28	−0.40
Economic variables of business development (5)			
New business density (new registrations per 1000 people ages 15–64)	−0.30	2.15	−0.25
Venture capital (% of GDP)	0.22	1.80	−0.49
Technology (ICT usage) and innovation (6)			
Enterprises with internet access (% of enterprises)	0.56	0.33	−0.41
Households with connection to the internet (% of households in the cities)	0.69	0.41	−0.49
Country's innovation index (index)	1.10	0.31	−0.72
The sharing economy variables (7)			
Individuals used dedicated websites or apps to arrange a transport service from another individual (% of individuals)	−0.05	1.90	−0.35
Individuals used dedicated websites or apps to arrange accommodation from another individual (% of individuals)	0.37	1.58	−0.54
Last online purchase: in the last 12 months (% of individuals living in the cities)	0.90	0.55	−0.65
Internet use: selling goods or services (% of individuals living in the cities)	0.85	0.66	−0.64

Note: colors highlight the values of centroids (red—lowest; yellow—medium; and green—highest).

New business density (new registrations per 1000 people ages 15–64) differs notably between Cluster 2 (Malta, Luxembourg, and Estonia) and the other clusters. Furthermore, in 2018, the World Bank's Entrepreneurship Survey [43] highlighted the same variables for the above-mentioned countries and distinguished them from other EU countries (Estonia (23.59), Malta (17.48), and Luxembourg (17.20)). This cluster has the highest centroid for the total share of venture capital investments as a percentage of GDP: the highest is in Malta (0.38%) and Luxembourg (0.32%). The analysis of average centroid values shows that Cluster 2 is distinctive from the other clusters, particularly in the average centroid of the factor evaluating sharing economy variables (7) (see Table 5). For the percentage of individuals using dedicated websites or apps to arrange a transport service from another individual, Estonia highly differs from other countries (22%, where the mean of the data sample was 6.33% in 2018 (Table 2)). Moreover, the highest percentage of individuals using dedicated websites or apps to arrange accommodation from another individual is in Luxembourg (37%, where the mean of the data sample was 12.81% in 2018 (Table 2)). This analysis supports the assertion that Cluster 2 could be labeled "top performance" countries in the aspect of the sharing economy in 2018. For SDG 10, Cluster 2 has a particularly high

annual purchasing power adjusted GDP per capita, which is especially high in Luxembourg (79.000 euro).

Table 5. Average centroids of clusters based on seven factors, 2018.

Factors	Cluster 1	Cluster 2	Cluster 3
SDG 8: Decent Work and Economic Growth (1)	0.35	0.02	−0.21
SDG 9: Industry, Innovation and Infrastructure (2)	0.75	−0.26	−0.40
SDG 10: Reduced Inequalities (3)	0.02	0.52	−0.12
SDG 12: Responsible Consumption and Production (4)	0.28	0.28	−0.22
Economic variables of business development (5)	−0.04	1.97	−0.37
Technology (ICT usage) and innovation (6)	0.79	0.35	−0.54
The sharing economy variables (7)	0.52	1.17	−0.55

Note: colors highlight the values of centroids (red—lowest; yellow—medium; and green—highest).

Cluster 3—the largest cluster with 15 countries—has the lowest centroids among the three clusters. This cluster has significantly low average centroids (see Table 5) for the factors evaluating sharing economy variables and technology (ICT usage) and innovation. The lowest percentages of individuals using dedicated websites or apps to arrange transport from another individual (% of individuals) and accommodation from another individual (% of individuals) are in Cyprus (0% and 2%, respectively), Czechia (1% and 3%, respectively) and Bulgaria (1% and 5%, respectively). The percentages of individuals living in cities and having purchased or sold goods or services in the previous 12 months are significantly low in these countries: Romania (27% made the last online purchase in 12 months, 3% had sold goods or services), Cyprus (37% and 1%, respectively), Bulgaria (27% and 8%, respectively) and Greece (40% and 3%, respectively). The low centroids for the technology (ICT usage) and innovation variables are mainly due to the low innovation indexes of the countries in Cluster 3. The lowest indexes are in Romania (32.89), Bulgaria (48.80), and Croatia (60.22). Table 5 shows significantly large negative values related to SDG 9 or factor 2. This is affected by the variable percentage of human resources in science and technology of the active population aged 25–64: the lowest values are in Romania (only 27.90%), Bulgaria (36.80%), Italy (37%), and Hungary (37,30%). Gross domestic expenditure on R&D is very low in Romania (0.50% of GDP), Cyprus (0.62% of GDP) and Latvia (0.64% of GDP), while the average gross domestic expenditure on R&D is 2.18% of GDP.

5. Discussion

The research described in this paper has several implications. The results suggest that the sharing economy offers possibilities for the sustainable economic development of countries and, at the same time, argues that the sharing economy is not sustainable by default. Additionally, the analyzed phenomenon is demonstrated to be an IT platform-based business model that supports sustainability through "access over ownership" [8,26,27].

This study provides a theoretical overview of the sharing economy in the context of sustainability and illustrates its contribution to the framework of SDGs and sustainable economic development, complementing the latest research studies [8,11,15]. The economic research literature reports that the sharing economy has a novel relationship with SDGs; thus, current and further research on this issue is important and relevant.

The majority of research studies [8,9,11,15,28] have argued that the sharing economy can be conceptualized as a business model that supports the achievement of the SDGs. The current study presents a conceptual model of the sharing economy's impact on countries' sustainable development based on seven factors: SDG 8—Decent Work and Economic Growth (1); SDG 9—Industry, Innovation and Infrastructure (2); SDG 10—Reduced Inequalities (3); SDG 12—Responsible Consumption and Production (4); Economic variables of business development (5); Technology (ICT usage) and innovation (6); and sharing economy variables (7). The presented conceptual model, based on seven factors and their measurement, could be the subject of further investigation and used by academics, politicians, practitioners and especially entrepreneurs acting in the sharing economy.

The investigation was performed based on the above-specified conceptual model and a data sample of 27 EU countries in 2018. The presented results reveal the importance of factors that measure new business development possibilities and strategies of venture capital investments in the country. However, the results of the research are limited by the countries investigated in the research and the chosen period of the survey. Thus, the current research conceptual model could be used in further analysis for additional periods.

Several studies on carsharing in the context of sustainability [40] have argued that the sharing economy may cause traffic congestion in urban spaces and reduce the demand for public transport. Additionally, other researchers have reported that carsharing positively and negatively impacts the environment and sustainable development [44]. The current research provides interesting results based on statistical data analysis of EU countries in 2018. Firstly, the variable "Individuals using dedicated websites or apps to arrange a transport service from another individual" differs between Estonia (22% of individuals) and the other countries. Secondly, the variable "Average CO_2 emission per km from new passenger cars (g CO_2 per km)" was the highest in Estonia (131.40). The figures of these two variables support research literature indicating that shared transport may have a negative impact on sustainability, but this statement needs more comprehensive analysis based on a broader data sample, which could be a valuable future research direction.

This investigation, mainly based on the results of K-means cluster analysis, revealed disparities between EU countries. As a result of this analysis, three clusters of EU countries were generated, where Cluster 2 (Luxembourg, Malta, and Estonia) has the greatest disparities from the other clusters in the factor measuring business development and the sharing economy variables. These three altogether different countries were grouped into one cluster mainly because of the significantly high values of new business density registrations per 1000 people (ages 15–64) and remarkable differences from other clusters in the variables measuring the sharing economy. In Estonia, the increase in the above-mentioned statistical values may be explained by the legalization of ridesharing services, introduced in the media as the "Uber law", and the state's acknowledgment of sharing platforms, framing them as a potential business model [42]. This regulation entered into force in 2017, making it the first European country to include ridesharing in the official system, not as a part of the taxi business but as an individual business category named "ridesharing" [42]. The above-mentioned studies show evidence of political and legal factors that could be added to the proposed conceptual model in future analyses.

Current research study supports latest research studies of other researchers [45], who argues the amount of the households with connection to the internet and amount of an enterprises with internet access in the countries as the one of the important aspects providing the engagement in the sharing economy.

Potential future research directions include examining not only SDGs in the economic dimension but also social and environmental SDGs and further exploring and comparing the results generated in this study. Nevertheless, the future research direction cover not only the positive aspects of the sharing economy, but negative consequences too, which recently became the relevant question in the latest studies of the sharing economy [46].

6. Conclusions

The sharing economy is a relevant theme in the public and research discourse and has significant potential to become recognized as a factor in countries' sustainable development.

In the analyzed research literature, the notion of "access over ownership" is a substantial factor in improving business performance for sustainability. This supports the statement that the sharing economy is substantially related to countries' sustainable development, including the achievement of SGDs. The key results in this paper demonstrate relationships between the sharing economy and SDGs. Furthermore, this study provides a theoretical view of the phenomenon of the sharing economy and presents a conceptual model of the factors of the sharing economy that affect countries' sustainable development based on SDGs. Accordingly, in developing the presented conceptual model, the current

research provides an economic assessment of the sharing economy in the context of SDGs by analyzing European Union countries, with a particular emphasis on their economic growth. This economic evaluation contributes to filling a gap in previous research studies and uses clustering analysis to characterize the sharing economy of EU countries.

The results of the analysis also highlight that the sharing economy offers an opportunity to strengthen economic and digital development in small countries.

The current research has some limitations. The results of the presented case study are based on EU countries in a specific period, which is insufficient to determine concrete characteristics of the analyzed countries; therefore, the presented conceptual model could be used by academics for further research with a broader geographical and temporal scope to identify more in-depth long-term effects of the sharing economy.

This study contributes to the themes arising in research on the sharing economy's role in the sustainable development and achievement of SDGs.

Author Contributions: Conceptualization: V.K. and V.P.; methodology: V.K. and V.P.; validation: V.K. and V.P.; investigation: V.K. and V.P.; resources: V.K. and V.P.; data curation: V.K. and V.P.; writing—original draft preparation: V.K. and V.P.; writing—review and editing: V.K. and V.P.; visualization: V.K.; supervision: V.K. and V.P. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data available in a publicly accessible repository that does not issue DOIs Publicly available datasets were analyzed in this study. This data can be found here: [Eurostat: https://ec.europa.eu/eurostat/data/database, European Innovation Scoreboard: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en; WB: https://data.worldbank.org/] (accessed on 6 February 2021).

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

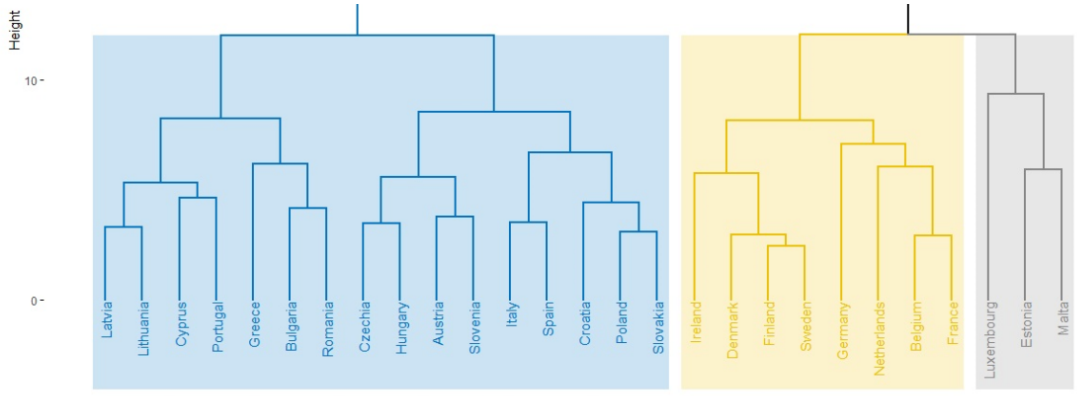

Figure A1. Dendrogram of hierarchical cluster analysis based on the Ward method.

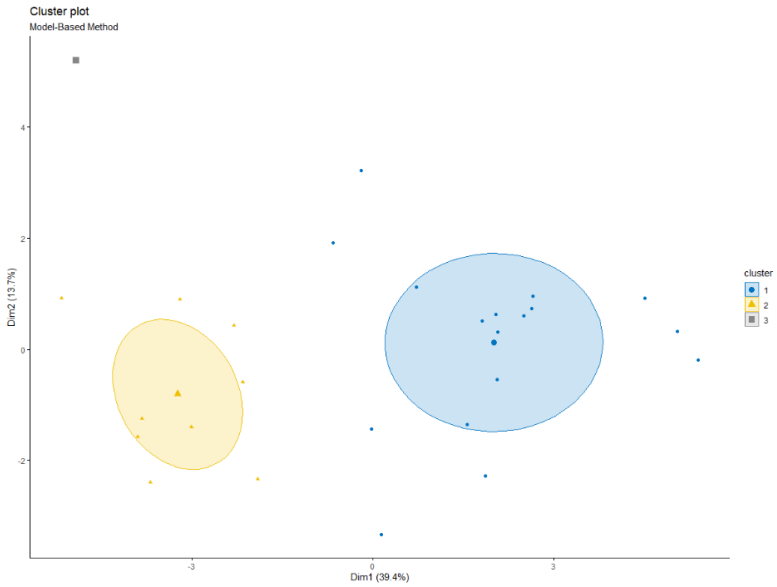

Figure A2. Results of model-based clustering analysis.

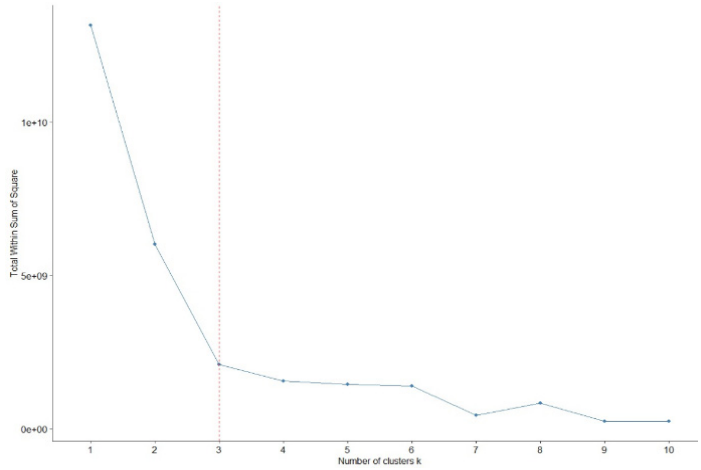

Figure A3. Number of clusters (Elbow method).

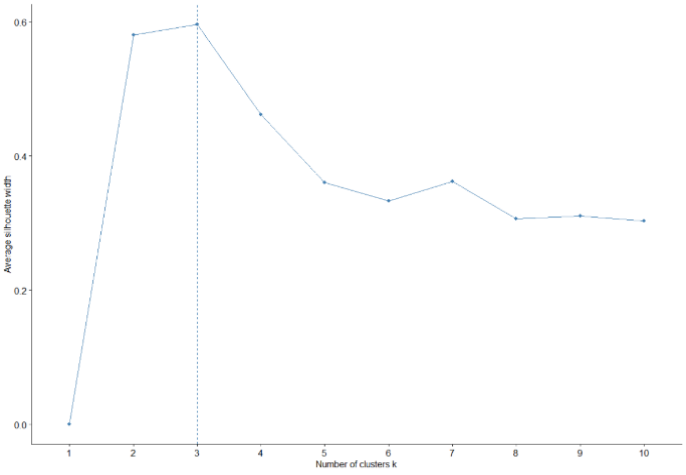

Figure A4. Number of clusters (Silhouette method).

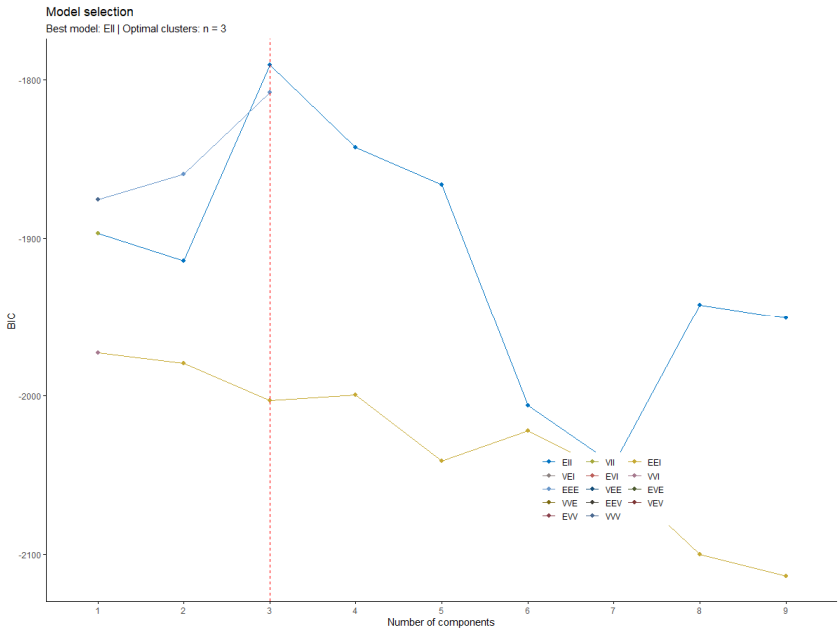

Figure A5. Number of clusters using BIC scores (model-based method).

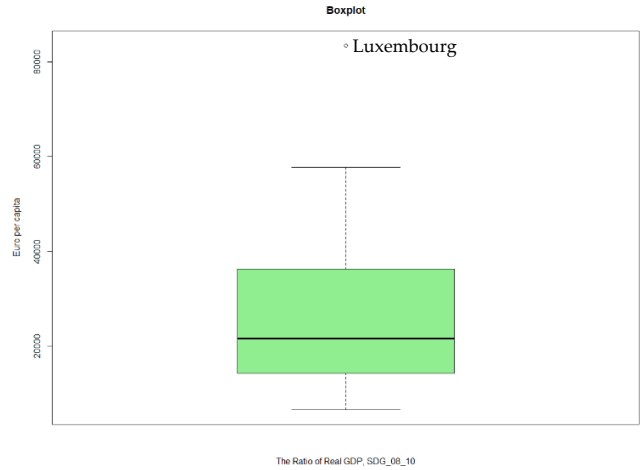

Figure A6. Box plot of SDG_08_10.

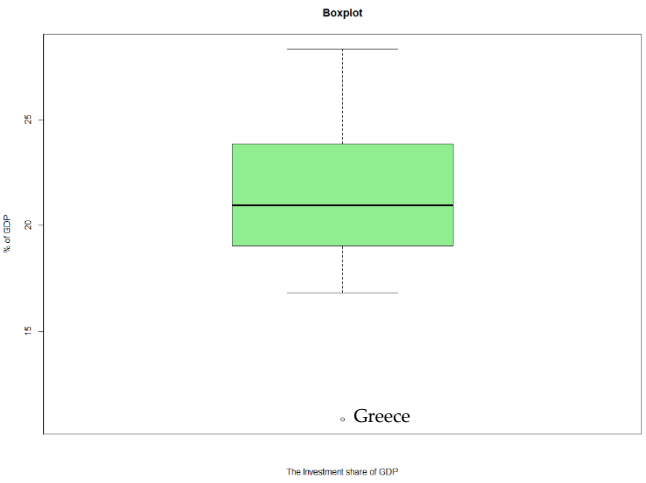

Figure A7. Box plot of SDG_08_11.

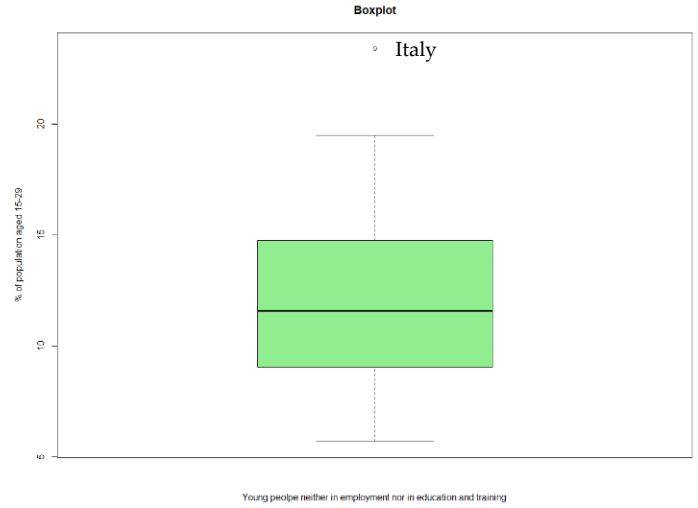

Figure A8. Box plot of SDG_08_20.

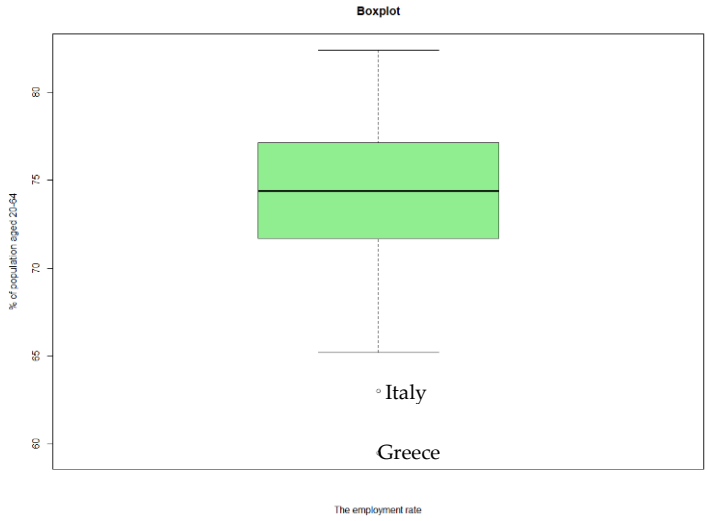

Figure A9. Box plot of SDG_08_30.

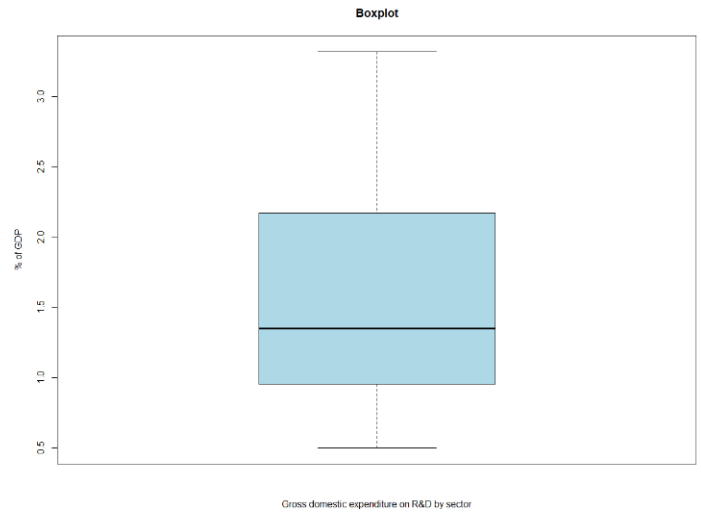

Figure A10. Box plot of SDG_09_10.

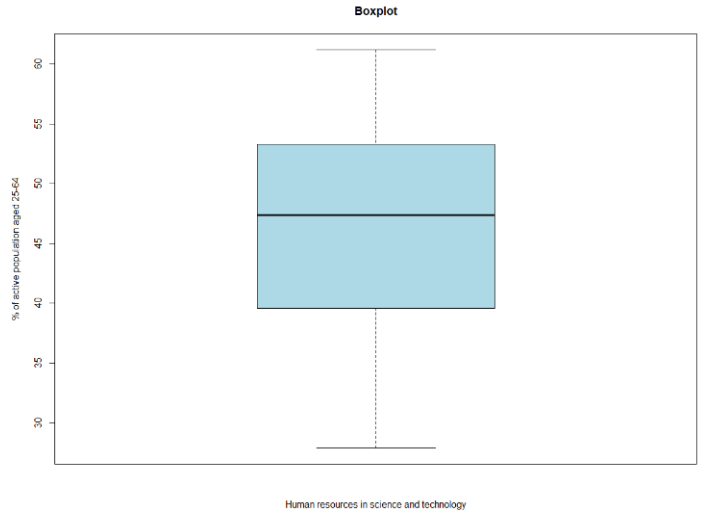

Figure A11. Box plot of SDG_09_21.

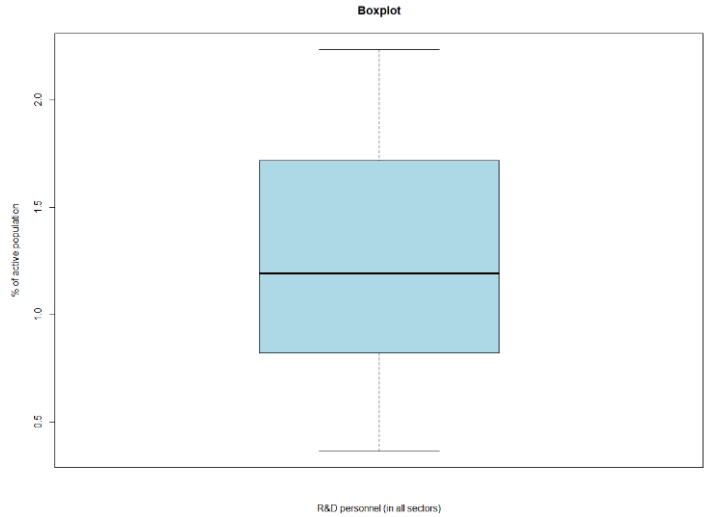

Figure A12. Box plot of SDG_09_30.

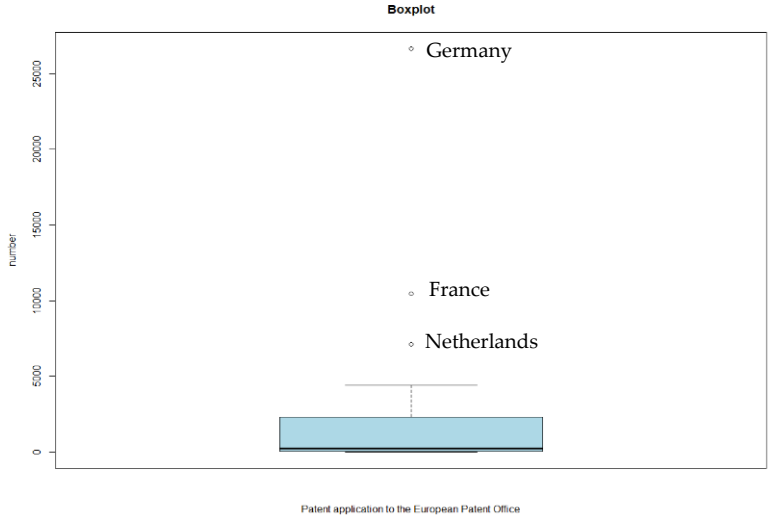

Figure A13. Box plot of SDG_09_40.

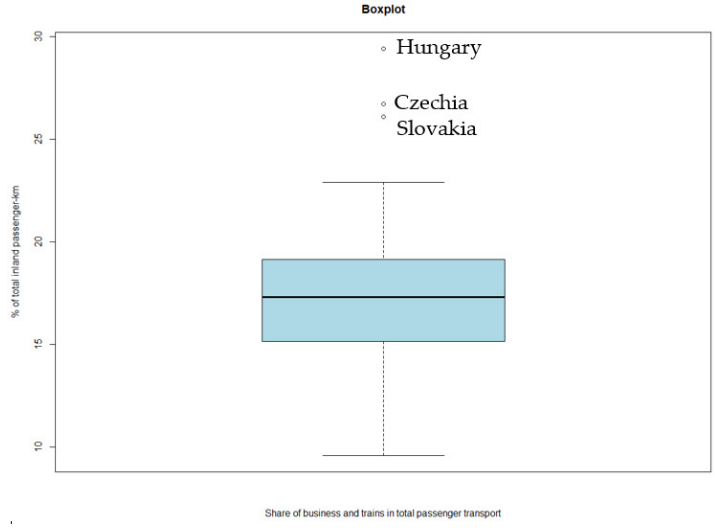

Figure A14. Box plot of SDG_09_50.

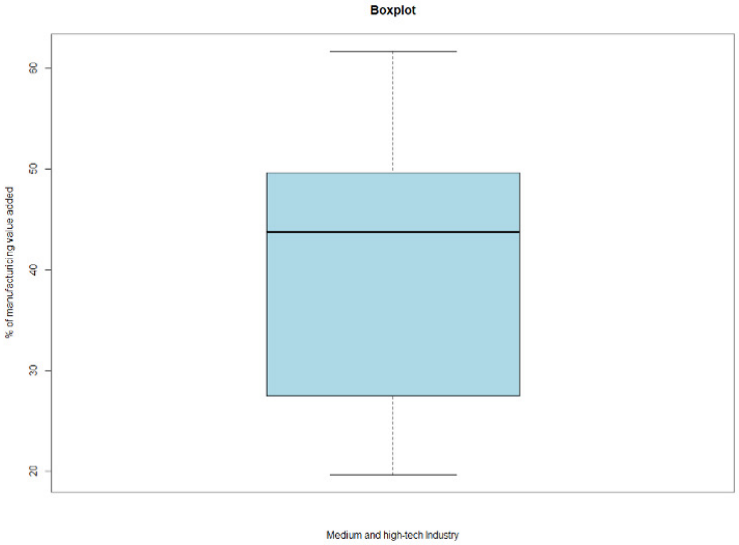

Figure A15. Box plot of Medium&HT_ind.

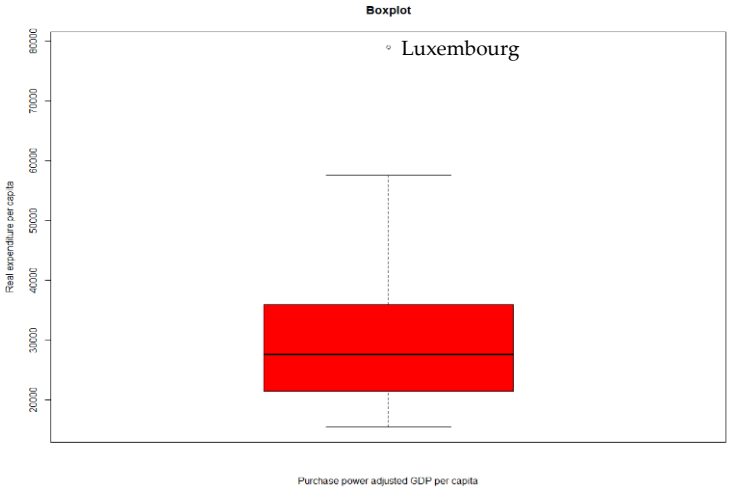

Figure A16. Box plot of SDG_10_10.

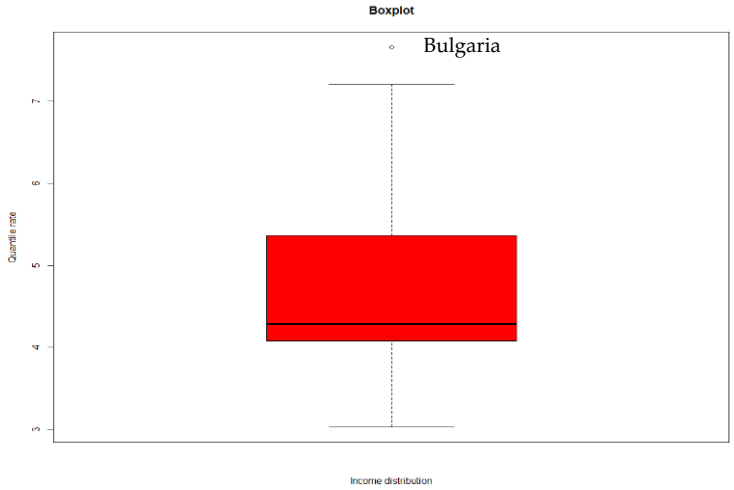

Figure A17. Box plot of SDG_10_41.

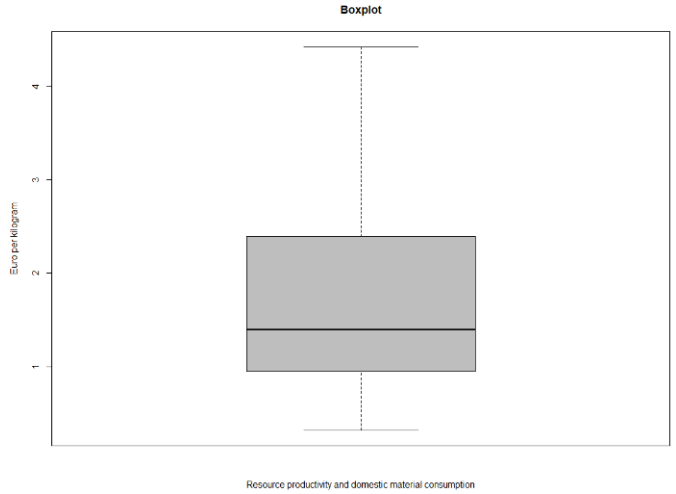

Figure A18. Box plot of SDG_12_20.

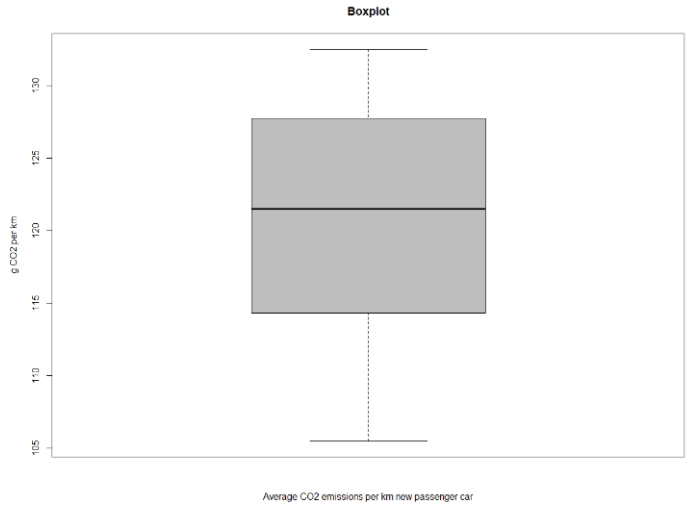

Figure A19. Box plot of SDG_12_30.

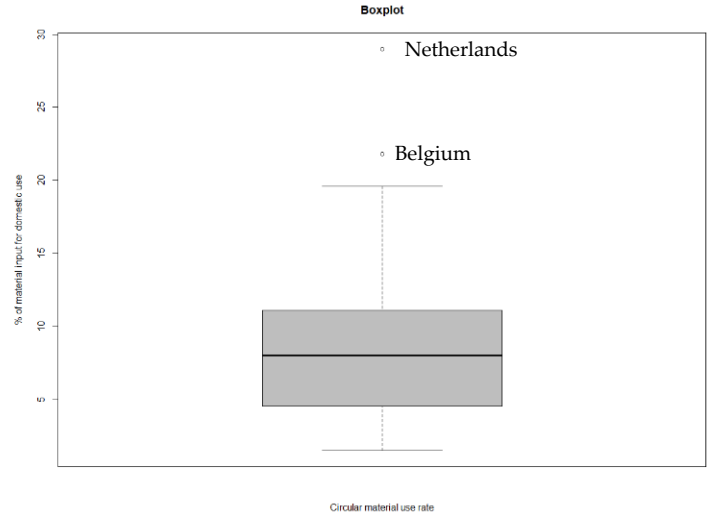

Figure A20. Box plot of SDG_12_41.

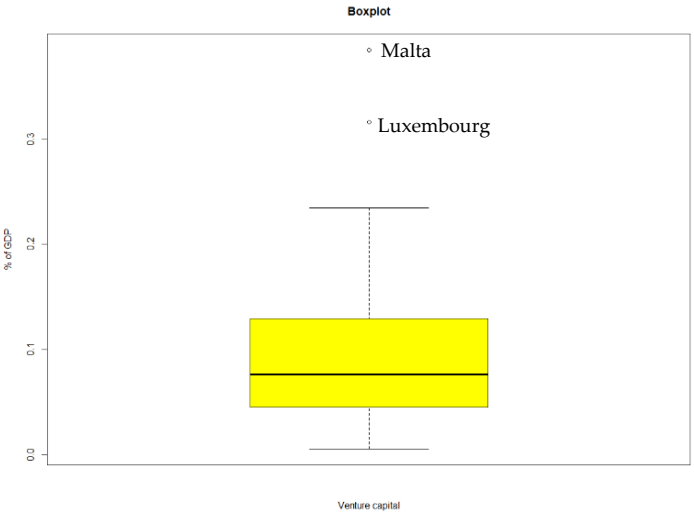

Figure A21. Box plot of New business.

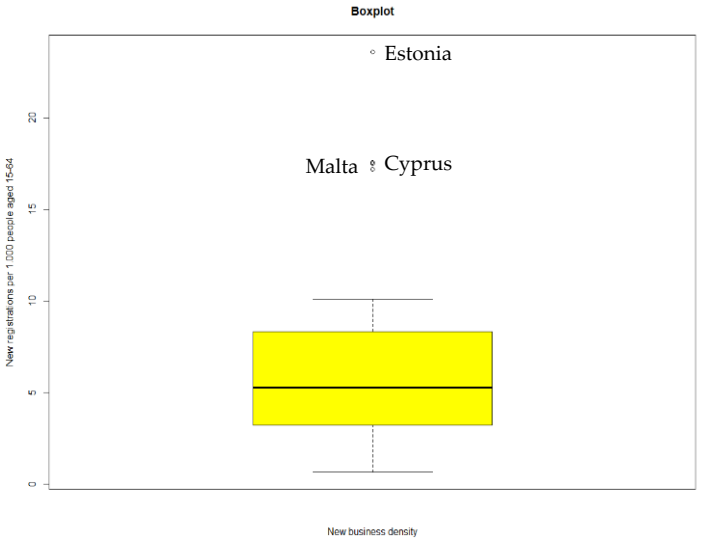

Figure A22. Box plot of Venture_cap.

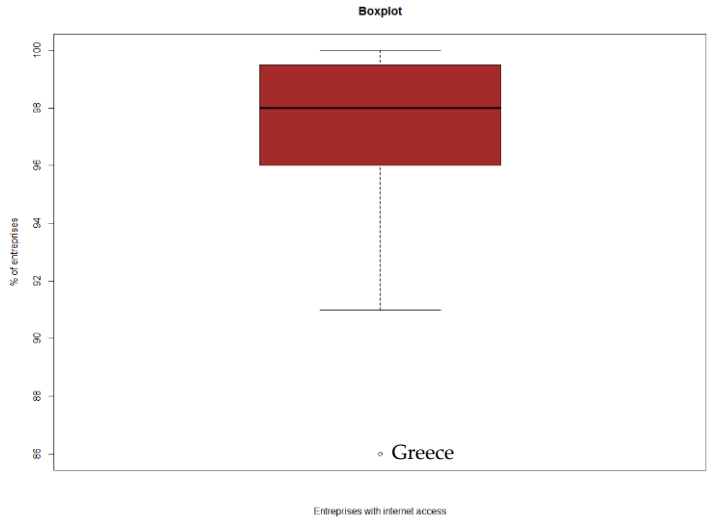

Figure A23. Box plot of Enterpr_with_internet.

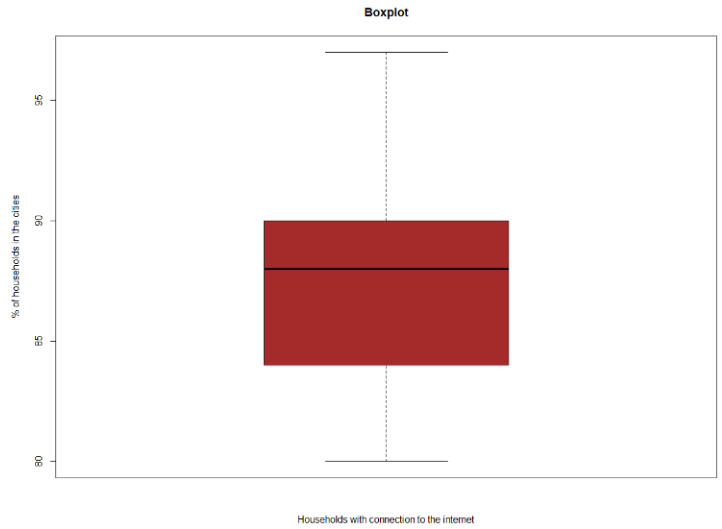

Figure A24. Box plot of Household_with_internet.

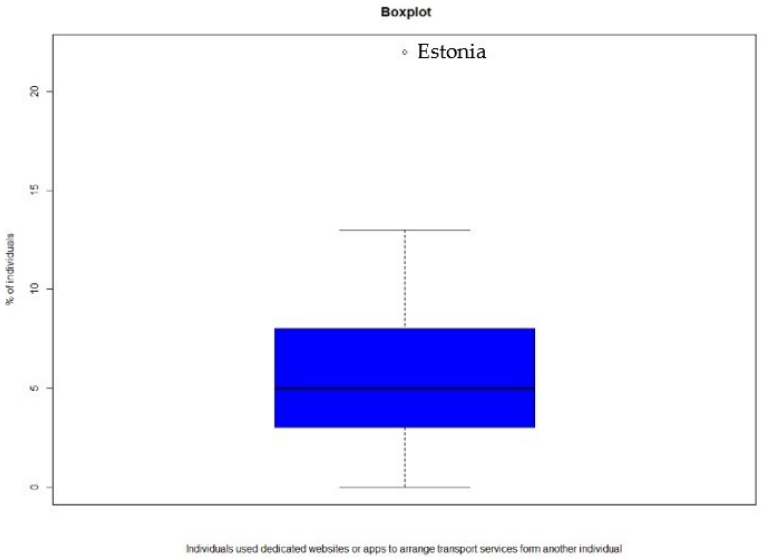

Figure A25. Box plot of Collab_econ_tranpcort.

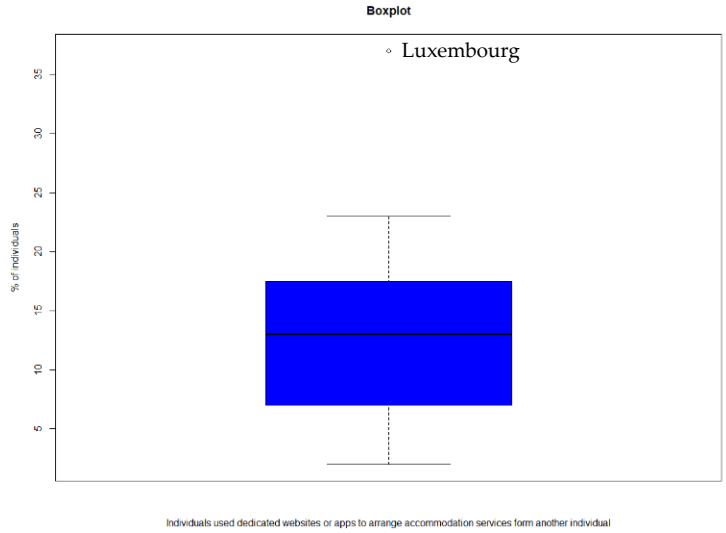

Figure A26. Box plot of Collab_econ_accommod.

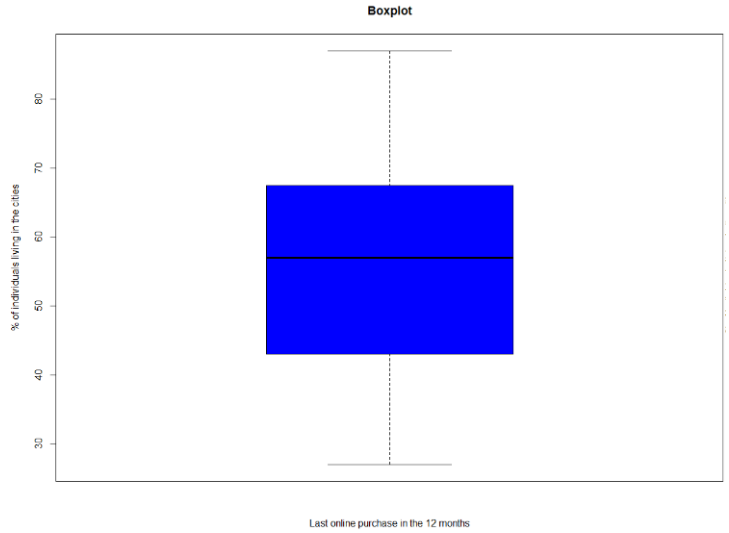

Figure A27. Box plot of Last_olnine_purchase.

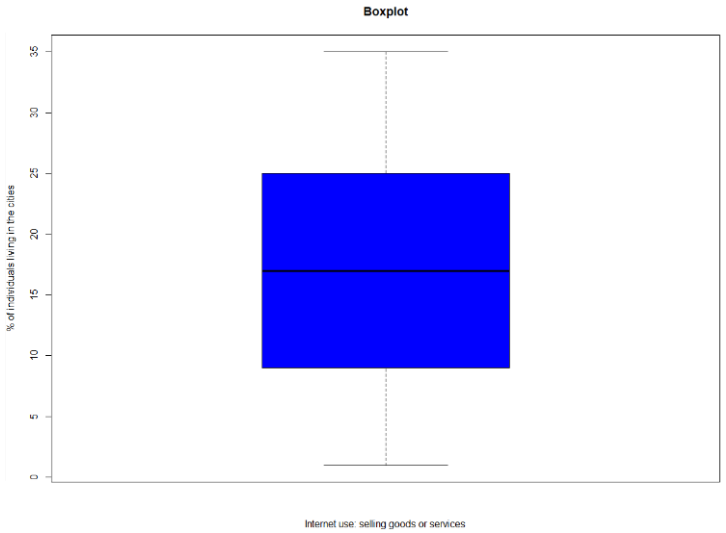

Figure A28. Box plot of selling_goods_or_serv.

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