KAUNAS UNIVERSITY OF TECHNOLOGY

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THE IMPACT OF THE SHARING ECONOMY ON THE COUNTRY'S SUSTAINABILITY

Doctoral dissertation
Social Sciences, Economics (S 004)

2024, Kaunas

This doctoral dissertation was prepared at Kaunas University of Technology, School of Economics and Business, Academic Centre of Economics, Business and Management during the period of 2018–2023.
The doctoral right has been granted to Kaunas University of Technology together with Klaipėda University and Lithuanian Energy Institute.

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Edited by: English language editor Brigita Brasienė (Publishing House *Technologija*), Lithuanian language editor Aurelija Gražina Rukšaitė (Publishing House *Technologija*)

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The public defense of the dissertation will be held at 10 a.m. on 8 March, 2024 at the public meeting of Dissertation Defense Board of Economics Science Field in Rectorate Hall at Kaunas University of Technology.

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The doctoral dissertation was sent out on 8 February, 2024.
The doctoral dissertation is available on the internet http://ktu.edu and at the libraries of Kaunas University of Technology (Gedimino 50, Kaunas, LT-44239, Lithuania), Klaipėda University (H. Manto 84, Klaipeda, LT-92294, Lithuania) and Lithuanian Energy Institute (Breslaujos 3, Kaunas, LT-44403, Lithuania).

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KAUNO TECHNOLOGIJOS UNIVERSITETAS

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DALIJIMOSI EKONOMIKOS POVEIKIS ŠALIES TVARUMUI

Daktaro disertacija
Socialiniai mokslai, ekonomika (S 004)

2024, Kaunas

Disertacija rengta 2018-2023 metais Kauno technologijos universiteto Ekonomikos ir verslo fakultete, Ekonomikos, verslo ir vadybos akademiniame centre.
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Disertacija bus ginama viešame Ekonomikos mokslo krypties disertacijos gynimo tarybos posėdyje 2024 m. kovo 8 d. 10 val. Kauno technologijos universiteto Rektorato salėje.

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Disertacija išsiųsta 2024 m. vasario 8 d.
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Už visapusišką palaikymą, padrąsinimus ir *pozityvią energiją dėkoju vyrui Egidijui, dukrai Agnei* ir *sūnui Mantui*.

For all the support, encouragement and positive energy, I am thankful to my husband Egidijus, daughter Agnė and son Mantas.

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INTRODUCTION

Relevance of the research

Nowadays, the development of the sharing economy and the significant attention it has received from the scholars, researchers (Daglis, 2022; Yin et al., 2021; Hossain, 2020; Schor, 2020; Zhang et al., 2019; Godelnik, 2017; Sundararajan, 2016), entrepreneurs, practitioners (PwC, 2018; Wallenstein and Shelat, 2017; Thomas et al., 2017; PwC, 2014; PwC, 2013), policymakers (European Commission, 2021; European Commission, 2019; Codagnone and Martens, 2016; European Commission, 2012), citizens and other users demonstrate this phenomenon's global socioeconomic importance and relevance. The sharing economy, which involves the sharing of assets and services among individuals or companies, has gained significant popularity as a business model.

Previous research studies demonstrate that the sharing economy brings possibilities for new business and is driven by the information technologies and Internet (Hossain, 2020; Geissigner et al., 2019; Zhang et al., 2019; Frenken, 2017; Belk, 2014), enable more effective and sustainable utilization of resources that are underutilized and limit overconsumption (Laukkanen and Tura, 2020; Seegebarth, 2016). Therefore, the economic examinations and statistical data demonstrate that the sharing economy generates relevant economic value for various sectors with a particular impact on the hospitality and transportation industries (PwC, 2018; Godelnik, 2017). The sharing economy is an appealing phenomenon not only due to its economic benefits, but due to its potential for fostering social connections and promoting environmentally sustainable behaviours. Further on, the analysis of theoretical and empirical research studies emphasizes the importance of sharing economy to the country's sustainability (Curtis and Mont, 2020; Laukkanen and Tura, 2020; Mi and Coffman, 2019; Leung et al., 2019; Retamal, 2019; Curtis and Lehner, 2019; Geissigner et al., 2019; Ritter and Schanz, 2019; Plewnia and Guenther, 2018; Martin, 2016) and argues that it generates sustainable advantage in the perspective of economic, social, environmental and innovation sustainability. Yin et al. (2021) argue that the sharing economy offers a sustainable approach by integrating the environmental, social and economic dimensions, and it tackles resource consumption by means of temporary ownership access to goods or services. However, it is challenging to estimate how the sharing economy impacts the country's sustainability in the quantitative approach.

A number of scholars (Kauffman and Naldi, 2020; Kathan et al., 2016; Demailly and Novel, 2014) have argued for the significance of the sharing economy as an economic trend that fosters the creation of sustainable value. This emphasizes the relevance of the sharing economy from the standpoint of reducing consumption and resource and energy consumption, thereby having the potential to contribute to the attainment and development of a country's sustainability. Additionally, drawing from the findings of Laukkanen and Tura (2020), Curtis and Mont (2020) literature analysis, it can be claimed that the sharing economy is meaningful for a country's

sustainability, as it facilitates the creation of value in the aspect of economic, innovation, social and environmental sustainability. Based on the research literature analysis of Yin et al. (2021), the sharing economy is a significant phenomenon because of its economic benefits as well as its potential to foster innovation development social connections and promote environmentally sustainable practices. The sharing economy presents a sustainable viewpoint by consolidating the environmental, social, innovation and economic dimensions. It tackles the resource consumption by means of temporary access privileges to product or service ownership. Due to the exponential growth of the global population, there arises a necessity to formulate economic strategies, such as the commencement of the sharing economy, which facilitates the optimization and sharing of resources as opposed to individual ownership of new items. However, a comprehensive analysis of this phenomenon in macroeconomic level has not been conducted yet. There is a notable absence of a model that incorporates a comprehensive methodology including the main driving forces of the sharing economy, the relations between the sharing economy and the country's sustainability and overall impact assessment of this phenomenon on the country's sustainability. Thus, the importance of such a research and model in the above-mentioned approach is relevant in the theoretical and practical dimensions, as it could be one of the tools valuably enabling to contribute to the solutions of the circumstances related to country' sustainability.

Scientific problem and the extent of its investigation

Despite the considerable attention that scholars (Daglis, 2022; Yin et al., 2021; Hossain, 2020; Curtis and Mont, 2020; Schor, 2020; Curtis and Mont, 2019; Zhang et al., 2019; Godelnik, 2017; Frenken, 2017; Frenken and Schor, 2017; Acquier et al., 2017; Sundararajan, 2016) have devoted to the sharing economy, it still lacks a coherent definition of this phenomenon.

Laukkanen and Tura (2020), Curtis and Mont (2020), Schor (2020), Ritter and Schanz (2019), Munoz and Cohen (2017), Aloni (2016), Heinrichs (2013) investigated the sharing economy in the context of sustainability. Nevertheless, a thorough examination of the relationship between the sharing economy and the country's sustainability and a comprehensive research on the impact of sharing economy on the country's sustainability in macroeconomic level are still needed. The researchers have investigated the environmental impacts of the sharing economy, focusing on particular sectors (in accommodation (Enochsson et al., 2021), ride hailing (Lanamaki and Tuvikene, 2021), car sharing (Ramos et al., 2020; Münzel et al., 2019), bike sharing (Yijie and Dan Shen, 2019), construction industry (Li et al., 2019), nations or geographic areas (Dabbous and Tarhini, 2021) in OECD countries and Southeast Asian cities (Retamal, 2019)). The sharing economy encompasses a wider range of examples and not only car or room sharing. The sharing economy currently offers a diverse array of services, encompassing areas such as tourism, transportation, labour, delivery, financial (short-term loans), work or other space sharing, consumer goods, etc. Additionally, most of the numerous research analysis and empirical studies related to the sharing economy are concentrated on the

microeconomic level, and the empirical studies are designed mainly based on the data of the shared items consumers' interviews (Chi et al., 2020; Zhang et al., 2019; Bocker and Meelen, 2016). However, the above-mentioned studies could not be fully employed in order to make holistic estimations of the sharing economy in the context of a country's sustainability.

Consequently, as the examination of the sharing economy in micro-level may be frequent among scholars, it is limited in research facilitating cross-country comparisons in macro-level. Currently, there is a lack of research examining the correlation between the sharing economy and the country's sustainability through the utilization of cross-national macroeconomic data. Additionally, there is a need from scholars (Hossain, 2020; Kauffman and Naldi, 2020) and practitioners for practical and applicable tool or guidelines, enabling to assess the impact of the sharing economy on the country's sustainability. The present investigation attempts to fill this gap, which could hold significant implications for policymakers, entrepreneurs and scholars.

Furthermore, the research study by Yin et al. (2021) investigated the sharing economy and its main impact on the country's environmental sustainability. However, that study was limited because of the sampling period, as it covered only 2018, and it did not cover all the sustainability dimensions, as it did not involve economic, innovation and social sustainability. The above-mentioned research is constructed based on the Timbro Sharing Economy Index (TSEI), issued in 2018 (Bergh et al., 2018). TSEI represents a pioneering effort by Stockholm-based scholars to build a global index of the sharing economy. The purpose of the index was to quantify the extent of the sharing economy activities on a global scale and facilitate cross-national comparisons of the sharing economies. TSEI is constructed only based on the data of 2018 for 165 nations. Thus, the above-mentioned research is limited because of the sample size and is restricted to the use of time series, or panel data analyses; this has been highlighted by Yin et al. (2021) as well. Leung et al. (2019) advocate that there is a need for a more holistic approach in evaluating the sharing economy in the context of the country's sustainability instead of analysing mainly only accommodation and transport sectors. Geissigner et al. (2019) support the statement that the sharing economy contributes to the development of the country's sustainability, and there is a need for further research considering the above-mentioned dimension.

To summarise the above-mentioned statements and the debate in academic discourse on the links between the sharing economy and country's sustainability, it can be argued that there is a reasonable need to present more holistic approach of the sharing economy and develop a methodology for assessing the impact of the sharing economy on a country's sustainability, enabling to employ it for a comparative analysis across different countries.

The scientific problem – how to evaluate the sharing economy's impact on the country's sustainability.

The object of the work – the impact of the sharing economy on the country's sustainability.

The main aim of the research – to develop a methodology, enabling to assess the impact of the sharing economy on the country's sustainability and apply it empirically in the case of the European Union countries.

The main objectives of the research are as follows:

1. to identify the most comprehensive theoretical approaches for conceptualizing the sharing economy, its drivers and business models;
2. to specify the comprehensive conception and measurement of the country's sustainability;
3. to examine and illustrate the sharing economy's theoretical aspect in relationship with the country's sustainability;
4. to prepare the methodology for the evaluation of the impact of the sharing economy on the country's sustainability;
5. to identify the key steps for constructing the composite index for the evaluation of the country's sustainability in its relationship with the sharing economy ($I_{CountSusShE}$);
6. to empirically validate the methodology for the evaluation of the impact of the sharing economy on the country's sustainability on the example of the countries of the European Union.

Research methods and software

- Systematic comparison, classification and logical analysis of the theoretical research literature in the themes of sharing economy and country's sustainability were examined. The relationship between the sharing economy and the country's sustainability were identified based on the theoretical research analysis.
- Composite index construction method was used in order to design the index for the evaluation of the country's sustainability in its relationship with the sharing economy ($I_{CountSusShE}$).
- Multivariate statistical analysis has been used in order to compare the statistical data of the research; the cluster analysis was performed employing hierarchical, Ward's method, K-means analysis and Model-based clustering. All calculations of cluster analysis were done using software R 4.0.3.
- The application of correlation and OLS regression methods was used in order to investigate the impact of the sharing economy on the country's sustainability. The calculations were done using software R 4.0.3. and Microsoft Excel.

The scientific novelty and practical significance of the research

- The concept of the sharing economy has been clarified with reference to this research and illustrated based on the main three key characteristics of this phenomenon, and it was highlighted that the sharing activities could be not only between the individuals, but among individuals and/or companies as well. The evolution of the sharing economy as an economic phenomenon has been proposed, presenting a more comprehensive overview to this process. Additionally, the extended matrix of the sharing economy, based on the parties involved in the sharing action and

tangibility of the shared items, has been developed. The matrix gives explicit overview of the sharing economy's business models.

- The relationship of the sharing economy and the country's sustainability have been determined at the macroeconomic level. The illustrated linkages of the sharing economy and the country's sustainability, carried out at the macroeconomic level, could be used by the national policy makers for developing countries sustainability guidelines and the researchers in future studies analysing the sharing economy and its significance for the country's sustainability.
- The conceptual model for evaluating the sharing economy's impact on the country's sustainability integrates and supplements the previous research works through a more holistic attitude to the sharing economy and the country's sustainability, as it covers four main dimensions of sustainability in relation with the sharing economy: economic, innovation, social and environmental. The previous research studies mainly emphasize three dimensions, not involving innovation dimension as a separate one. Moreover, this research work confirms the positive relationships of the sharing economy and the country's innovation sustainability aspect, as several previous research studies investigated mainly the environmental approach of the sharing economy, or mainly concentrated on a specific sector of the sharing economy (for instance, transport or accommodation). Additionally, the constructed model confirms that the development of the sharing economy's phenomenon impacts the country's sustainability, leads to greener transition and more sustainable societies.
- The developed composite index $I_{CountSusShE}$ can be used as a comprehensive, cross-country or cross-regional index that enables a comparative analysis between different countries and could be employed as a relevant way of investigation for the country's sustainability performance. Thus, the country's policy makers, researchers and scholars could use this index, as one of the tools for investigating the country's sustainability level in the aspect of sharing economy.
- The defined methodology of the impact of sharing economy on the country's sustainability and the constructed composite index give advantage to estimate the sustainability performance and use it for evaluating the impact of the sharing economy on the country's sustainability. Additionally, it highlights the separate variables of the constructed index, and specific separate variables should be taken into account as factors that are positively or negatively reflecting the country's sustainability. This methodology could be applied and used by the researchers in further research studies. Moreover, it could be practically used by the governments of the countries or employed by different European or other executive agencies as a supporting tool enabling to monitor and evaluate the progress of the country's sustainability based on the relationships with the sharing economy. It is important to note that the developed methodology can be used in future empirical studies both with the sharing economy indicators used in this study and can be easily adapted to other sharing economy macroeconomic data at the country or regional level.

Research limitations

One of the primary limitations of the research is related to the statistical data concerning the sharing economy at the macroeconomic level. The statistical office of the European Union (EUROSTAT) collected the data related to the accommodation and transport sharing economy, but only for the period of 2017–2019, and again, only for specific sectors. Thus, EUROSTAT has experimental data related to the accommodation sharing economy (number of stays at short-stay accommodation), but only form 2018. However, this date relates only to some sectors of the sharing economy and limits the date of the other sectors (shared goods, workspaces, shared knowledges etc.). The present study utilized the Crunchbase database to obtain statistical annual data linked to the sharing economy across various nations during the research period of 2008–2020. During the composition of the thesis, the author was not aware of the existence or availability of any other reliable source of information that systematises historical data on the sharing economy at the macroeconomic level by the country. The research data is limited to the period of 2008–2020 regarding that the latest data was unavailable during the research preparation period.

The structure of the dissertation

The research framework was established based on the objectives outlined in this dissertation. The dissertation comprises several key components, including an introduction, three chapters, conclusions, a list of references and appendixes. The dissertation is comprised of 151 pages, 29 tables, 28 Figures and 22 annexes. The present dissertation incorporates 167 research literature sources in total. Furthermore, Figure 1 illustrates a schematic representation of various phases that were involved in the development of this dissertation.

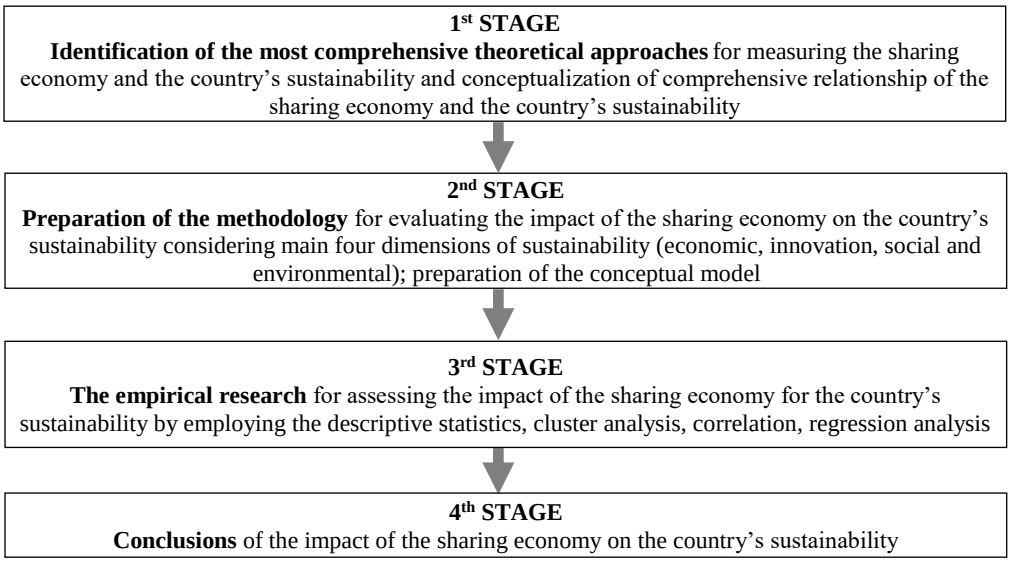


Figure 1. The essential stages of the dissertation development

1. THEORETICAL APPROACH OF THE SHARING ECONOMY AND COUNTRY'S SUSTAINABILITY

This chapter of the dissertation identifies the most relevant theoretical approaches and the historical background of the sharing economy, examines the main driving forces of the sharing economy, describes and schematically presents the sharing economy's business models based on the theoretical analysis. Therefore, this chapter presents the theoretical overview of the country's sustainability aspect and its comprehensive relationship of the sharing economy and the country's sustainability in the 4 theoretical dimensions: economic sustainability, innovation sustainability, environmental sustainability and social sustainability.

1.1. Theoretical background of the sharing economy

The prompt progress of the sharing economy over the last decade has significantly risen the usage of the definition "sharing economy" in the research literature; however, there still are many discrepancies among researchers explaining this phenomenon. The sharing economy has become an increasingly significant object of practical and theoretical research (Kauffman and Naldi, 2020; Hossain, 2020; Ritter and Schanz, 2019; Zhang et al., 2019; Geissiner et al., 2019; Habi et al., 2017; Aloni, 2016; Barnes and Mattsson, 2016), because of the extremely rapid development of technology and innovation worldwide. The scientific literature analysing the sharing economy and its prospects (Hossain, 2020; Schor, 2020; Zhang et al., 2019; Godelnik, 2017; Sundararajan, 2016; PwC, 2015) demonstrates that the sharing economy has a notable economic, social, environmental and innovation impact on the industry, on a global scale.

As emphasized by the European Economic and Social Committee (2016), the definition of the sharing economy has been trying to link a number of activities, and this business model, which has become the subject of the scientific discussion, covering a wide range of different activities, services and goods, has so far no common concept (Karobliene et al., 2019). Over the past decade, the phenomenon of the sharing economy has been defined with various terms, such as "the mesh" (Gansky, 2010), "access-based consumption" (Bardhi and Eckhardt, 2012), "collaborative consumption" (Botsman and Rogers, 2011), "in web platforms facilitated peer-to-peer exchanges" (Aloni, 2016), "crowd-based capitalism" (Sundararajan, 2016), "access-based consumption of products and services that can be online and offline" (Barnes and Mattson, 2016) etc. Several research studies explain that "sharing economy" could be explained as an umbrella term used for sharing of items as well as second-hand markets, exchange platforms, peer-to-peer lending, engagement economy (Frenken, 2017; Acquier et al., 2017), which operate through online platforms (Hamari et al., 2016). The examples of such kind of economic models are Zipcar, Airbnb, Uber, Freecycle, Facebook, YouTube and other business models where customers can access an item online and use it corresponding to their needs. Based on the several research studies (Belk, 2014; Curtis and Mont, 2020), the sharing economy has been characterized as an economic business model facilitated by the internet and

operated through the digital platforms and/or the applications with a significance of access to underutilized goods or services instead of ownership. The researchers Curtis (2014), Laukkanen and Tura (2020), Parente et al. (2018), Ferrel et al. (2017), Finck and Ranchordas (2016), Frenken and Schor (2017), Hossain (2020), Munoz and Cohen (2017), Ritter and Schanz (2019) have emphasized that the sharing economy increases the usage of underutilized items, mainly for money, but sometimes, for free (for instance, couch surfing (free home sharing) and freecycle (providing free underutilized items to peers)), avoiding overconsumption.

In the academic discourse (Plepys and Singh, 2020; Buheji, 2020; Karobliene et al., 2019; Parente, 2018; Acquier et al., 2017; Richardson, 2015; Bardhi, 2012), the sharing economy is mainly described as an economic ecosystem that is typically based on the temporary access to physical goods or services using internet-based platforms that connect different members of communities (buyers and sellers or users and providers). Some scientific literature of the sharing economy (Parente, 2018) highlights that this phenomenon reduces the transaction expenses and fosters trust to share items among unknown persons enabling this type of business to compete with the traditional ones.

Thus, in this work, the sharing economy is 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 (Figure 2). Additionally, the main performers of the sharing economy are the providers of the shared items (for instance, Airbnb hosts, Uber drivers), the users (consumers or service receivers, for instance, Airbnb guests, Uber passengers), acting based on the information technology (hereinafter, IT) or digital platforms.

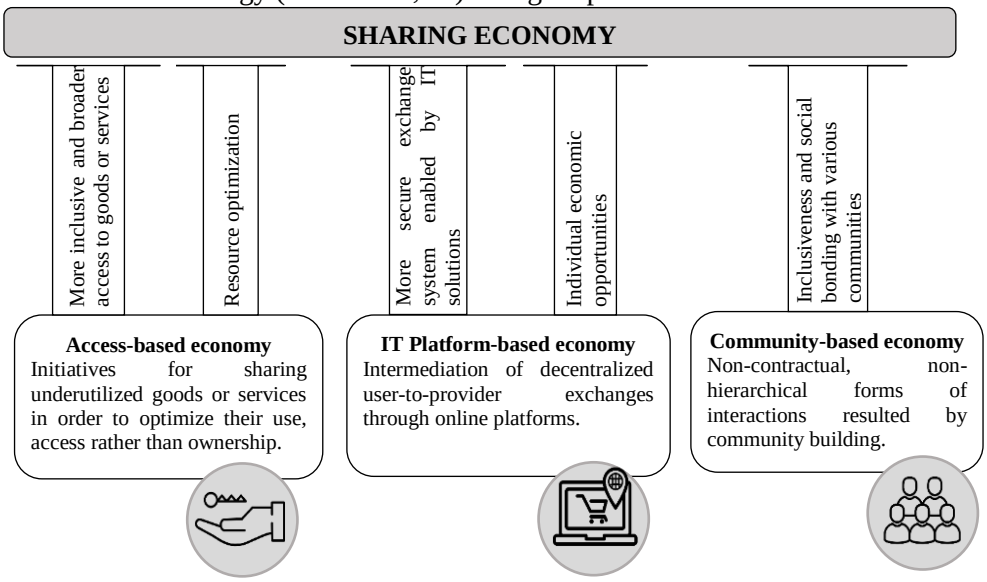


Figure 2. The essential pillars of the sharing economy (adapted based on Karobliene et al. (2019), Acquier et al. (2017))

The *access-based economy* arguably demonstrates the main aspect of this pillar highlighting the initiative of sharing underutilized resources to increase their effective use, leading to resource optimization (Figure 2). Recently, companies have offered services to users instead of selling products; in the economic research literature, this phenomenon is called the "product-service system" or "servitization" (Acquier et al., 2017), for instance, car-riding services, luxury clothes, accommodation, expensive tools and other equipment. This makes an impact on the environmental issues, because the access-based economy promotes sustainable solutions instead of irrepressible purchasing of products (Karobliene and Pilinkiene, 2021; Acquier et al., 2019).

The second indicated basis of the sharing economy, the *IT platform-based economy*, accurately retains that the activities of the sharing economy are supported by the digital solutions, where providers and users act to generate the expected value according to the individual needs of the involved party (Figure 2). 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. According to Srineck's (2017) research study, it is arguable that the digital platforms are becoming increasingly important in modern capitalism. This theory backs up Evans and Gawer's (2016) global study, which found that more than 70% of unicorns, i.e., private startups with revenues valued at or above $1 billion, are platform-based organizations (Karobliene et al., 2019). The total value of such kind of companies was more than $4.3 trillion in 2016; this demonstrates the importance of the platform-based economy, which is as well one of the essential elements of the sharing economy. The research conducted by Curtis and Mont (2020) indicates that the main function of the sharing platform is to moderate and facilitate social interactions and economic transactions among the players of the sharing economy.

The third basis of the sharing economy (Figure 2), the *community-based economy*, illustrates the activities, regulated with the help of "non-contractual, non-hierarchical, or non-monetized forms of interactions" (Acquier et al., 2017). Several researchers specify that building solidary communities, obtaining social missions and having common aims are the primary purposes rather than the generation of economic value.

Examining the concept of the sharing economy, three main characteristics were identified in this research work: (1) access to items but not ownership; (2) *ad hoc matchmaking*, when supply and demand is balanced on demand and the needs of the peers supported by the digital solutions; (3) microtransactions – transactions operated with sharing exchanges are individual and could be for profit or not (Bergh et al., 2021).

Following the above-mentioned reasoning, the theoretical overview of the sharing economy is illustrated in Figure 3.

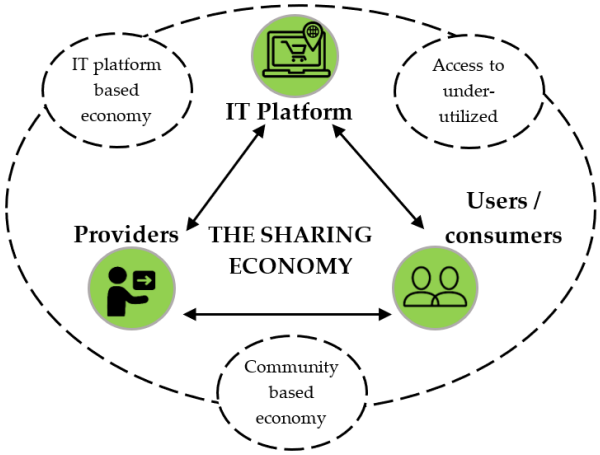


Figure 3. Theoretical approach of the sharing economy (Karobliene and Pilinkiene, 2021)

The sharing economy is defined as the interaction between *the providers* (sometimes referred as sellers) of shared items (services or goods) and *users* (or customers) mediated by *IT platforms*, facilitating access to items instead of ownership (Rojanakit et al., 2022; Curtis and Lehner, 2019; Sutherland and Hossein, 2018). Furthermore, the sharing economy mainly involves three major types of players: *the shared items' providers*, *the users* and *IT platform providers*; however, there are other stakeholders of this phenomenon: local government, interest groups, non-governmental organizations (NGOs) etc. (Hossain, 2020). The relationship among the major players and other stakeholders is mainly more social (emotional) and relates to the community-based economy. For example, the accommodation hosts perform an important role in the sharing economy highlighting the service quality, positive evaluations, trust and satisfaction from the guests, and this builds a community of potential guests.

Zhang et al. (2019) define the sharing economy with particular characteristics that make it stand out from the other types of business: "nonownership, temporary access and redistribution of material goods or less tangible assets such as money, space or time".

Therefore, the economic research studies and statistical data presents that the sharing economy is creating considerably amounts of economic value to different types of sectors, and especially, it makes an influence on hospitality and transport sectors. In 2014, Airbnb received about 425,000 guests per night, and it was generally 22% larger than Hilton Worldwide (PwC, 2015). Hereinafter, the sharing economy is developing rapidly, and 105 million of U.S. inhabitants or 51% of the U.S. adult population were consumers of the sharing economy platforms as the users of the

shared goods and services in 2015 (Godelnik, 2017). Overall, the 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 the global hotel chains, such as Marriott (Kauffman and Naldi, 2020).

Currently, the sharing economy involves different types of shared items or services 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 Airbnb, Lyft, Uber or Zipcar (Leung et al., 2019). Thus, the operations of the sharing economy have a significant effect on the economies of countries all around the world. For example, Statista forecasted that the value of the global sharing economy will come to USD 335 billion by 2025, while it was USD 14 billion in 2014 (Kauffman and Naldi, 2020). However, these estimations were predicted before the beginning of the COVID-19 pandemic, which has made a negative impact on the global economies. Remarkably, Uber had a market value of USD 71 billion at the beginning of 2020, which had dropped to USD 37 billion by the spring of 2020, and one of the food-delivery services GrubHub dropped from USD 5.35 billion to USD 2.92 billion (Kauffman and Naldi, 2020).

The sharing economy generally is more relevant in urban cities and has potential to spread in all the sectors of industry and notably, where it has possibility to be operated based on the IT platforms. Mont et al. (2020) argues that "sharing in cities is promising because of the high density add high levels of income of urban population, which leads to high levels of consumption and results in high volume of underutilized assets". Some researchers (Daglis, 2022; Cohen and Kietzmann, 2014) demonstrate the sharing mobility as one of the dominant in the sharing economy, offering intercity services enabled by innovative IT solutions. According to this perspective, many urban cities are becoming a substantial background for the sharing economy development, and these cities are called Smart Cites in economic research studies (Akande et al., 2020; Jonek-Kowalska and Wolniak, 2022; Gori et al., 2015).

The sharing economy is common nearly to all the sectors of the economy; however, it is most relevant to the mobility and transport and accommodation (Hossain, 2017). According to Daglis (2022), the most common sharing practice is sharing of space, allowing users and providers on different online platforms to book or offer accommodation or spaces for working or any other activities. The key sectors of the sharing economy and examples are listed in Table 1.

Table 1. The key sectors of the sharing economy (Pouri and Hilty, 2021; Hodkinson et al., 2017)

The key sector	Shared items/services	Examples of the sharing economy
Mobility and transport	Ride Sharing (when passengers and drivers are going in the same direction)	BlaBlaCar
	Ride Sourcing (when passengers order the ride from the pool of vehicles)	Uber, Lyft, OlaCabs
	Ride Splitting (when passengers order the ride and the costs for the ride are split between them)	Uber Pool, Lyft Line
	Vehicle Sharing (cars, bikes, jets, etc.)	Zipcar, AutoShare, Boatsetter
Spaces	Accommodation	Airbnb, HomeAway, Coachsurfing
	Work Space	ShareDesk, PivotDesk, WeWork
	Storage Space	MakeSpace, Spacer, SpaceOut
	Recreation Space	596 Acres, Club Cultural Matienzo
Skills/ Talents	Personal Services	TaskRabbit, Handy, DogVacay, Fivver, Urbansitter, Wag!
	Professional Services	Catalant, Crowdspring, Andela, BidWilly
Financing	Money Lending	LendingClub, Zopa, Prosper
	Crowdfunding	Kickstarter, Gofundme, Ingiegogo, CircleUp
	Insurance	InsPeer, Wesura, Friendsurance
Health	Medical Equipment	Cohealo
	Medical Services	CrowdMed, Med Zed, Dr. on Demand
Utilities	Telecommunications	Fon, OpenGarden
	Information	Open Data Soft
	Energy	Trec, Vanderbron, Gridmates
General goods	Used/Unused Products	Thred up, Warpit, Letgo
	Loaner Products	Peerby, Rent the Runway, Rocksbox
Food	Meals	EatWith, VizEat, MealSharing, OLIO
Learning	Pear-To-Pear Learning	P2PU, SharingAcademy, Skillshare
	Open Courses	Coursera, KHANAcademy, Udemy

From the perspective of systems theory, Leung et al. (2019), the ecosystem of the sharing economy is defined as a combination all the frames ecosystem and interest groups based on their functions and interactions with one another (Figure 4).

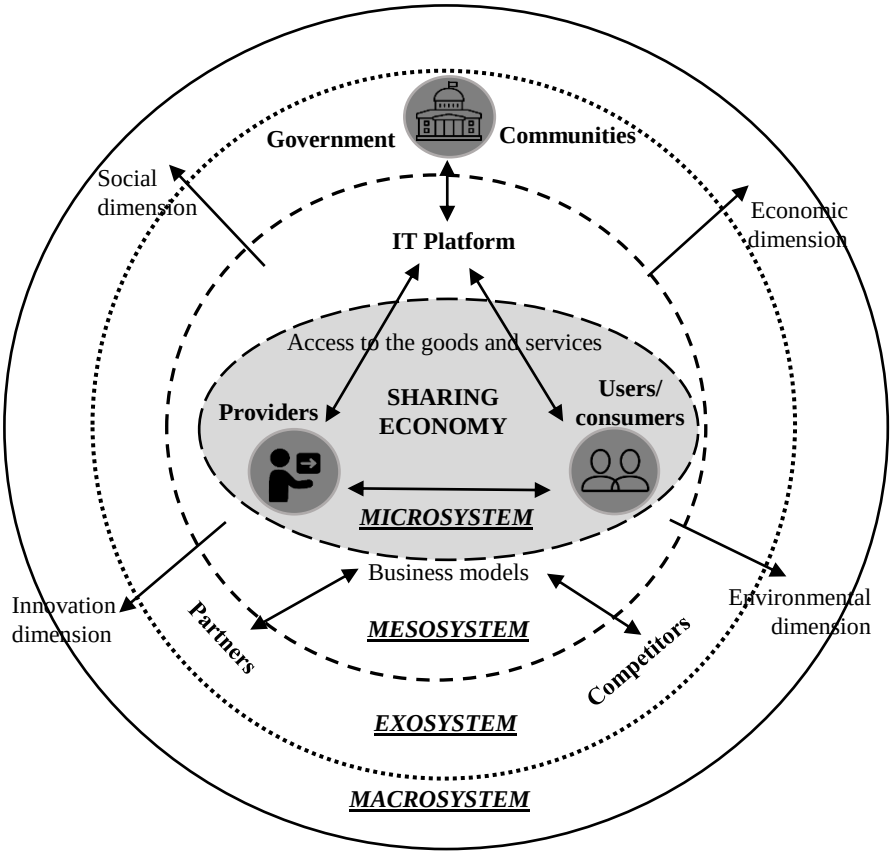


Figure 4. The ecosystem of the sharing economy (Leung et al., 2019)

The sharing economy incorporates triadic of the services or items providers, users (or consumers) and IT platforms that interact in the environment. The first corresponds to the relationships between the providers and users (microsystem). The IT platforms act as intermediary agents in the second layer, the mesosystem, connecting providers and users on a broad scale with the aid of contemporary technology, and enables access to the goods and services. The exosystem, which is the third layer, consists of partners, competitors, government and communities. These four interest groups have an impact on the providers, users and IT platforms of the sharing economy and are affected by them as well. The business models of the sharing economy present opportunities and difficulties for both partners and competitors. Government regulates and supports the operation of the sharing economy IT platforms through governance and legislation activities. The interactions between the four parties is one of the essential components of the sharing economy that enables the development of this phenomenon. Macrosystem is the last layer of the analysed ecosystem based on the system theory, and it is composed of economic, social, innovation and environmental dimensions. The sharing economy is analysed in the

macroeconomic level in this thesis as an economic phenomenon, generating an impact on the country's sustainability.

1.2. The evolution of the sharing economy

According to Frenken and Schor (2017), the sharing economy can be defined as the act of consumers providing temporary access to their underutilized physical assets, often in exchange for monetary compensation. This interpretation suggests that the sharing economy as a subject has been present throughout human history. Based on the research of Karobliene et al. (2019), analysing the evolution of the sharing economy, the collaboration of this nature was prevalent among relatives, acquaintances or neighbours; however, the extent of such collaboration was restricted due to the reliability concerns associated with unfamiliar customers. The research done by Marcus Felson and Joe L. Spaeth (1978) in the approach of collaborative consumption is widely recognized as the seminal work that laid the groundwork for the theory of the sharing economy. The initial evidence of the collaborative consumption was described as the sharing of resources among individuals within familial or social groups by Marcus Felson and Joe L. Spaeth (1978). Figure 5 illustrates the evolution of the sharing economy based on the main companies and essential encouragements of the sharing economies.

Despite the fact that the collaborative consumption, presented in the aforementioned book, was not in line with the contemporary definition of the sharing economy, the concept of sharing has received attention from both academic and business communities. According to Karobliene et al. (2019), the emergence of information communication technologies and the increasing popularity of Web 2.0 have facilitated the advancement of online platforms that foster user-generated content and collaborative sharing of items. As Zhang et al. (2018) have noted, these developments have expanded the avenues for sharing underutilized resources and skills. According to Marshalls research (2019), the inception of the contemporary sharing economy can be traced back to 1990. During this time, Berners-Lee and his team developed pioneering technology with public applications, including user-friendly web interfaces and email. At the outset, the Internet was predominantly utilized by the research communities; however, by 1995, it had already been appropriated for commercial purposes as well. Two businesses that serve as examples are Book Stacks Unlimited, which initiated e-commerce in 1992, and Amazon, which was established two years later (Karobliene et al., 2019). In 1995, Pierre Omidyar founded eBay with the objective of facilitating online sales of goods and services while fostering a mutually beneficial relationship between individual sellers and buyers (Marshal, 2015). However, some scholars (Bergh et al., 2021) argue that eBay and Amazon or other companies similar to them are not the examples of sharing economy. They state that buying or selling goods with transfer of ownership are not the sharing economy. Other researchers (Plewnia and Guenter, 2016; Codagnone et al., 2016; Martin, 2016) refer that these cases are parts of sharing economy; nevertheless, they are acting based on a different business model of the sharing economy (as presented in the sub-section 1.4 of this research work).

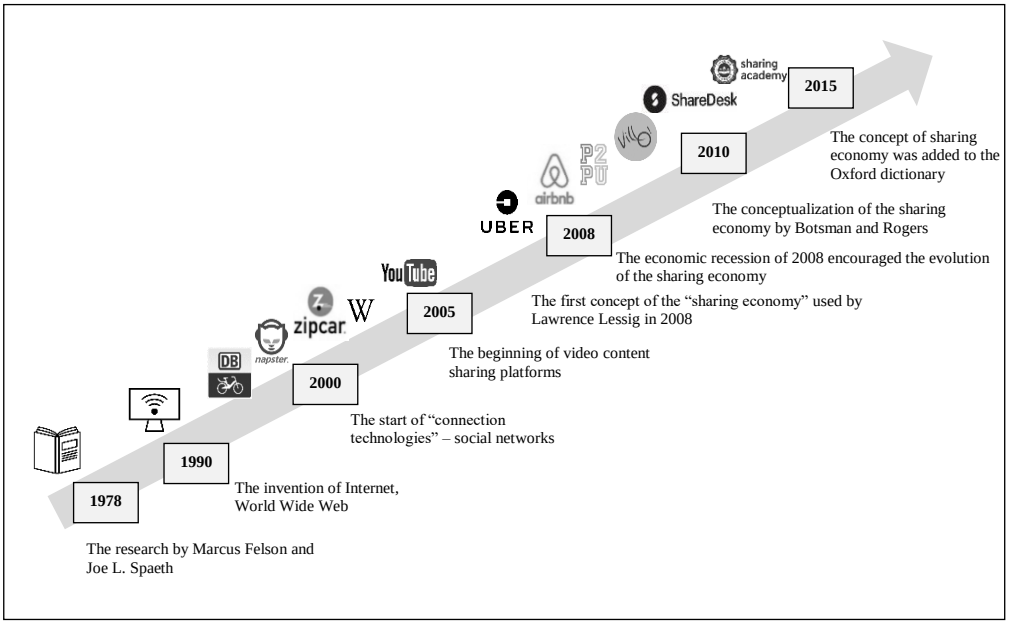


Figure 5. Evolution of the sharing economy (based on Karobliene et al. (2019) with logos from respective company websites and icons from https://thenounproject.com/)

According to Karobliene et al. (2019), the emergence of the sharing economy in the beginning of the twenty-first century was facilitated by the advancement of contemporary technology. The utilization of social networks and data exchange has facilitated the development of trust among the individuals who lack prior acquaintance, thereby promoting a swift dissemination of underutilized commodities, experiences and competencies. Napster serves as an example of peer-to-peer sharing of digital audio and media files, which is a pioneering phenomenon in the realm of information communication technologies (Karobliene et al., 2019) (Figure 5). An additional illustration is the "Call a Bike" initiative, which is a German bicycle rental program that was founded in 1998 and has been in operation since 2000. The sharing of digital content, including user-generated videos and photographs, has become increasingly prevalent through the use of open-source software storage platforms such as GitHub and SourceForge, content sharing platforms such as YouTube, Facebook, and Instagram, online encyclopaedias, for example, Wikipedia, and peer-to-peer sharing networks, for instance, The Pirate Bay. The increasing popularity of social networks, referred to as "connection technologies" by Sunjoo Oh and Moon (2016), has facilitated the enhancement of social connections, leading to increased trust between providers and users of shared items and the growth of the sharing economy. Moreover, considering the benefits of social network technologies, the act of sharing products is no longer constrained by the geographical or temporal factors. The growing popularity of social networking has led to the emergence of the first sharing

economy-based companies that provide car rentals (such as Zipcar, Greenwheels and GoGet), bike rentals (such as Call a bike and City Rader), peer-to-peer money lending (such as Zopa, Lending club and Prosper), accommodation (such as Couchsurfing) and other services for consumer communities. According to Oh and Moon (2016) as well as Hamari (2016), among other scholars, the assessment of the sharing economy was prompted by two primary factors: the worldwide economic downturn in 2008 and the rapid advancement of communication technologies. According to Marshall's (2015) analysis, the rising popularity of the sharing economy began to be documented in the latter part of 2008, subsequent to the worldwide financial downturn. The decrease in consumer confidence towards businesses, coupled with an increase in unemployment and a decline in consumer purchasing power, has resulted in individuals reducing their expenditures and seeking alternative means of income. The worldwide economic downturn has had an impact on the behavioural patterns of individuals. For instance, a survey conducted in the United States indicates that people are adopting a more frugal lifestyle by prioritizing sharing over ownership (Sunjoo Oh and Moon, 2016). According to Goudin's (2016) analysis, there are two primary factors that demanded the growth of the sharing economy, namely, the underutilization of resources and skills. During the period of economic recession, sharing economy platforms, for instance, Airbnb and Uber, emerged as international business models (Karobliene et al., 2019).

Based on Laurenti et al. (2019) Lawrence Lessig, a Professor from Harvard and founder of Creative Commons, is widely recognized as the first scholar to employ the term "sharing economy" in 2008. However, Lessig employed this term in reference to culture, but not the shared items. Then, the publication of the book *What's Mine is Yours: The Rise of Collaborative Consumption* by Botsman and Rogers in 2011, the term "sharing economy" has gained significant attention among scholars and industry professionals (Cheng, 2016). Botsman and Rogers were the pioneering authors who identified the distinctions between the collaborative consumption and the sharing economy. The primary feature of the sharing economy, as identified, is the utilization of a platform whereby individuals share their underutilized possessions.

There is ongoing debate among scholars regarding the precise definition of the term "sharing economy". However, in 2015, despite these disagreements, the concept of the sharing economy was officially recognized and added to the Oxford dictionary, and this phenomenon is described as: "An economic system in which assets or services are shared between private individuals, either for free or for a fee, typically by means of the Internet". Consequently, based on the current research, this description was clarified accordingly: the sharing economy is 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 among individuals and/or companies** for a fee or for free.

1.3. The drivers of the sharing economy

The growth of the sharing economy and its importance on economic development stimulates questioning **what factors and conditions are encouraging the sharing economy as a perspective business model**.

As per the report published by PwC in 2015, the sharing economy generated a revenue of $15 billion globally in the same year. It is anticipated that the sharing economy will witness a surge in revenue and is expected to generate $335 billion within the next decade. According to Campbell's (2018) research, the official statistics suggest that the sharing economy is projected to contribute around 10% to China's gross domestic product (GDP) by 2020 and is expected to increase to 20% by 2025. According to the author, this particular economic model facilitated the transactions worth of $500 billion among approximately 600 million individuals in the year 2017. Hence, it is imperative to elucidate the predominant factors that contribute to the noteworthy influence of the sharing economy on economic progress. Additionally, in the research discourse, the researchers as well highlight the supplementary factors. For instance, Yin et al. (2021) argue that the main driving forces of the sharing economy is the increasement of the population, limited resources, rapid processes of urbanization and processive performance of the technologies.

The studies of Daglis (2022), Enochsson et al. (2021), Karobliene et al. (2019), Hodkinson et al. (2017), Goudin (2016), Bocker and Meelen (2016), Owyang et al. (2013) explore the primary factors that drive the sharing economy, including economic, social, environmental and technological factors. The approaches taken by these researchers vary in their examination of the effects of these factors on both users and providers of the sharing economy and are illustrated in Figure 6.

The sharing economy is influenced by the **economic, social, environmental** and **technological factors**, which are stimulating the growth of providers and users of this business model. Bocker and Meelen (2016) conducted a survey in Amsterdam, which revealed that the sharing economy in the accommodation sector is primarily driven by the economic incentives, whereas sharing in other sectors, such as car and meal sharing, is predominantly motivated by the social factors. The findings of this study indicate that individuals who are young and have lower income tend to prioritize economic considerations, while those who are young, have higher income and have obtained higher levels of education tend to prioritize social and societal considerations. Additionally, the study suggests that females tend to prioritize environmental considerations more than males. Bocker and Meelen's (2016) research demonstrated that individuals who participate in the sharing economy are primarily driven by the economic incentives, whereas the providers of these services are less motivated by the financial gain.

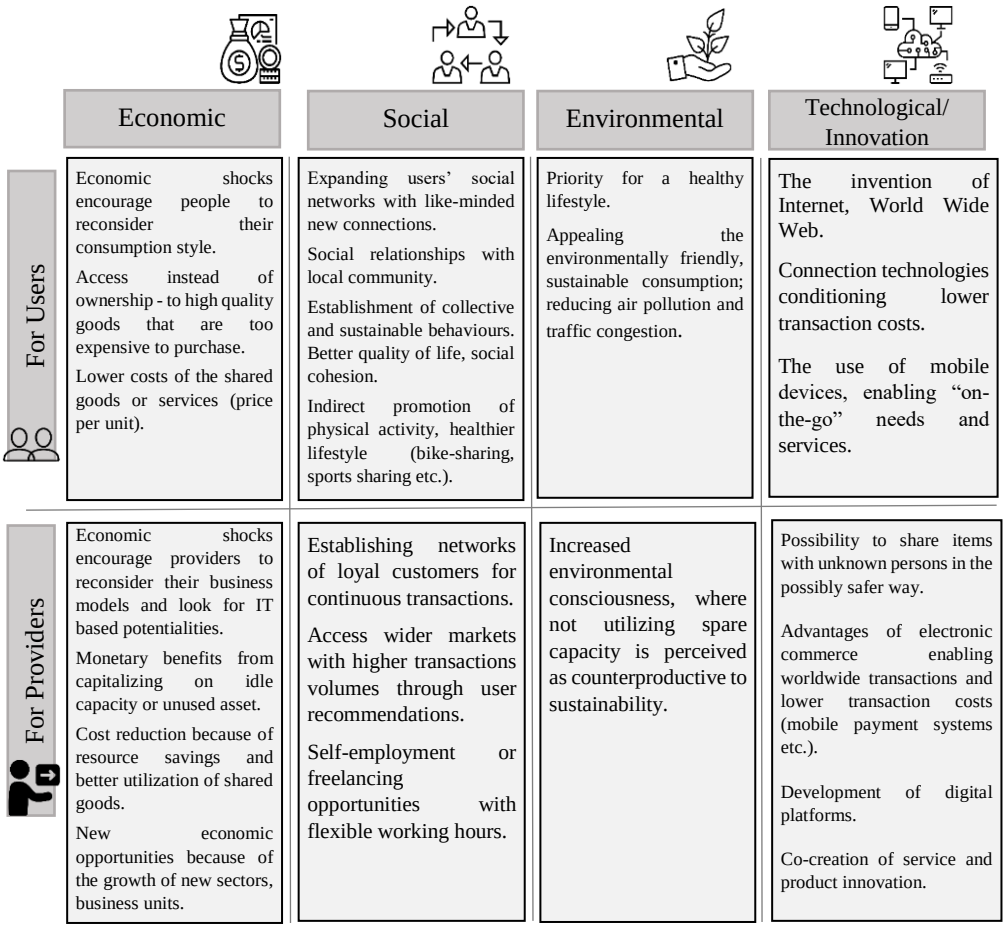


Figure 6. The main driving forces of the sharing economy from users and providers perspective (adapted based on Daglis (2022), Enochsson et al. (2021), Karobliene et al. (2019), Plepys and Singh (2019), Hodkinson et al. (2017), Oh and Moon (2016), Owyang et al. (2013))

The worldwide economic downturn that occurred in 2008 and subsequent economic decline have led to a shift in the distribution of individuals' financial resources. According to Oh and Moon (2016), in the aftermath of a crisis, a significant majority of American residents, specifically 80%, reduced their purchasing activity. Additionally, 90% of the population expressed a preference for a more convenient lifestyle that allowed for shared usage of items rather than individual ownership. The sharing economy has provided users with a significant benefit, including access to high-quality goods that may be cost-prohibitive to own. The **economic factors** that propel the sharing economy as a prospective economic model are generally favourable. The sharing economy's economic aspect is shown through the optimization of productivity of goods and services. The practice of sharing a particular

item that would otherwise be used infrequently by its owner has been maximized through the sharing economy, which provides users with access to the item at an economic premium. This collaborative approach results in time, cost and resource savings for the users, while providers earn supplementary income. According to Frenken (2017) and Mi and Coffman (2019), a significant effect of reduced transaction costs between service providers and consumers has been noticed. According to Ewans and Gawer (2016), the sharing economy facilitates the productivity of the economy by enabling highly efficient matching between providers and users of shared services or goods. The sharing economy contributes to more sustainable consumption, reduces the redundant production and generates revenues from the items that in other conditions would not generate any (Daglis, 2022).

The increasing popularity of smartphones, reduction in data costs and high concentration of individuals in urban areas have collectively spurred the growth of sharing platforms. The surplus capacity creates an ideal environment for collaborative efforts that effectively align supply with demand. As Hodkinson et al. (2017) additionally argued in their paper that "with uncertainty around pension systems across the world, sharing assets has the potential to augment pension income and can help prevent old-age poverty". The authors explained this statement by naming the potential benefits of the sharing economy, citing the example, for an elderly individual, residing in an urban area, who possesses a vehicle. This individual could potentially generate periodic income by participating in ride sharing through the utilization of a car sharing platform. According to Owyang et al. (2013), the sharing economy model has the potential to create economic value for both the provider and user, thereby fostering financial flexibility. To sum up, the sharing economy generates additional economic growth because of the increase in public spending (Plepys and Singh, 2020).

According to Frenken and Schor (2017) and Curtis and Lehner (2018), recent research suggests that the sharing economy is influenced by **social and societal factors** rather than being driven solely by the altruistic motives, as previously believed. In addition, the proponents of the sharing economy assert that social concerns hold greater significance and worth from a societal standpoint compared to the conventional business model. According to Frenken and Shor's (2017) argument, sharing platforms offer users the advantage of establishing novel social connections and even forging new relationships among participants of the sharing economy. The sharing economy has the potential to decrease social inequality by facilitating a more equitable distribution of goods and services. Researchers Plepys and Singh (2020) as well argue that the sharing economy contributes to the social benefits of customers by providing access to goods and services when people do not have the financial possibility to buy and own them.

Another social concern about the sharing economy is the aspect that this economic phenomenon provides possibility for self-employment or freelancing opportunities with flexible working hours. However, it can generate not only as a positive factor, but as a negative as well: sometimes, the salaries in the sharing economy are lower, and the periods of employees' employment are shorter than in

than in the usual market (Schor, 2020). Thus, it could be the factor conditioning income inequality (Daglis, 2022).

According to a study conducted by PwC in 2015, a significant proportion of sharing economy users, specifically 78%, adhere to the notion that the sharing economy effectively reduces unnecessary waste. According to Mi and Coffman (2019), this economic model has the potential to generate positive environmental outcomes by decreasing the quantity of resources utilized for meeting customer demands, mitigating pollution and fostering sustainable communities. According to the research conducted by Zhang and Mi (2018), the use of bike sharing in Shanghai resulted in the reduction of 25,000 tons of carbon dioxide (CO2) emissions and 64 tons of nitrogen oxide (NOx) emissions. Additionally, bike sharing contributed to a savings of 8,358 tons of petrol.

In recent times, the sharing economy platforms have provided significant prospects for resource sharing among individuals residing in the urban areas and other regions. The resources of tangible and intangible assets provide a beneficial basis for facilitating exchange through **communication technologies on the sharing platforms**. According to Frenken (2017) and Mi and Coffman (2019), the reduced transaction costs between providers and users are a significant factor that promotes growth of the sharing economy. In contemporary times, the financial transactions have become more convenient and cost-effective due to the advancements in communication technologies, as noted by Narasimhan et al. (2018). The emergence of digital platforms has facilitated user access to goods and services tailored to their specific needs. Simultaneously, it has enabled service and product providers to optimize their supply to match the user demands.

The above-mentioned factors may suggest that the sharing economy has emerged and developed as a prevalent business model in urban areas over the past decade, as noted by Hodkinson et al. (2017). The sharing economy has the potential to increase the supply during the peak seasons and align with high demand. This is exemplified in the tourism industry where sharing platforms enable property owners and hosting service providers to offer accommodations during peak periods, rather than investing in new construction. Ewans and Gawer (2016) conducted a global survey, which revealed a significant surge in the sharing economy since 2010. According to the research carried out by Ewans and Gawer (2016), sharing economy enterprises attained a collective market value of $4.3 trillion in the year 2015 and provided employment to 1.3 million individuals globally. According to the study, the sharing economy has emerged as a significant driver of innovation in recent times. This is evidenced by the fact that in 2014, nine sharing economy platforms held more than eleven thousand patents in the United States. The sharing economy business model has been adopted by numerous start-up companies and has received direct funding from various investment resources, such as venture capitals, incubators and accelerators.

1.4. The business models of the sharing economy

Analysing different scientific articles (Curtis and Mont, 2020; Habibi et al., 2017; Hamari et al., 2016; Belk, 2014) it has been noted that the sharing economy is described as a business model facilitated by the internet and operated through the digital platforms and/or the applications and generating an access to underutilized items instead of ownership. Generally, the definition of a business model lacks common interpretation in the economic literature (Bocken et al., 2014; Arend, 2013); however, in this research it is described as a method how an organisation chooses to establish and deliver value propositions for its customers, generate profits and provide a steady stream of revenue for the organization and contribute to the public benefits creation (Teece, 2010; Monoz and Cohen, 2017). A new generation of business models has been developed with the development of Web 2.0 technologies for the sharing economy. The companies are able to exploit market segments more effectively than ever before due to the business models of the sharing economy. The business models of the sharing economy are highly various and dynamic, for example, Uber with carpooling ad development with new facilities, i.e., driverless cars (Leighton, 2016).

Following the analysis of scientific articles and existing empirical studies, the business models of the sharing economy can be grouped into several different categories, based on the different research perspectives. Table 2 demonstrates the most common types and categories of the sharing economy business models that were identified by different authors.

Table 2. The main business models of the sharing economy

Author	**The type of the business model of the sharing economy**	**The category of the business model of the sharing economy**
Curtis (2021), Soltysova and Modrak (2020), Li et al. (2020), Agarwal and Steinmetz (2019), Curtis and Lehner (2019), Tunca (2016)	Parties involved in the action type (who is sharing to whom?)	Consumer to consumer (C2C or P2P) Business to consumer (B2C) Business to business (B2B) Public to citizen (Pub2Cit) Crowdfunding/ Crowdinvesting
Laukkanen and Tura (2020), Plewnia and Guenter (2016)	Orientation to profit	Non-profit For-profit
Curtis (2021), Curtis and Mont (2020)	Practice type	Shared space Shared mobility Shared goods Shared consumables Shared resources

Ritter and Schanz (2019)	Value proposition type	Product oriented (PO) Use-oriented (UO) Result-oriented (RO)
Curtis (2021), Curtis and Mont (2020), Ritter and Schanz (2019), Meeusen et al. (2017)	Revenue stream type or monetisation based	None Registration fee-based model Singular transactions model Subscription-based model Commission-based model Membership-based model Advertisement-based model Data mining Sponsorship Donations, public or private project funding Unlimited platforms

In the latest economic research studies, the most common business models of the sharing economy are explained based on the *parties involved in the sharing action*. Some researchers examine them as business models based on the sharing platform type (Curtis, 2021; Curtis and Mont, 2020; Soltysova and Modrak, 2020; Meeusen et al., 2019):

- Consumer to consumer (C2C), often used as peer-to-peer P2P (Plewnia and Guenther, 2017) – sharing between users, who have equal or very similar situation based on the class, age, rank, etc., for instance, Uber, Airbnb, Peerby, Turo, Getaround, etc. (Curtis, 2021);
- Business to consumer (B2C) – sharing goods owned by company to consumers, operates as one-side market, for instance, MyWheels, GreenWheels, Freedom Boat Club, etc. (Curtis, 2021);
- Business to business (B2B) – sharing between business or organizations, sharing idling resources, which are particular to the organizations business sectors (e.g., medical, construction equipment), for instance, Planned, Quill, etc. (Curtis, 2021);
- Public to citizen (Pub2Cit) – shared items are offered to citizens and maintained or supported by governmental organizations or institutions, for instance, Bike Share Toronto, Cyclocity, etc. (Curtis, 2021);
- Crowdfunding/Crowdinvesting – this model refers to the practice of funding, when many donors or investors chip in funds small amount of money for some special projects, initiatives, and this model works in the following principle: from one person's funds to many, from many to one, from many to many, for instance, Zopa, LendingClub etc.

Analysing the sharing economy's business models, the researchers divide if the models are *oriented to profit* or not. Munoz and Cohen (2018) refer that the sharing economy business model, which is acting for-profit, mainly is mission-driven, and the primary object is the environmental or social welfare, for instance, Timebanks, Kiva, etc.

Further on, the economic research literature presents business models of the sharing economy analysed according to the *practice type* between a resource owner and a resource user as mediated by the platform (Curtis and Mont, 2020). The researchers refer that the above-mentioned consideration is mainly important when the sharing economy's platforms are studied as sustainability implications. Shared spaces define sharing apartments, parking places, idling rooms; shared mobility considers ridesharing, bike sharing, carsharing practice mediated by the users and shared spaces providers operated in the online platforms. Shared goods include such items as furniture, home equipment, tools, luggage, consumer electronics and other durable or non-durable items. The examples of shared consumables are items considered as one-time used, for instance, hair care products, office suppliers, ink cartages, etc. Conclusively, the sharing of resources, such as energy, water, heat etc. are significant when evaluating the sharing economy in the sustainability aspect, incorporating recovery and recycling efforts (Plewnia and Guenther, 2018).

In addition to this, in the academic discourse (Ritter and Schanz, 2019), the sharing economy business models are analysed based on the value proposition categories:

- product oriented (PO) – business models are operated approaching to sell underutilized products with the additional services mediated by the sharing platform (e.g., take-back agreement, maintenance or financing scheme). The customer gets the ownership of tangible products with small intangible service arrangements, for instance, Vinted, eBay.
- use-oriented (UO) – business model where the ownership of the shared item belongs to the provider, who sells it, and the provider ensures the functionality and maintenance of the shared product, while the users can use all or part of the shared item, for instance, Airbnb, short term car rent Uber Pool, CityBee.
- result-oriented (RO) – business model when the results or competences are offered as a shared item on the IT platforms, for instance, taxi services using the platform Uber, freelance labour services platform TaskRabbit.

The scientific literature review (Curtis, 2021; Curtis and Mont, 2020; Meeusen et al., 2019) identified the additional sharing economy's business models based on *revenue stream type* or monetisation process:

- None – cases when the platform of the sharing economy is volunteer-run and there are no sources of revenue generated by this type of model, mainly oriented to creating social value;

- Registration fee-based model – the users are charged with the registration fee once they register the sharing economy platform and gain the access to the offers of the platform;
- Singular transactions model – the users are charged with transaction fees by sharing (IT) platform each time when the goods or services are accessed (e.g., 0.10 Eur for transaction);
- Subscription-based model – the users are charged periodically by the IT platform for the access to the goods or services;
- Commission-based model – the prearranged percentage fee, and it is included in the price of the shared item, for example, 5% from the price of shared item price;
- Membership based model – the costs for the usage of the sharing platform and may give an access to the added value features of the platform (e.g., forums, reviews, discounts, etc.);
- Advertisement based model – with paid advertisements on the sharing economy IT platform;
- Data mining – with practice to use or sell data generated on the platform;
- Sponsorship, donations or public and private project funding – with the practice to receive funds for the development of sharing economy activities or related objectives;
- Unlimited platforms – models with no perspective for revenue streams, mainly operating on volunteer reason.

Thus, when evaluating the sharing economy's business models, the researchers as well highlight the aspect if the sharing economy business models are for-profit or non-profit oriented. Furthermore, based on the research literature study (Plewnia and Guenther, 2017), it was summarized that the sharing economy is assessed according to the tangibility of the shared items. Based on this methodology, the sharing economy evaluation matrix is presented in Table 3.

Table 3. The matrix of the sharing economy based on the parties involved in the action and tangibility of shared items (according to Meeusen et al. (2019), Plewnia and Guenther (2017))

Business models of the sharing economy		***Tangible*** **Shared items and tangibility of shared items**							
Type of model based on the parties involved in the action *(who is sharing to whom?)*	**Orienta-tion to profit**	**Products (redistri-bution)**	**Material (recovery and recycle)**	**Product service system (PSS)**	**Space**	**Money**	**Workforce (time and skills)**	**Knowledge and education**	**Data and information**
Business to consumer (B2C)	**Non-profit**								
	For-profit								
Consumer to consumer (C2C or P2P)	**Non-profit**								
	For-profit								
Business to business (B2B)	**Non-profit**								
	For-profit								
Public to citizen (Pub2Cit)	**Non-profit**								
	For-profit								
Crowdfunding/ Crowdinvesting (CrowdF/ CrowdI)	**Non-profit**								
	For-profit								

The first dimension divides the sharing economy matrix based on the parties involved in the action (B2C, C2C, B2B, Pub2Cit, CrowdF/CrowdI); the second dimension differentiates the orientation to profit or non-profit cases. Thus, eight categories of the shared items are sorted: materials, products, product service system (SS), space, money, workforce, knowledge and education, information and technology (Plewnia and Guenther, 2017). Further on, the tangibility of the shared items is demonstrated in the matrix as well.

1.5. Theoretical conception and measurement aspects of the country's sustainability

Sustainable development in scientific literature is mostly referred to as "green growth" and a significant aspect for the country's economic growth, innovation

development and regenerative resource use leading to climate, i.e., neutral economy (Egenolf and Bringezu, 2019). Initially, G.H. Brundtland (1987) gave a comprehensive definition of sustainable development: "the ability for the present generation to fulfil their needs without compromising the ability of future generations to meet their own needs" (WCED, 1987). However, the terms "sustainability" and "sustainable development" are not the same thing: "From the systems theory point of view, 'development' is a process, and 'sustainability' is the final stage of the object" (Staniškis et al., 2022). Meanwhile, recent researchers argue that "the 'development' is not a synonym for 'growth'. Development could be degrowth, stable state or growth, depending on country/regional economic, environmental and social situation, defined by the system performing index, boundaries and limitations" (Staniškis et al., 2022).

However, the conception of sustainability appears from various aspects, which relates reserve of resources, ecological capacity building, effective and innovative use of technology solutions (Dong and Hauschild, 2017).

Based on the research literature analysis, the **country's sustainability could be described as a resilient, low carbon economy, equitable, efficient production based on the social interconnectedness** (Staniškis et al., 2022) or **the concept that covers economic, environmental and social welfare for the society over time** (Lozano, 2008).

In addition to this, **the country's sustainable development "meets the needs of the present, without compromising the ability of future generations to meet their own needs"** (Report of the World Commission on Environment and Development: Our common feature).

It is noteworthy that in 2015, the General assembly of the United Nations published the 2030 Agenda for Sustainable Development with 17 sustainable Development Goals (hereinafter SDGs) and 169 targets, approaching international and national sustainable development in economic, environmental, social and governance dimensions. These targets have various numbers of indicators listed in the 2030 Agenda as a guideline for countries to make some progress achieving the goals of country's sustainability, and finally, the goals of universal sustainability as well.

Principally, many research studies (Pieloch-Babiarz et al., 2021; Rahdari and Rostamy, 2015; Manara and Zabaniotou, 2014; Huang et al., 2012; Lopes, 2012; Lozano, 2008) highlight three pillars or dimensions of sustainability: economic, environmental and social. Moreover, the researchers (Suganthi, 2019; Rohács and Simongáti, 2007) discuss that sustainability becomes more complex and needs to be analysed involving additional pillars. However, in general, sustainable development seeks to generate economic process avoiding the negative impacts on the environment with the support and advantages of state-of-art research and its effective and optimal development in the industry and other sectors. Thus, considering the above-mentioned statement, the innovation becomes one of the key dimensions for sustainable economic development, and it is widely accepted by the economic researchers and stated in their research studies (Bruno and Tirca, 2019; Retamal, 2019; Suganthi, 2019; United nations, 2019; Rosati and Faria, 2019; Daunoriene et al., 2015; Maxim,

2014; Lopes, 2012; Barbieri et al., 2010). Exploring the country's sustainability based on the economic research studies, the framework sustainability with the essential dimensions were elaborated in this dissertation (Figure 7).

Figure 7. The framework of country's sustainability in relationship with the sharing economy (according to Pieloch-Babiarz et al. (2021), Rahdari and Rostamy (2015), Bruno and Tirca (2019), Suganthi (2019), Lopes (2012), Barbieri et al. (2010))

Based on the European Commission's The Bioecenomy strategy, which was adopted in 2012 and reviewed in 2017, the key objectives, leading to the long-term sustainability of Europe are as follows: *"(1) ensuring food security, (2) managing natural resources sustainably, (3) reducing dependence on non-renewable resources, (4) mitigating and adapting to climate change, and (5) creating jobs and maintaining EU competitiveness"* (European Commission, 2018). These objectives correspond to the four maim sustainability dimensions elaborated by the researchers and mentioned above.

In this dissertation, **country's sustainable development is presented as a regular process, which combines four different dimensions of sustainability: economic, innovation, social and environmental** (Figure 7). Additionally, **the close and effective interconnection and interaction among these four key pillars of sustainability generates the country's sustainability**. Further in this research, there are descriptions about each of the sustainability dimensions.

Economic sustainability is one of the major dimensions of the country's sustainability. It mainly refers to the economic efficiency, generating competitive preferences in the markets and considering from the organization's profile, generates benefitting operations, and in general, as Moldan et al. (2010) state, it mainly refers *to economic prosperity*. Based on the research literature analysis, economic sustainability is a process leading to the economic indicators improvement, focused on the economic welfare quality, interacted with environmental, social and innovation

sustainability (Long and Ji, 2019). The economic sustainability may lead to the economic growth and increase the national income, but not steadily in all the countries and all the groups of society of the country. Despite the fact that economic growth has contributed to the improvements in human, social and economic well-being, the occurred effects on groups of human societies and the whole environment are not always positively impacted. Economic sustainability advances human resources and capabilities, creates additional value, reduces costs as the result of interaction with innovation sustainability (improvements in energy and other raw resources inputs), launching and development of new markets etc. (Pieloch-Babiarz et al., 2021).

Innovation sustainability represents one of the most important sustainability dimensions based on the latest research studies (Bruno and Tirca, 2019; Suganthi, 2019; Rosati and Faria, 2019; Maxim, 2014; Lopes, 2012; Barbieri et al., 2010). The continuing development of research, technology and innovations could lead to the rest three dimensions of sustainability (economic, environmental and social); this encourages the recycling, the use of renewable resources, applying new and effective research-based technologies in the organizations, generating less negative impact on the environment etc. Innovation development is one of the critical aspects generating long-term prosperity of the organizations. Over the past decades, innovation has become the main factor for creating competitive preferences in organizations and economies; moreover, it has been acknowledged by the researchers (Maier et al., 2020; Boons and Lüdeke-Freund, 2012) as one of the key pillars addressing the country's sustainability. Innovation sustainability generates country's sustainability towards *greater progress*, more profitable, environmentally cleaner and socially acceptable practice in the country's economy. According to Ghassim and Bogers (2019), innovations sustainability could balance the economic, environmental and social sustainability.

Social sustainability is the next pillar of the country's sustainability and concerns impact on the society, human communities, improves the living conditions in the qualitative aspect, refers to the care of the employees' health and safety conditions, assures health protection, impacts culture and education. In research studies, Lozano (2008) states that social sustainability mainly concerns *social equity* or as stated by others (Barbieri et al., 2010) claims that social sustainability is *for people*.

Environmental sustainability is the last major dimension of the country's sustainability involved in the research model in this dissertation. Overall, based on the scientific literature study results, this dimension concerns the impacts on the environmental and mainly because of the use of natural, renewable resources, withdrawal of the toxic materials and the reduction of the pollution emission. The researchers (Singh et al., 2019; Lozano, 2008; Barbieri et al., 2010) argue that the environmental sustainability identifies the *environmental quality* and defines the advantages (as positive impact) or disadvantages (as negative impact) to the whole *planet*.

Based on the economic research literature analysis, the country's sustainability could be achieved during the continuous process interconnected with *four main*

sustainability pillars: economic, innovation, social and environmental. Evaluating the progress towards the country's sustainability commits quantifying this phenomenon, which shows the progress. The Eurostat and The Organisation for Economic Co-operation and Development (OECD) have divided the groups of indicators for evaluating the sustainability (governance, demographic changes, partnership, natural resources, climate change and energy, socioeconomic development, public health and others) and constructed a list of indicators (resource productivity, growth rate in GDP per capita, employment rate of older workers, people at risk of poverty, greenhouse gas emissions, renewable energy ant others). The indicators provide important information and present progress towards the accomplishment of SDGs and other sustainability goals to inform society, policy makers, researchers about the situation of the country's sustainability in the dimensions of economic, social, environmental and innovation. In this thesis, some of these indicators are used in the empirical research part for the measurement of the impact of the sharing economy of the country's sustainability. Based on the research literature review (Arbolino et al., 2022; Verma and Raghubanshi, 2018), it can be stated that the scholars indicate a need for the common framework to evaluate country's sustainability, group and analyse the indicators between different countries based on the main four sustainability dimensions; additionally, it is stated that there is a lack in common methodology. Usually, the disadvantages occur because of the misleading explaining and interpretation of the main definition of the country's sustainability and its main dimensions. In academic discourse, there are several different explanations of these definitions: this is a shortcoming for separate countries comparative analysis (Verma and Raghubanshi, 2018). In order to achieve an efficient analysis of the country's progress in economic, innovation, social and environmental sustainability progress and its comparative analysis within other countries, there is a need for coherent framework for the assessment of country's sustainability.

Table 4 presents the indicators for the country's *economic sustainability* measurement based on the research literature analysis. Economic sustainability is one of the key pillars evaluating the country's sustainability. Long lasting and sustained growth of economy is mainly assumed as an element of sustainable development by the authors (Laukkanen and Tura, 2020; Narayanan et al., 2019). The indicator's annual growth rate of the real Gross Domestic Product (GDP) per capita is the most common criteria for evaluating economic growth (Huan et al., 2019; Egenolf and Bringezu, 2019; Habib et al., 2019; Verma and Raghubanshi, 2018; Spangenberg, 2005). GDP is only a part of the overall concept of country's sustainability, and it does not consider numerous issues of the well-being and does not estimate the environmental externalities (Dutta et al., 2022; Van De Ven, 2019). This commits the statement, listed in the previous sub-section and presented in Figure 5, that all four key dimensions of the country's sustainability should act based on the long-term interconnections.

Table 4. Country's economic sustainability assessment and descriptions based on the literature review

Name of the assessment	Description and literature source
Index of Sustainable Economic Welfare (ISEW)	The macroeconomic index evaluates "the genuine progress of society, measuring sustainable welfare" (Long and Ji, 2019). ISEW was created by Herman Daly and John Cobb in 1989. This indicator includes economic, social and environmental variables.
Annual growth rate of the real Gross Domestic Product (GDP) per capita, %	The indicator is one of the key measurements in the country's economic development aspect and indicates the situation in the GDP change comparing two results of consecutive years (Lopes, 2021; Huan et al., 2019).
The investment share of GDP, %	Real capital investments are significant for evaluating the economic sustainability (Alfredsson and Malmaeus, 2019; Rockström and Pavan, 2017). This indicator shows the part of the investment in the GDP, and it is calculated as a percentage of GDP by gross capital formation This indicator refers to the share of the investment in the total production. It is obtained by calculating gross capital formation as a percentage of gross domestic product.
The employment rate, %	The rate of all employed persons from the total population in the country (Sustainable Development in the EU, 2020; Spangenberg, 2005; Long and Ji, 2019).
Economic freedom index	Economic freedom is one of the elements, sustaining the economic growth especially in the long-term prospects (The Heritage Foundation, 2022; Bergh et al., 2021; Hong and Lee, 2020).
Genuine Progress Indicator (GPI)	The indicator is created for the country's economic growth evaluation. It is sometimes considered as a substitute for GDP. In this indicator, the costs of negative aspects that impacted economy are involved as well, for instance, costs of ozone depletion, costs for crimes in the country and other (Long and Ji, 2019).
Global Competitiveness Index (GCI)	The index measures national competitiveness as a set of factors that determine the national level of productivity, and it is ranked Globally. The index identifies the productivity level of the nation.

Innovation sustainability and country's innovation system generates novel advantages for the organizations in a country to innovate their propositions of value, growth based on the research and development of modern technologies solutions, achieve new methods using advanced infrastructure, use renewable energy resources research and innovation-based solutions (WIPO, 2022; Rosati and Faria, 2019). The Global sustainable Development Report 2019 of United Nations claims that "the universal transformation towards sustainable development in the next decade depends on the simultaneous achievement of country's specific innovative pathways" (Independent Group of Scientists appointed by the Secretary-General, United Nations,

2019). Some scholars, e.g., Cillo et al. (2019), emphasize that "Given the growing importance of sustainability in innovation activities, researchers and practitioners are placing significant emphasis on understanding how sustainability issues and innovation practices can be reconciled". Table 5 presents the indicators for assessing the country's innovation sustainability based on the research literature analysis. Overall, human capital, understood as the employees in all country's labour market, intellectual property rights and R&D expenditure significantly contribute to the accomplishment of the country's sustainability. Habib et al. (2018) argue that the connection between human capital and development of the country's sustainability is substantial and drives to cost efficient, resource saving production. In addition, recruiting high-skilled professionals leads to a greater capability, increases the research and innovation development resulting in GDP growth in the country level. Over the past three decades, a series of pioneering breakthrough innovations have been made in a wide range of activities that have effectively transformed into productive enterprises, matured new industries and boosted economic growth (Mutmaz et al., 2018). According to Barbieri et al. (2010), the combination of innovation and social sustainability is one of the drivers, which encourage the country's sustainability. Recently, the researchers (Habib et al., 2018) have pointed that R&D, which are applied timely and continuously, are one of the key factors leading countries to the economic growth and innovation sustainability. Furthermore, intellectual property rights (IPR) are recognized as playing a significant role in establishing advancing environment for the country's creativity and innovation. IPR are linked to the economic sustainability through intermediation of links, such as human capital and innovation activities. Some of IPR examples are patents, confidential information, trademarks copyrights and designs, inventions etc. The annual amount of patent application to the patent office is the involvement in Table 5 as one of the main points allowing the country to gain innovation sustainability. The more IPR are protected, the more they will have a positive impact on the country's innovation sustainability. Additionally, according to the scholars (Habib et al., 2018; Rosati and Faria, 2019), the collaboration among universities and industries in R&D is referred as one of the factors impacting innovation sustainability.

Table 5. Country's innovation sustainability assessment and descriptions based on the literature review

Name of the assessment	Description and literature source
Gross domestic expenditure on R&D (% of DGP)	Gross domestic expenditure on R&D shows the percentage part of the total expenditure on R&D of all companies, universities, research organizations etc. in the country (Sustainable Development in the EU, 2020; Rosati and Faria, 2019).
Human resources in science and technology (% of active population aged 25–64)	The indicator is one of the key measurements evaluating innovation sustainability. It is the percentage of human resources in science and technology from the country's population (Sustainable Development in the EU, 2020; Rosati and Faria, 2019; Habib et al., 2018).

R&D personnel (in all sectors, % of population)	The indicator in question evaluates the proportion of research and development personnel categorized by the institutional sectors, namely: business enterprise, government, higher education and private non-profit. (Sustainable Development in the EU, 2020; Rosati and Faria, 2019; Habib et al., 2018).
Patent applications to the European Patent Office (number)	The indicator measures the number of patent applications applied to the European Patent Office by country (Sustainable Development in the EU, 2020; Rosati and Faria, 2019; Habib et al., 2018).
Venture capital (% of GDP)	Venture capital refers to the amount of financing that is extended to companies and entrepreneurs from the total GDP in the country (Hossain, 2020; Frenken and Schor, 2017; Muñoz and Cohen, 2017). Statistical data is available only from 2014; thus, this variable is not involved in the empirical research.
Global innovation index	The index ranks the most innovative economies globally, highlights innovation advantages and disadvantages of global economies (WIPO, 2022; Rosati and Faria, 2019).

The environmental sustainability is the further main dimension or pillar of the country's sustainability. Based on the scholarships, the environmental sustainability emphasizes the impacts on the environmental and mainly refers to the use of natural, renewable resources, withdrawal of the toxic materials and the reduction of the pollution emission (Staniškis et al., 2022; Singh et al., 2019; Moldan et al., 2012). Furthermore, Goodland (1995) developed the conception of environmental sustainability. In accordance with Goodland, environmental sustainability "seeks to improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, in order to prevent harm to humans". The scholars mainly conceptualize environmental sustainability as the set of 4 aspects: renewable and non-renewable resources, environmental pollution and waste (Moldan et al., 2012). Summarizing, the country's environmental sustainability contributes to the reduction of the country's manufacturing costs, reduction of the country's energy consumption and waste level (Gholami et al., 2020). Table 6 presents the indicators for assessing the country's environmental sustainability based on the research literature analysis. The assessment of the share of renewable energy in gross final energy consumption is indicated as one of the key aspects evaluating the environmental sustainability, as based on the research works of scholars (Lyeonov et al., 2019), it is assumed that increasing the share of renewable energy in total energy consumption leads to reducing greenhouse gas (GHG) emissions. Thus, GHG emission is listed as well by the researchers (Bilan et al., 2019; Singh et al., 2019; Lyeonov et al., 2019) as an important indicator for the country's sustainability. The measurement "circular economy performance in the country" is important for the environmental sustainability, especially, in the aspect of sharing economy performance. This measurement assumes the circular material usage rate and presents "the share of material recycled and fed back into the economy – thus savings environmental impact extraction of primary raw materials - in overall material use" (EUROSTAT). The indicator Green Investments (PICE) counts private

investments, jobs and gross value added related to the circular economy sectors. Although several researchers (Lyeonov et al., 2019) argue that it is one aspect, which contributes to the financial base for the environmental sustainability, it is not provided or calculated on behalf of all European statistic or other departments and authorities covering the whole period of this thesis research. As mentioned in the previous sub-sections, there are long-term interconnections between all four main sustainability pillars; thus, there are meaningful links among these key dimensions (economic, innovation, environmental and social). Finally, the Global Innovation Index (GII) which presents "the most innovative economies in the world, ranking the innovation performance of 132 economies, highlighting their innovation strengths and weaknesses, and pinpointing any gaps in their innovation metrics" (WIPO, 2022).

Table 6. Country's environmental sustainability assessment and descriptions based on the literature review

Name of the assessment	Description and literature source
CO2 emission per GDP	Carbon dioxide (CO_2) emission per GDP (Yin et al., 2021; Singh et al., 2019; Hanif and Gago-de Santos, 2017).
Share of renewable energy in gross final energy consumption	Demonstrates the use of new energy efficient and innovative technologies in the overall energy balance of the country (Lyeonov et al., 2019; Bilan et al., 2019; Dong and Hauschild, 2017; Ilidio Tomas Lopes, 2012).
Greenhouse gas (GHG) emissions	Indicates the total national emission including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulphur hexafluoride, nitrogen trifluoride and others from all sectors of the GHG emission makers (Singh et al., 2019; Lyeonov et al., 2019).
Circular economy performance in the country	"Open production systems – in which resources are extracted, used to make products and become waste after the product is consumed − should be replaced by systems that reuse and recycle resources and conserve energy" (Preston, 2012); "The share of the environmental impact from the production of a material or product that is retained in products and materials recovered from reuse, remanufacturing, or recycling" (Haupt and Hellweg, 2019; Huysman et al., 2017).
Resource productivity and domestic material consumption (euro per kilogram)	The indicator shows the GDP divided by domestic material consumption (DMC). "DMC assesses the total amount of materials directly used by an economy. It is defined as the annual quantity of raw materials extracted from the domestic territory of the focal economy, plus all physical imports minus all physical exports. It is important to note that the term 'consumption', as used in DMC, denotes apparent consumption and not final consumption" (EUROSTAT; Rockström and Pavan, 2017; Ilídio Tomás Lopes, 2012; Huang et al., 2012; Egenolf and Bringezu, 2019).

The quality of country's environmental performance	The amount of carbon dioxide (CO_2) emission demonstrates the quality of the country's environmental performance (Yin et al., 2021; Singh et al., 2019; Hanif and Gago-de Santos, 2017).
Green Investments (PICE)	Private investments, jobs and gross value added related to the circular economy sectors (EUROSTAT; Lyeonov et al., 2019).
Environment Performance Index	It is a measuring system indicating the country's sustainability aspect based on 32 environmental fulfilment indicators based on 11 categories, e.g.,: water resources, air quality, agriculture, climate, biodiversity and habit, health impact, water and sanity, forests and fisheries (Yin et al., 2021).
Environmental Sustainability Index (ESI)	ESI is an indicator, which measures the progress towards environmental sustainability. It presents the country's complex profile about the environmental situation based on the group of indicators involved in the index calculation.
Patents related to recycling and secondary raw materials	The indicator counts the number of patents in the theme of recycling and secondary raw materials (EUROSTAT).

The social sustainability is the fourth main dimension or pillar of the country's sustainability. However, as far as it is stated in the research literature, there is no single factor that determines social cohesion, human well-being and ecosystem integrity. These criteria are at least as important for the development of the country's sustainability as monetary value, although they must be evaluated according to their own criteria. It must be stated that there are significant links between economic, innovation, environmental and social impacts. The social cohesion, the satisfaction of the humans leads to the social sustainability. The scholars (Haq and Boz, 2020) argue that the growth of social capital (income generation), human capital (training and knowledge development of human) contributes to the growth of the economic, innovation and environmental sustainability and leads to the overall country's sustainability. The human equality (in social, environmental and economic perspectives) is one of the key issues assessing the country's social sustainability (Eizenberg and Jabareen, 2017), and the reducing of inequality strengthens people's capacities to handle vulnerabilities as well. Table 7 presents the indicators for assessing the country's social sustainability based on the research literature analysis. This series of indicators focuses on social sustainability, linking human social welfare, and reducing the inequalities within countries societies. Without addressing the aspects of human rights, equity issues, cultural values and differences between the different groups of the country's populations, the sustainability assessment would not be attained. Some scholars (Verma and Raghubanshi, 2018) even argue that social sustainability is the most essential dimension of all the dimensions of country's sustainability.

Table 7. Country's social sustainability assessment and descriptions based on the literature review

Name of the assessment	Description and literature source
Disparities in GDP per capita (purchasing power adjusted GDP per capita (real expenditure per capita))	"The disparities indicator for the country is calculated as the coefficient of variation of the Figures in the country. GDP per capita is calculated as the ratio of GDP to the average population in a specific year. Basic Figures are expressed in purchasing power standards (PPS), which represents a common currency that eliminates differences in price levels between countries to allow meaningful volume comparisons of GDP" (Sustainable Development in the EU, 2020; Rockström and Pavan, 2017).
Income distribution (quantile share ratio)	The assessment of the income distribution is one of the key elements to measure inequality within countries. It is one of human well-being indicators, and it significantly relates to the physical and economical security of the humans (Deborah et al., 2012; Rockström and Pavan, 2017; Rockström and Pavan, 2020; Sustainable Development in the EU, 2020).
People at risk of poverty or social exclusion (%)	This indicator corresponds to the sum of persons who are at risk of poverty after social transfers, severely materially deprived or living in households with very low work intensity (EUROSTAT; Ilídio Tomás Lopes, 2021; Ilídio Tomás Lopes, 2020; Sustainable Development in the EU, 2020).
Young people neither in employment nor in education and training (% of total population)	The indicator measures the share of the population aged 15 to 29 who is not employed and not involved in education or training (EUROSTAT; Rockström and Pavan, 2017; Rockström and Pavan, 2020; Sustainable Development in the EU, 2020).
Human development index	This is an index compiled of life expectancy, education and income per capita data set (Rosati and Faria, 2019).

Summarizing, the country's sustainability is the result of long-run close and effective interconnections between four main dimensions of this phenomenon: economic, innovation, social and environmental sustainability. Thus, the country's sustainability generates the impact for prosperity, progress, people and the planet.

1.6. Relationship of the sharing economy and the country's sustainability

Based on the research literature analysis (Laukkanen and Tura, 2020; Heinrichs, 2013), it can be argued that the importance of the sharing economy for the country's sustainability is significant because this phenomenon generates sustainable value creation. Staniškis et al. (2022) refers that the sharing economy "…is one of the new versions towards unsustainability reduction". Yin et al. (2021) confirm that the sharing economy is not the only tempting phenomenon because of the financial advantages, still it leads to more sustainable country's practices. This highlights the relevance of the sharing economy from the perspective of reducing consumption and

human, capital, innovation and energy resource usage, thus potentially supporting the achievement and improvement of Sustainable Development Goals (Mi and Coffman, 2019; Wang et al., 2019). Furthermore, in the era of global clime change, the sharing economy has become even more essential in the countries' sustainability dimension.

In addition, it can be argued that the sharing economy shifts markets in favour of the growth of the nation's sustainability from the perspectives of economic, social, and environmental sustainability. This emphasizes the claim that the sharing economy acts are based on the access to underutilized goods or services. The sharing economy is defined as a socioeconomic system that uses a technology-based market and contributes to more sustainable consumption by leveraging underutilized assets, but the study by Curtis and Mont (2020) reveals that this system is not sustainable by default.

In the recent research studies of the scholar, the definition "access over ownership" is stated as an essential factor in conceptualizing business improvement for sustainability (Curtis and Mont, 2020; Aloni, 2016; Munoz and Cohen, 2017; Ritter and Schanz, 2019). However, "access over ownership" by itself is not sufficient to ensure the country's sustainability, especially in cases of hyper-competition (for instance, the bike-sharing boomed, and then, the bike-sharing platforms flooded the market and generated overcapacity, resulting in underutilized goods in China in 2016) (Laukkanen and Tura, 2020). Thus, the sharing economy has the advantage of increased sustainability compared with traditional business systems. In the context of sustainability, there are four main stakeholders of this system: the owners and users of the shared items, enterprises and public authorities or governments. The theoretical framework of relationships between the main stakeholders of the sharing economy in the context of a country's sustainability is presented in Figure 8.

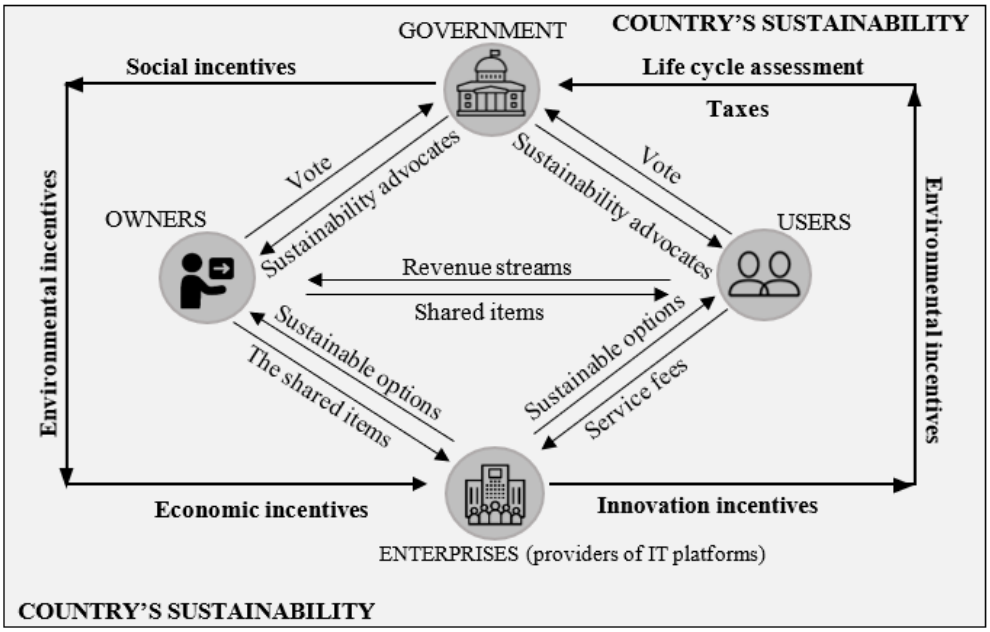


Figure 8. The theoretical framework of relationships between the main stakeholders of the sharing economy in the context of country's sustainability (Karobliene and Pilinkiene, 2021)

As presented in Figure 8, the countries' governments potentially have the greatest ability to promote the growth of sharing models by offering economic (for example, reduced taxes and subsidies) innovation (for example, competitional programmes for R&I development), social or environmental incentives (for instance, communication campaigns and referencing). These incentives can as well be converted into the advantages for businesses' bottom lines (Karobliene and Pilinkiene, 2021). Instead of using the sharing economy as a tool for economic expansion, businesses emphasize sustainability as one of its key goals. Finally, by choosing to share or use underutilized commodities or services rather than buying or selling objects, the owners and users of shared items play essential roles in the sharing economy's framework, and sustainability may be a key factor in these decisions.

Furthermore, according to some scholars (Boar et al., 2020; Curtis and Lehner, 2019), the sharing economy is considered as an aspect that enables consumption in more sustainable method and leads to a well-being of all country's economy. These considerations (Curtis and Mont, 2020; Kauffman and Naldi, 2020; Mi and Coffman, 2019; Geissingner et al., 2019) emphasize the relationships of the sharing economy with the country's sustainability as well as its influence on SDGs.

It is important to point out, that based on the research study, the concept of the country's sustainability with all its main four pillars (economic, innovation, social and environmental) can be fostered by the sharing economy, with practice of more optimal use of the materials and resources, the creation of networks of people, social and economic well-being. "By tapping into idle capacities and using tangible and intangible resources more efficiently, the sharing economy can help to meet the needs

of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, as cited in Plewnia and Guenther, 2017).

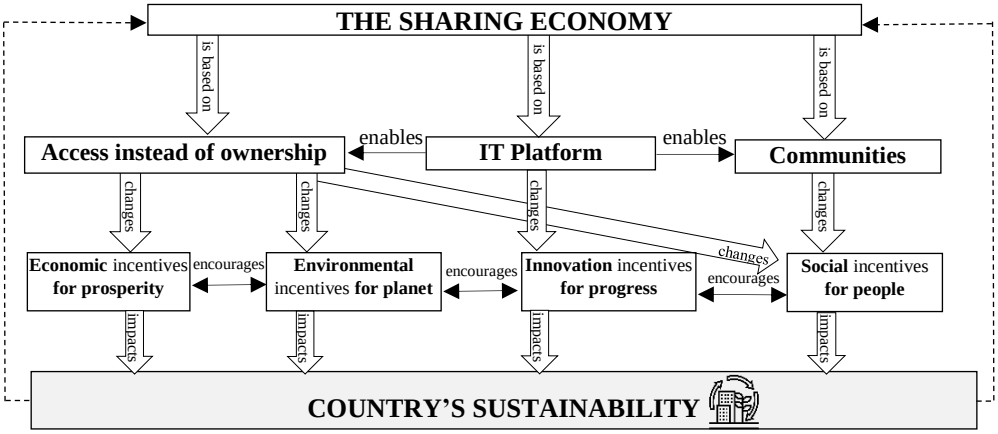


Figure 9. The theoretical framework of relationships between the sharing economy and country's sustainability (created by the author)

The theoretical framework of relationships between the sharing economy and the country's sustainability is graphically presented in Figure 9. Based on several research studies (Belk, 2014; Curtis and Mont, 2020), the sharing economy is characterized as access-based, IT platform-based and community-based economy. Additionally, it is economy facilitated and enabled by the Internet and operated through the digital platforms and/or the applications (Belezas and Daniel, 2023) with a significance of access to underutilized goods or services instead of ownership. Current research work contributes to the above-mentioned characteristics of the sharing economy and demonstrates its importance in the country's sustainable development. The dotted lines in Figure 9 show the feedback generated by the country's sustainability to the sharing economy. However, these relationships will not be investigated in more detailed method in this research study, as it is not the main object of this work.

The evidence that the sharing economy is access-based instead of ownership, found in the research literature, presents the significant impact of the sharing economy on the country's sustainability in all four main sustainability dimensions. The sharing economy reduces social inequalities by giving an advantage to the access of the assets of items for social groups, who are not able to own the shared goods because of the limited financial resources. The sharing economy promotes an increase in resource efficiency, generates new value creation, stimulates innovation development, entrepreneurship creation, lower consumption and reduces waste etc. Additionally, the sharing economy is noticeably relevant in urban cities. From this point of view, large numbers of cities are growing into "natural environmental for the sharing economy, due to increase in users and also in the available goods and services. These cities are known as Smart Cities" (Daglis, 2022).

The findings based on the theoretical analysis demonstrate the relationships between the sharing economy and the country's sustainability (Figure 9), and these

aspects encourage the construction of the conceptual framework for the impact of the sharing economy on the country's sustainability assessment. The structure of conceptual framework is presented further in chapter 2 of this dissertation.

2. THE METHODOLOGY FOR EVALUATING THE IMPACT OF THE SHARING ECONOMY ON THE COUNTRY'S SUSTAINABILITY

This chapter of the dissertation, based on the theoretical analysis, formulates the most suitable methodology for evaluating the impact of the sharing economy in the context of the country's sustainability and presents an overview of the existing indices analysing the sharing economy. Thus, the conceptual framework emphasizes the main theoretical aspects of the sharing economy, and its relationships with the country's sustainability considering the 4 main dimensions: economic sustainability, innovation sustainability, environmental sustainability and social sustainability, is constructed. In order to make the empirical evaluation of the sharing economy's impact on the country's sustainability, the index is constructed, and the structural elements of the index are presented and analysed below. Finally, the conceptual model is supplemented with the structural elements of the index.

2.1. The methods and indices for evaluating the sharing economy in the content of country's sustainability

Although there are many research analysis in the theme of the sharing economy, this phenomenon still lacks common theoretical and practical quantitative methods for making the general assessments in the macro-economic level and in the context of the country's sustainability. The above-mentioned context is significant, as the sharing economy has an important influence on the country's sustainability. In the latest empirical research studies, the sharing economy mainly is examined by employing such methods as the online surveys or interviews of the sharing economies users and providers or data of some particular sharing companies. Additionally, the most common research examples in the latest research literature are mainly focused on the car sharing and accommodation sectors, using the examples of platforms such as Uber, Lyft, car2go and Airbnb, but not the sharing economy as the whole concept. This shortcoming could be explained as the lack of well-determined and worldwide accepted regulation system and policy about the sharing economy (Daglis, 2022).

Table 8 presents the examples of several research methods for evaluating the sharing economy in the context of sustainability used by the scholars and researchers.

Table 8. The examples of the research methods analysing the sharing economy and impacts on the country's sustainability (adapted based on Plepys and Singh (2020), Pouri and Hilty (2018), Cooper et al. (2016))

The dimensions of analysed impact	Employed methods and types of used data	Limitations
GHG savings caused by car mileage and ownership rates	Different models of car park systems, Life circle assessment (LCA) Online surveys – the type of vehicle and travelled kilometres	Microeconomic level; analysed only environmental impact, excluded social, economic and innovative

Changes in overall mobility dimension	User survey about the changes caused by the car sharing	Microeconomic level; included only limited categories of impact
Changes in mobility patterns, car user behaviour, expenses	User survey about behaviours	Microeconomic level
Material efficiency and employment impacts	Material flow and economic data in mobility and construction sectors	Mobility and construction sector
ICT enabled sharing economy impact on sustainability	The life-cycle impacts, enabling impacts and structural impacts (LES) model	Conceptualizing the digital sharing economy in the context of sustainability

Based on the research literature analysis, there are only few indices for the evaluation of the sharing economy, although not from the perspective of the country's sustainability.

The Timbro Sharing Economy Index (TSEI) is the first international index of the sharing economy created by the researchers in Stockholm (Bergh et al., 2018). The index was developed for measuring the amount of the sharing economy activities in global perspective and comparing the sharing economies in different nations. The Timbro Sharing Economy Index has been created by using traffic volume data and scraped data on the websites; the index as well presents an insight according to the factors who are driving the sharing economy. The data on monthly traffic for 286 services across 213 nations was gathered for the index construction. Bergt et al. (2018) classified 286 companies as the sharing economy cases from the dataset of 4,651 worldwide candidates. Figure 10 illustrates the most highly ranked twenty countries according TSEI in 2018. According to TSEI, the countries such as Iceland, The Turks and Caicos Islands, Montenegro, Malta and New Zealand are the top list nations. Summarizing, it could be stated that the countries with highly developed Internet infrastructure and strong potential in the tourism sector have notable sharing economies. Additionally, the TSEI report points that the case of Iceland illustrates the advantages of the sharing economy when this phenomenon raised rapidly in the tourism sector and the shared accommodation services supply fitted the growth of the demand, which in the traditional tourism industry would not have given such an effect (Bergt et al., 2018). However, the TSEI has limitations, and Giovanini (2021) refers that the main weakness of this index is "a limited sample of the companies, and the use of the traffic data on websites only, to the detriment of traffic in applications, which are the main channel for use of these technologies" (Giovanini, 2021). Additionally, the TSEI is available only for 2018.

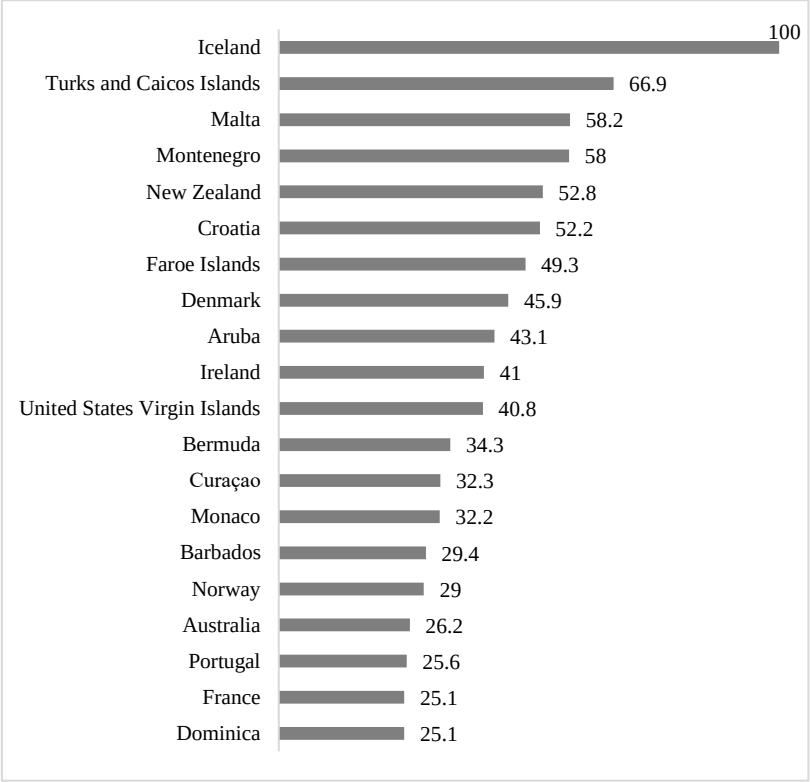


Figure 10. The countries TOP 20 according to the global rankings based on TSEI in 2018 (Bergh et al., 2018)

Another index of the sharing economy was created by the Consumer Choice Centre, Washington (Panzaru, 2022). The index provides information for the consumers about the accessibility and availability of the sharing economy services in the countries. The index analyses 60 cities all around the world, and it is constructed based on the surveys and includes the ride-sharing services, accommodation sharing services, e-scooters, carpooling, car sharing, gym sharing applications. The index is limited in time period as it is available with some updates from 2020.

The impact of the sharing economy on the country's sustainability is argued by a significant amount of recent research studies (Enochsson et al., 2021; Laukkanen and Tura, 2020; Hossain, 2020; Zhang et al., 2019; Mi and Coffman, 2019; Martin, 2016). The sharing economy causes economic, innovation, environmental and social impacts on the country's sustainability, as shared consumption items are used instead of the hyper-consumption assets.

The research conducted by Acquier et al. (2017) study shows that the sharing economy, or access-based economy, gives advantages for customers, achieving wider and cheaper services in a short period. This makes an impact on the environmental

issues, because the access-based economy promotes sustainable solutions instead of irrepressible purchasing of products.

However, although the sharing economy has been studied in the context of sustainability and characterized as "an opportunity for sustainability" (Boar et al., 2020), a research gap as well remains due to the lack of a clear set of measurable variables of the sharing economy's impact on the country's sustainability in the macroeconomic level. Furthermore, the research analysis and frameworks with evaluation methodologies regarding the impact of the sharing economy on the country's sustainability have shortcomings. Considering the given context, the empirical model for evaluating the impact of the sharing economy for the country's sustainability was created in this research work and is presented in the further sections of the work.

From the theoretical perspective, the directions of the impact of the sharing economy for the country's sustainability in this research are indicated as follows:

- economic impact generating country's economic sustainability;
- innovation impact generating country's innovation sustainability;
- social impact generating country's social sustainability;
- environmental impact generating environmental sustainability.

The economic impact of the sharing economy on the country's sustainability

The sharing economy impacts the job creation and employment rate of the country, promotes entrepreneurship, growth of the new business units in the country and potentially growing the culture of start-ups (Kathan et al., 2016), overall increases GDP, the investments amount in the country (the investment share of GDP, %).

The innovation impact of the sharing economy on the country's sustainability

The sharing economy facilitates the intensity of R&D activities in the country, human resources amount in science and technology related activities, the amount of patent applications, contributes to the country's position in the European Innovation Scoreboard.

The environmental impact of the sharing economy on the country's sustainability

The country's sustainable consumption is one of the positive impacts facilitated by the sharing economy (Yin et al., 2021; Chi et al., 2020; Hossain, 2020; Acquier et al., 2017). Several studies on carsharing and mobility sharing in the theme of the country's sustainability have stated that the sharing economy may lead to the traffic congestion in cities and scale down the need for public transport. Additionally, other researchers have reported that carsharing positively and negatively impacts the environmental sustainability. For instance, Schor (2020) argues that the sharing economy in the accommodation sector increases citizens travel, pressure on the environment and causes the usage of environmental resources. Nevertheless, based on the research of Yin et al. (2021), it can be declared that the activities of the sharing

economy have a more positive impact on the environment rather than negative because of the additional consumption encouraged by this economy.

The social impact of the sharing economy on the country's sustainability

The scholars, who analysed the sharing economy and its impact on the social dimension, argue that it generates diverse positive aspects. This phenomenon creates new social networks, relationships, "creates social bonding between participants" (Hossain, 2020), makes conditions for the social equality within a country and between different countries. Additionally, sharing the knowledge makes important social impact by driving societies in more competitive, educated, qualified communities in the country.

Although there are a lot of studies about the sharing economy and its relationships with the country's sustainable development or country's sustainability, but it lacks the conceptual framework for the evaluation of the sharing economy's impact on the country's sustainability analysis. The below given conceptual framework presents the main theoretical conceptions of the sharing economy and its impact on the country's sustainability in the context of four main sustainability dimensions.

2.2. The structure of the conceptual model for evaluating the impact of the sharing economy on the country's sustainability

In order to develop a conceptual model for evaluating the impact of the sharing economy on the country's sustainability, it is important to analyse all the structural components of the sharing economy in detail and estimate the relationship between the sharing economy and country's sustainability. The research literature analysis demonstrates the shortcoming in the existing frameworks for evaluating the impact of the sharing economy in the content of the country's sustainability. Although the phenomenon of the sharing economy is popular between the researchers; still, there is a lack of frameworks analysing the sharing economy in a macro-level. There is an excessively large number of indicators assessing the country's sustainability. The scholars (Verma and Raghubanshi, 2018) confirm that there is a need to indicate the most important indicators in the country's sustainability aspect in four main dimensions of sustainability. Plepys et al. (2020) argue that the general effect of the sharing economy on the national economies are still not sufficiently investigated, and there is a need for a research framework concerning this theme. However, it should be noted that a conceptual model for evaluating the impact of the sharing economy in the context of country's sustainability would help to suggest recommendations for governments to achieve economic welfare in the country: growing GDP, reducing unemployment, social inclusion, saving the resources and other changes driving to sustainability.

The conceptual model for evaluating the impact of the sharing economy on the country's sustainability was developed with a set of measurable indicators of the sharing economy and the country's sustainability considering four main dimensions of the country's sustainability in this sub-section.

The conceptual model is built following these logical steps:

1. a structure of the conceptual model for the assessment of the impact on the sharing economy for the country's sustainability was developed based on the analysis of the scientific literature.
2. the structure of the conceptual model for the assessment of the impact of the sharing economy on the country's sustainability was accomplished with the identified directions of the driving forces and areas of the impact.
3. the variables that will measure the country's sustainability in relationship with the sharing economy were identified and selected.
4. the composite index for the measurement of the country's sustainability in relationship with the sharing economy was constructed.
5. the impact of the sharing economy on the country's sustainability was evaluated based on the correlation of the composite index and the variables of the sharing economy.

The above-listed steps align with the methodological process for building a composite index that was analysed by the researchers Fernandez and Ruiz-Martos (2020). They state that this process begins with the development of the conceptual model, and based on it, the indicators must be selected that assess the different dimensions of the research concept.

The structural model for evaluating the impact of the sharing economy in the context of country's sustainability based on the analysis of the latest theoretical scientific literature is presented in Figure 11.

The current research shows that the sharing economy is a perspective economic phenomenon, which commits to the impact on the country's regions and global economies and gives opportunities for sustainability creation by providing access to the underutilized items, impacting the well-being, saving resources by the optimal usage etc. The sharing economy in economic research papers is being described as a measure solving such challenges as overconsumption and income inequality.

The structural model was developed based on the essential factors (described thoroughly in the sub-section 1.3) driving the sharing economy and is illustrated at the top layer of Figure 11. Hereinafter, the impact directions of the sharing economy on the country's sustainability based on the four main sustainability dimensions (economic, innovation, social and environmental sustainability) are illustrated in the bottom layer of Figure 11.

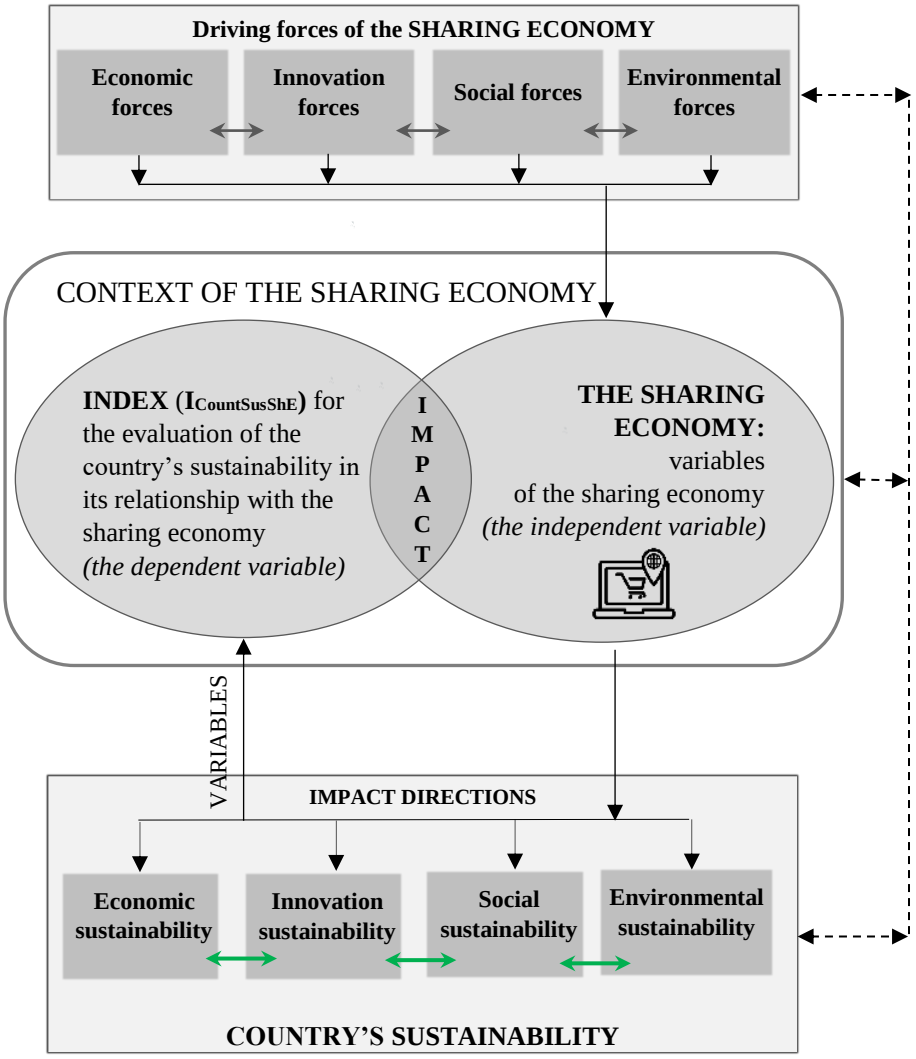


Figure 11. The conceptual model for evaluating the impact of the sharing economy in the context of country's sustainability

The main driving forces (top layer of Figure 11) of the sharing economy interact with each other and support the main pillars (access-based economy, IT platform-based economy and community-based economy) of the sharing economy, resulting in the collaboration between the main actors of the sharing economy: the providers, the users, the enterprises and the governances.

In the bottom layer of the presented model (Figure 11), the green arrows demonstrate the interconnections between the four main dimensions of the country's sustainability (economic, innovation, social and environmental) as they are tightly interconnected to each other with long-term links, as it is described in the sub-section 1.5.

The black dashed arrows illustrate the both way relationships between the country's sustainability, the sharing economy and the driving forces of the sharing economy. However, these relationships will not be investigated in more detail in this research study, as it is not the main object of this work.

Further on, in the middle of the conceptual model, the impact of the sharing economy on the country's sustainability is illustrated, as an interconnection between the index $I_{CountSusShE}$ (index for the evaluation of the country's sustainability) and the sharing economy variables.

Later, the framework is validated in the empirical research in the case of the European Union Member States in chapter 3.

In the framework of this research, the following hypotheses are raised by defining the contribution and impact directions of the sharing economy on the country's sustainability.

H1: *The sharing economy has a positive general impact on the country's sustainability: there is a positive direct relationship between the sharing economy and the country's sustainability.* On the contrary, according to several researchers (Schor, 2020; Giesel and Nobis, 2016), the sharing economy does not generate only positive effect. Based on the above-mentioned researchers, the sharing economy in the accommodation and transport sectors may put more strain on the environment, use more environmental resources and create a variety of unfavourable consequences, such as traffic congestion, CO2 emissions and air pollution. Therefore, in this dissertation, the ***H1*** was raised in order to investigate the general direction of the relationship between the sharing economy and the country's sustainability.

H2: *The sharing economy generates the most significant impact on the country's innovation sustainability dimension comparing with other country's sustainability dimensions: economic, social and environmental.* According to the theoretical research (Rojanakit et al., 2022; Curtis and Lehner, 2019; Acquier et al., 2017), the sharing economy is influenced by the technologies and enabled by IT platforms. Thus, the innovation dimension should be one of the substantial approaches considering the countries sustainability in relationship with the sharing economy. However, some researchers (Hossain, 2020; Plepys and Singh, 2020; Li et al., 2019) concentrate on economic, social and environmental impact on the country's sustainability and omits the innovation dimension of the country's sustainability. In this dissertation, the ***H2*** was raised in order to check the significance of the country's innovation sustainability with its relationship with the sharing economy.

H3: *There is a direct positive relationship between the circular material usage rate and the sharing economy.* Several researchers (Henry et al., 2021; Aldieri et al., 2021; Yin et al., 2012) argue that there exists a potential for establishing the links between the circular economy and the sharing economy. However, these links are mainly investigated in the theoretical approach; thus, it is relevant to explore the links between these two phenomena empirically. This research aimed to investigate the relationship between the circular material usage, as one of the key indicators of the circular economy and the sharing economy. In order to accomplish this, the research hypothesis H3 was formulated and examined.

2.3. The selection of indicators for the assessment of the sharing economy in macroeconomic level

The measurement of the sharing economy at the macro-level is still complicated, as there are no common statistical indicators measuring this phenomenon, mainly because of the overpopulation of different scientific explanations of the definition "sharing economy". Additionally, this phenomenon lacks internationally approved policies or an accepted common statistical measurement system at the macro-economy level. Although there are many studies that analyse the sharing economies in the countries, as OECD (2019a) points out, there are still questions about how to measure the sharing economy for evaluating its performance in different countries and how to monitor the impact of the sharing economy on the countries' economies and sustainability.

EUROSAT, responding to the need for a common methodology to measure the sharing economy, initiated experimental data for the sharing economy from 2018 (EUROSTAT uses the definition "collaborative economy", https://ec.europa.eu/eurostat/web/experimental-statistics/collaborative-economy-platforms). The above-mentioned experimental data is observed for the short-term accommodation operated via sharing platforms (Airbnb, Booking.com, Tripadvisor and Expedia Group). This means, that the data is obtained directly from the main online accommodation platforms, but not via national local authorities or via business interviews. The sharing accommodation providers are not always properly described in the national registers, and in most cases, it is difficult to collect data from them. This innovative approach of data collecting employs the digital footprint, which is casted on the online sharing platforms. Such a new approach gives possibility to obtain the quality assessment and management of the sharing economy data. However, this data is still limited for a short period, as it is only generated from 2018.

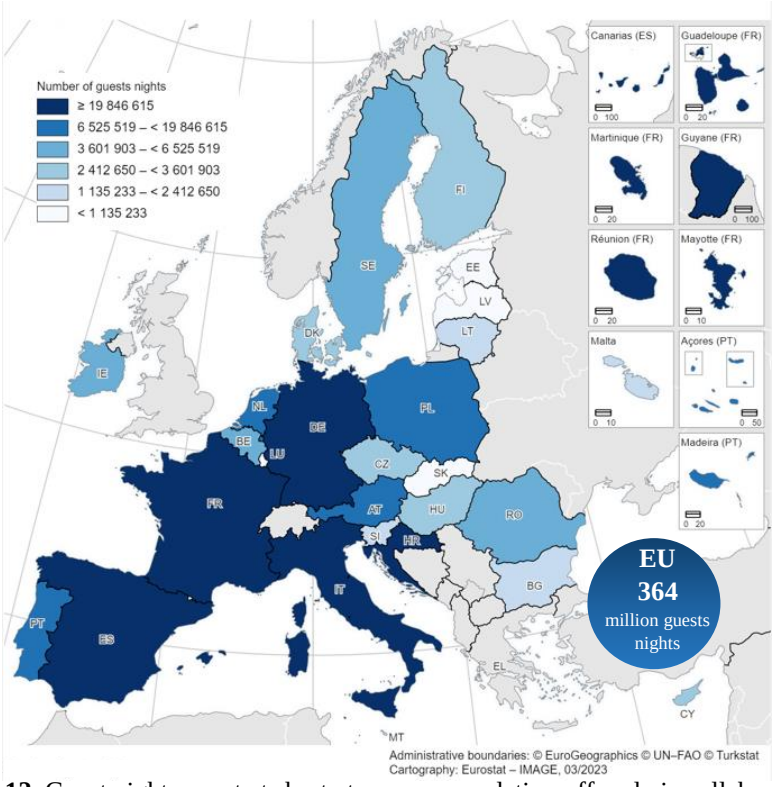


Figure 12. Guest nights spent at short-stay accommodation offered via collaborative economy platforms by NUTS 3 regions in 2021 (data from EUROSTAT, experimental statistics developed by the author using the tool: https://ec.europa.eu/eurostat/web/gisco/gisco-activities/map-generator)

Figure 12 demonstrates the statistical data of the guest nights spent at short-stay accommodation offered via collaborative economy platforms in 2021. According to EUROSTAT experimental data in 2021, nearly 364 million nights were books using platforms of collaborative economy. The most popular countries were France, Spain, Italy, Germany and Croatia.

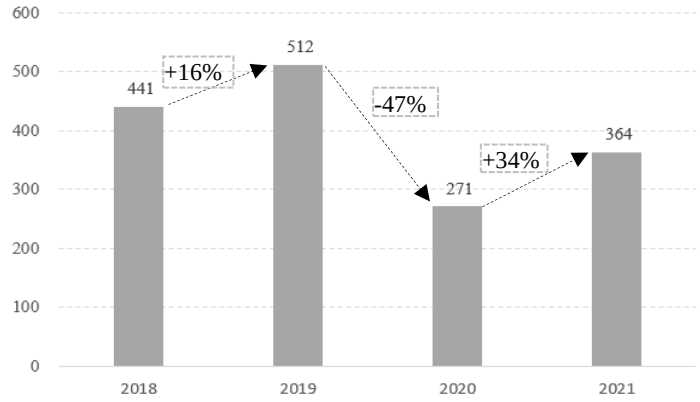


Figure 13. Annual numbers (in millions) of guests' nights spent at short-stay accommodation offered via collaborative economy platforms in EU-27 countries, 2018–2021 (EUROSTAT, experimental statistics)

Figure 13 illustrates the dynamics of annual numbers of guests nights spent at short-stay accommodation offered via sharing platforms (Airbnb, Booking.com, Tripadvisor and Expedia Group) in EU-27 countries from 2018 to 2021. The Covid-19 pandemic impacted accommodation significantly. Comparing the statistics (Figure 13) of 2020 and 2019, there was a strong decrease of 47%, and comparing 2021 and 2020, there was a recovery of 34%, but it still not reached the numbers of the guests nights before the outbreak Covid-19 pandemic, which resulted in tight travel and accommodation restrictions in the majority of countries.

According to the analysis of theoretical and practical studies analysing the methodologies for the assessment of the sharing economy in macroeconomic level, there were identified the sharing economy's variables, which are listed in Table 9.

Table 9. The identified sharing economy's variables based on the theoretical and practical studies analysis

Variable	**Description**	**Source/comment (*if relevant*)**
The amount of the sharing economy companies in the country	The amount of the sharing economy's companies with B2B cases (number) in the country according to the founded date	Crunchbase database (https://www.crunchbase.com)
Variables indicated in the latest research studies about the sharing economy, but not involved in the empirical research because of the data limitations		
Individuals who use the collaborative economy for transport services	Individuals used dedicated websites or apps to arrange the transport services from another individual (% of individuals)	Eurostat/statistical data available only for the period from 2017 to 2019
Individuals who use the collaborative economy for	Individuals used dedicated websites or apps to arrange accommodation	Eurostat/statistical data available only for the period from 2017 to 2019

accommodation services	services from another individual (% of individuals)	
Number of stays at short-stay accommodation	Annual number of stays at short-stay accommodation offered via collaborative economy platforms	Eurostat experimental data/during the dissertation preparation period, the data was only available for the period from 2018 to 2020

The Crunchbase database was used to identify the statistical data of the sharing economy companies in the countries in this dissertation. Crunchbase is a database containing information about the start-ups and technology related enterprises. The database is searchable, navigable and editable via the following website: https://www.crunchbase.com. This database is widely used by the scholars, researchers and practitioners (European Commission, 2021; Vitkauskaite and Vaiciukynaite, 2020; Woodcock and Graham, 2019; Munoz and Cohen, 2018; Dalle et al., 2017; Dervojeda et al., 2013) due to the provided content regarding the innovative business activities worldwide. The database's Query Builder was used to filter the number of the sharing economy's companies in the countries. The sharing economy cases were identified using the filter and the search phrases "sharing economy", "collaborative economy", "P2P", "C2C", "B2B" and location of EU countries for the time period from 2008 to 2020. The search for the cases were conducted in the period between January and February of 2022.

2.4. The methodology for constructing the composite index for the evaluation of the country's sustainability in relationship with the sharing economy

Based on the research literature, the composite indicators are frequently used by the scholars and researchers, national or international institutions, statistical offices for the evaluation of the complex phenomenon, for instance, the development of national economy, innovation or environment (Saisana et al., 2005). The indices give an advantage to aggregate the different indicators into a single measure of the analysed phenomenon in the region, country or industry. Mazziotta and Pareto (2013) highlight the benefits of composite indices and refer that it can be summed up as follows: unidimensional evaluation of the aspect of the research, simple interpretation of a battery of many individual indicators and generalisation of the hypothesis testing or data analysing.

The theoretical and practical research analysis stated that the sharing economy and the country's sustainability are one of the main important themes in the recent scientific studies, but the framework or other methods, such as indices, are missed. As it was discussed in the previous sub-sections, there is an excessively large number of indicators assessing the country's sustainability, and there is a lack of indicators measuring the sharing economy in the macro-economy level. Additionally, the scholars agree that the sharing economy is one of the possibilities to drive country into the evidence of sustainability. Thus, there is a theoretical and practical issue for the construction of index for the evaluation of the country's sustainability in

relationship with the sharing economy and based on it, make an assessment of the impact of the sharing economy on the country's sustainability.

Based on the research study, the country's sustainability is a multi-dimension phenomenon, consisting of four main dimensions: economic sustainability, innovation sustainability, social sustainability and environmental sustainability; thus, composite indicator is a relevant method for the evaluation of the impact in the theme of this dissertation. Mazziotta and Pareto (2013) confirm that the research objectives, such as social inequality, development, welfare, progress, quality of education, etc., need to be evaluated in the combined method, this means the "combination of different dimensions, to be considered together as the proxy of the phenomenon" (Mazziotta and Pareto, 2013). The above-mentioned method is enabled by applying the composite indices. Therefore, in this research, based on the literature analysis, the construction of an index is selected as one of the methods, appropriate for the evaluation of the impact of the sharing economy for the country's sustainability.

The key steps for constructing the composite index for the evaluation of the country's sustainability in relationship with the sharing economy is illustrated in Figure 14.

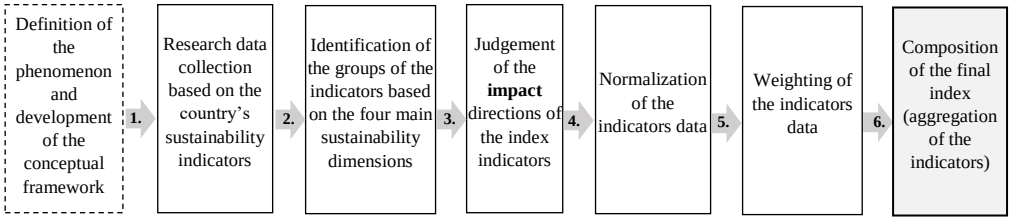


Figure 14. The key steps for constructing the composite index for the evaluation of country's sustainability in relationship with the sharing economy (according to Dolge et al. (2020), Razmjoo et al. (2019), Maxim (2014), Mazziotta and Pareto (2013), Krajnc and Glavic (2005))

Research data collection and processing

In this dissertation, the empirical research is done based on the statistical data of the European Union countries (27 countries in total, excluding the United Kingdom, as it is not a member of the EU from 2020 and because of the common occurrence of the missing data of the UK from 2020). The statistical data was obtained from the open data databases, available from World Bank, EUROSTAT, The Heritage Foundation and Crunchbase database. Crunchbase is a commercial company providing statistical information about the innovative companies. In most cases, Crunchbase has a free of access for the academic research with some limits for downloading the data, etc. Recently, this database has become well-known among the researchers and scholars (Woodcock and Graham, 2019; Munoz and Cohen, 2018; Dalle et al., 2017), especially because of availability of the data related to innovative, IT based companies, start-ups or cases of venture capitals in the countries. The Crunchbase database was used to obtain the data regarding the amount of the sharing economy's companies numbers established in the country during certain year data of

the sharing economy companies. The selection of the characteristics of the sharing economy companies in EU-27 using a Crunchbase database is presented in Table 10.

Table 10. The selection of the characteristics of the sharing economy companies in EU-27 using a Crunchbase database

Description keywords	**Location of the companies**	**Company's operating status**	**Number of results after each step, calculated based on**
"Sharing economy", "collaborative economy", "P2P", "C2C", "B2B"	EU 27 countries	"active" or "closed"	Year based on the founded date of the company

Source: created by the author

The definition "collaborative economy" was included in the keywords as one of the characteristics for data search in Cranchbase database, based on the broader definition of the sharing economy, which includes sharing and collaborative consumption businesses, as a used practice of other scholars (Giovanini, 2021; Valant, 2016) in the empirical research. P2P, C2C and B2B characteristics were involved in order not to lose the sharing economy's companies; the chosen location – EU-27 countries.

The overall data set includes the annual statistical data from 2008 to 2020. The empirical research includes 23 different indicators in total, and 19 of them were employed in the process of the index construction (see sub-section 2.4.7).

The missing values for some research data, for instance, "enterprises with Internet access" (missing data for the period from 2008 to 2011), "circular material usage rate" (missing data for the period from 2008 to 2009), were interpolated using linear trendline method (Zhang et al., 2021). The linear interpolation was done based on the mathematic Formula 1 (Zhang et al., 2021):

$$y = y_1 + (x - x_1) \times \frac{(y_2 - y_1)}{(x_2 - x_1)}; \quad (1)$$

where x_1 and y_1 are the first coordinates, x_2 and $y_2$are the second coordinates, x is the point to make the interpolation, y is the interpolated value. All the calculations were done using R 4.0.3. and Microsoft Excel. The summary of the overall 24 indicators and the data source of the empirical research are presented in Table 11.

Table 11. The indicators used in the research and data sources

Name of the indicator	Description of the indicator	Measurement	Data source	*Data code*
The amount of the sharing economy's companies	The amount of the sharing economy's companies with B2B cases in the country	number	Crunchbase	*SE*
The sharing economy's companies' density rate	The amount of the sharing economy's companies with B2B cases in the country/in total, 1,000 new business registrations in the country	rate	calculated	*SE_density_rate*
Total new business registrations in country	The amount of total new business registrations in the country	number	World Bank Entrepreneur-ship Database	*Total_new_business*
Enterprises with Internet access	Enterprises with Internet access in the country/total enterprises in the country	percentage of total enterprises	Eurostat	*Enter_with_int*
Households with connection to the Internet	Households with connection to the Internet/total households in the country	percentage	Eurostat	*Households_with_int*
New business density	New business density (new registrations per 1,000 people aged 15–64) in the country	rate	World Bank Entrepreneur-ship Database	*New_business*
Annual growth rate of the real Gross Domestic Product (GDP) per capita	The indicator is calculated as the ratio of the real GDP to the average population of a specific year. GDP measures the value of the total final output of goods and services produced by an economy within a certain period of time	percentage change on the previous data	Eurostat	*Growth_of_GDP_per_cap*
The investment share of GDP	The total investment for the total economy, government, business as well as household sectors in country/total GDP in country	percentage	Eurostat	*Invest_share*
The employment rate	All employed persons aged from 20 to 64/total population in the country	percentage	Eurostat	*Employ_rate*

Economic freedom index	Economic freedom index measures the economic freedom based on 4 main categories (rule of law, government size, regulatory efficiency, open markets) of 12 indicators	index	https://www.heritage.org/index/	*Econ_freed_index*
Gross domestic expenditure on R&D	Gross domestic expenditure on R&D in all sectors/total GDP	percentage	Eurostat	*GDE_on_R&D*
Human resources in science and technology	Human resources in science and technology/active population aged 25–64 in the country	percentage	Eurostat	*Human_in_tech*
R&D personnel	R&D personnel in all sectors/total population	percentage of the population in the labour force numerator in full-time equivalent (FTE)	Eurostat	*R&D_personn*
Patent applications	Patent applications to the European Patent Office	number	Eurostat	*Patent*
Purchasing power	Purchasing power adjusted GDP per capita (real expenditure per capita)	percentage	Eurostat	*Purchase_power*
Income distribution	The indicator measures the unequal distribution of income. It is determined as the ratio of the total income obtained by the top 20% of the population (the top quintile) to the total income received by the bottom 20% of the population (the bottom quintile)	ratio	Eurostat	*Income_dist*
People at risk of poverty or social exclusion	This indicator represents the number of individuals who are in danger of poverty after receiving social transfers, severely materially impoverished or in homes with a very low labour intensity	percentage	Eurostat	*People_at_risk*

Young people neither in employment nor in education and training	The indicator estimates the proportion of the 15–29 age group that is neither employed, nor engaged in education or training (the part of the total population)	percentage	Eurostat	*Y_people_n_empl*
Carbon dioxide (CO_2) emission	CO_2 emissions by resident units (production activities and households)	tonne	Eurostat	*CO2_emmision*
Annual GDP	GDP at market prices	current prices, million euro	Eurostat	*GDP*
Carbon dioxide (CO_2) emission per GDP	Carbon dioxide (CO_2) emission per unit divided from the total annual GDP	metric tons per euro of GDP	calculated	*CO_2_emmision_per_GDP*
Resource productivity and domestic material consumption	The indicator presents GDP divided by the domestic material consumption (DMC). DMC metric counts the total amount of materials that are directly utilized by the economy	Euro per kilogram	Eurostat	*Resource_prod*
Circular material usage rate	The circular material use rate (CMR) quantifies the proportion of recovered and reused materials in total material use. The CMU is defined as the ratio of the material's circular usage to its total use	percentage	Eurostat	*Circular_mater*
Share of renewable energy in gross final energy consumption by sector	The indicator measures, in accordance with the Renewable Energy Directive, the proportion of renewable energy consumption in the total amount of final energy consumed. Gross final energy consumption consists of the energy utilized by the end-users (final energy consumption) plus grid losses and power plant self-consumption	percentage	Eurostat	*Share_of_renew_energy*

The identification of the groups of indicators of the composite index

Various studies (Fernandez and Ruiz-Martos, 2020; Mazziotta and Pareto, 2013) analysing the composition of the indices, emphasize that the indicators should be chosen due to the relevance to the research approach and research period, analytical soundness, statistical data accessibility, etc. In this dissertation, the indicators are grouped into four groups based on the theoretical evidence. The country's sustainability is arranged in four key dimensions: economic sustainability, innovation sustainability, social sustainability and environmental sustainability. The identification and selection methodology of the indicators of the composite index is divided into four impact dimensions in the context of country's sustainability.

Global sustainability reports typically present a set of sustainable development indicators that can be employed to evaluate the country's sustainability performance. They translate sustainability issues into quantifiable measures of economic, environmental, innovation and social performance with the ultimate goal of aiding in the resolution of the most important sustainability issues.

Table 12 presents the four main themes of country's sustainability involved in the empirical model.

Table 12. The themes of the country's sustainability involved in the empirical model

The theme of the sustainability	Description	Source
Economic sustainability	The theme of sustainability is linked to the results of financial performance, long-term economic growth	Zhao et al. (2019), Steurer et al. (2005), Azapagic and Perdan (2000)
Innovation sustainability	The theme of sustainability is linked to the development of competitiveness, leadership and sustainable development through innovation and technology	Suganthi (2019), Ilidio Tomas Lopes (2012)
Social sustainability	The theme of sustainability related to the social responsibility, protection and focused on the community development	Zhao et al. (2019), Azapagic and Perdan (2000)
Environmental sustainability	The theme of sustainability is linked to the clean environment and efficient use of energy and other resources	Zhao et al. (2019), Azapagic and Perdan (2000)

Further on, the classification of the indicators into four key dimensions of the sustainability was developed.

Step 1. Classification of the indicators based on the country's economic sustainability measurement methodologies

According to the research study, described in the first theoretical part of the work, the economic sustainability indicators in relationship with the sharing economy are presented in Table 13.

Table 13. The economic theme of the country's sustainability and indicators involved in the empirical model

Indicator's name and description	Source
Growth of the country's GDP per capita – annual growth rate of the real GDP per capita, %	Ilídio Tomás Lopes (2021), Kauffman and Naldi (2020), Giovanini (2021), Sustainable Development in the EU (2020), Bergh et al. (2018)
Country's investment share of GDP – the indicator shows the investment for the total economy, government, business as well as household sectors share of GDP, %	Pieloch-Babiarz et al. (2020), Rockström and Pavan (2017), Sustainable Development in the EU (2020)
The employment rate – the indicator measures the share of the country's population aged 20 to 64 which is employed, %	Fernandez and Ruiz-Martos (2020), Sustainable Development in the EU (2020), Spangenberg (2005), Long and Ji (2019)
New business density – new business entities registrations per 1,000 people aged 15–64 in the country	Laukkanen and Tura (2020)
Economic freedom index – examines 177 nations on the four major policy categories: rule of law, size of the government, regulatory effectiveness and open markets. This index as well considers several specific issues such as government integrity, intellectual property rights, tax burden and other	Bergh et al. (2021), Giovanini (2021), Bergh and Bjørnskov 2020

Step 2. Classification of the indicators based on the country's innovation sustainability measurement methodologies

Based on the research study described in the theoretical part of the dissertation, the innovation sustainability indicators are presented in Table 14.

According to the OECD (2019; 2019a), the innovation indicators are very significant in measuring the nations sustainability, as innovations promote long-term prosperity by increasing knowledge of people, society, growth that is fostered by the applied research. The increasement of gross domestic expenditure to R&D and other conceivable indicators encourages the country to innovation sustainability.

Table 14. The innovation theme of the country's sustainability and indicators involved in the empirical model

Indicator's name and description	Source
Gross domestic expenditure on R&D – the indicator measures gross domestic expenditure on R&D (GERD) as a percentage of GDP, (% of DGP)	Sustainable Development in the EU (2020), OECD (2019), Rosati and Faria (2019)
Human resources in science and technology – this indicator measures human resources in science and technology as the share of active population in the group of age from 25 to 64 (%)	Sustainable Development in the EU (2020), Rosati and Faria (2019), Habib et al. (2018)

R&D personnel – this indicator measures the share of R&D personnel in all these sectors: governmental, higher education, business organizations and private non-profit organizations. Data are reported as a share of economically active population in full-time equivalents (the labour force in all sectors, % of the population)	Sustainable Development in the EU (2020), Rosati and Faria (2019)
Enterprises with Internet access – the indicator indicates the enterprises where employed persons have access to the internet, (% of enterprises)	Yin et al. (2021), Giovanini (2021), Huang et al. (2012)
Households with connection to the Internet – the indicator indicates the households with Internet connection type, i.e., broadband (% of households in the cities)	Yin et al. (2021), Giovanini (2021), Huang et al. (2012)
Patent applications to the European Patent Office – this indicator tracks the number of the requests for an invention's protection that are submitted to the European Patent Office (EPO)	Sustainable Development in the EU (2020), OECD (2019), Rosati and Faria (2019)

Step 3. Classification of the indicators based on the country's social sustainability measurement methodologies

Based on the research study described in the theoretical part of current research work, this step aims to develop the methodology for the measurement of the country's sustainability in social sustainability dimension considering the relationship with the sharing economy. The indicators, employed for the measurement of the country's social sustainability based on the research analysis, are demonstrated in Table 15.

Table 15. The social theme of the country's sustainability and indicators involved in the empirical model

Indicator's name and description	Source
Purchasing power adjusted GDP per capita – this indicator tracks the disparities of GDP per capita. GDP per capita is determined by dividing the GDP in a given year by the average population. Basic figures are tracked in purchasing power standards (PPS), which represents a common currency that eliminates disparities in price levels between the nations to allow the comparisons of GDP (coefficient of variation in %)	Sustainable Development in the EU (2020), Rockström and Pavan (2017)
Income distribution (quantile share ratio) – the indicator is a measure of inequality of income distribution. It is calculated as the ratio of total income earned by 20% of the nation with the highest income (the top quintile) to that earned by the 20% of the nation with the lowest income (the bottom quintile)	Fernandez and Ruiz-Martos (2020), Sustainable Development in the EU (2020), Rockström and Pavan (2017), Rogers et al. (2021), Eizenberg and Jabareen (2017)

People at risk of poverty or social exclusion – the indicator tracks the part of people who are at risk of income poverty, severe material deprivation or live in households with very low work intensity (%)	Ilídio Tomás Lopes (2021), Sustainable Development in the EU (2020)
Young people neither in employment nor in education and training – the indicator tracks the share of the population aged 15 to 29 who are not employed and not involved in education or training (% of total population)	Sustainable Development in the EU (2020), Rockström and Pavan (2017)

Step 4. Classification of the indicators based on the country's environmental sustainability measurement methodologies

According to the latest research analysis presented in the theoretical part of this research work, this step aims to develop a methodology for the measurement of the country's sustainability in environmental sustainability dimension considering the relationship with the sharing economy. Table 16 presents the environmental sustainability indicators, as derived from the research study outlined in the theoretical section of this work.

Table 16. The environmental theme of the country's sustainability and indicators involved in the empirical model

Indicator's name and description	**Source**
Carbon dioxide (CO_2) emission per GDP – CO2 emissions of GDP (kg per purchasing power parities (PPP) $ of GDP)	Yin et al. (2021), Singh et al. (2019), Zhou et al. (2018), Hanif and Gago-de Santos (2017)
Resource productivity and domestic material consumption – the indicator measures the GDP divided by domestic material consumption (DMC). DMS tracks the amount of all the materials used by the economy (euro per kilogram)	Rockström and Pavan (2017), Ilídio Tomás Lopes (2012), Huang et al. (2012)
Circular material usage rate (CMU) – the indicator tracks the share of the material recovered and responsibly again used in the circle of the economy. The CMU is explained as the ration of the circular use of resources to the total material use (% of material input for domestic use)	Rockström and Pavan (2017), Huang et al. (2012), Haupt and Hellweg (2019)
Share of renewable energy in gross final energy consumption by sector (%) – this indicator is described as the share of renewable energy consumption in gross final energy consumption. The gross final energy consumption is the energy utilized by the end-users (final energy consumption) calculated with grid losses and self-consumption of power plants	Fernandez and Ruiz-Martos (2020), Adedoyin et al. (2020), Ilídio Tomás Lopes (2012)

The judgement of the impact direction of the composite index indicators on the country's sustainability

After identifying and grouping the indicators into four dimensions, it is required to assess the probable impact and relationship of the indicators on the country's sustainability. All selected variables, based on the theoretical research, were separated into two groups, i.e., (1) with a positive impact and (2) with a negative impact on the country's sustainability.

The effect of each indicator on the country's sustainability is evaluated using the rule of thumb (Dolge et al., 2020; El-Kholy and Akal, 2020; Greco et al., 2019) in order to determine if an indicator is positively or negatively influenced by the country's sustainability. On the one hand, the indicators have a positive effect on the country's sustainability if their rising value accelerates the rise of economic, innovation, social or environmental sustainability. On the other hand, the indicators have a negative influence on the country's sustainability if their increasing value hinders the improvement of the progress of sustainability.

Table 17 provides a summary of the impact evaluation's findings based on the theoretical and practical studies' cases analysis described in the first part of the dissertation.

Table 17. The impact directions of the indicators on the country's sustainability using the rule of thumb (based on Dolge et al. (2020), El-Kholy and Akal (2020), Greco et al. (2019))

Dimension	Indicator	Impact directions on the country's sustainability (positive or negative)
Economic	Annual growth rate of the real GDP per capita	positive
	The investment share of GDP	positive
	The employment rate (% of population aged 20 to 64)	positive
	New business density (new registrations per 1,000 people aged 15–64) in the country	positive
	Economic freedom index measures economic freedom based on 4 main categories (rule of law, government size, regulatory efficiency, open markets) of 12 indicators	positive
Innovation	Gross domestic expenditure on R&D (% of DGP) in all sectors	positive
	Human resources in science and technology (% of the active population aged 25–64)	positive
	R&D personnel (in all sectors, % of population)	positive
	Enterprises with Internet access (% of total enterprises) in the country	positive
	Households with connection to the Internet (% of households in the cities) in the country	positive

	Patent applications to the European Patent Office	positive
Social	Purchasing power adjusted GDP per capita (real expenditure per capita)	positive
	Income distribution (quantile share ratio)	negative
	People (all age classes) at risk of poverty or social exclusion (%)	negative
	Young people neither in employment nor in education and training (% of total population)	negative
Environmental	Carbon dioxide (CO_2) emission per GDP	negative
	Resource productivity and domestic material consumption (euro per kilogram)	positive
	Circular material use rate (% of material input for domestic use)	positive
	Share of renewable energy in gross final energy consumption by sector	positive

Categorization based on the indicator's effect on the country's sustainability, according to the four dimensions, is required, because it defines the calculation approach for the data normalization in subsequent development processes of the composite index (Dolge et al., 2020; Krajnc and Glavič, 2005).

The normalization of the indicators of the composite index

As described in the theoretical part of this research, the country's sustainability is a naturally complex concept with varying meanings in different contexts. The indicators of progress towards sustainability are measurements that describe the circumstances under which resource utilization are more sustainable, and they are frequently analysed over time period and compared to the alternative approaches. Thus, multiple indicators towards the country's sustainability include economic, innovation, social and environmental metrics. Various indicators are measured in specific units, which relate to the metric of theme question. Having a standardized unit of measurement facilitates the comparison and synthesis of indicators (Pollesch and Dale, 2016). Normalization is the technique of transforming original units of measurement into standard measurement. In the research literature (Pollesch and Dale, 2016; Mazziotta and Pareto, 2013), it is referred to as unit scaling or standardization; however, the terminology varies depending on the process's functions and the research discipline.

This stage of the current research work is intended to normalize the indicators of the index. Normalization is required in addition to any data aggregation because the indices within a data set frequently have varying measurement units (monetary value, percentage, index, numbers, kilograms, rates, etc.). Consequently, it is necessary to standardize the indicators by converting them to plain, dimensionless numbers (Mazziotta and Pareto, 2013; Saisana et al., 2005). Some indicators could be positively correlated with the analysed phenomenon (positive polarity), while others may be negatively correlated (negative polarity). This is another significant reason for the normalization of the indicators. Normalization techniques, described in the

research literature (Mazziotta and Pareto, 2013; Saisana et al., 2005; Krajnc and Glavič, 2005), include ranking, rescaling (or min-max transformation), standardization (or z-scores) and indicization (index number transformation or distance from a reference).

Normalization is used by scientific researchers and scholars and is prompted by a variety of studies that are as well analysing the sustainability aspects (Pollesch and Dale, 2016). The primary objective of normalization in sustainability assessment is to convert measurements of indicators, which are typically obtained in different units, to a common unit of measurement in order to compare and prepare them for incorporation into a construction of index for the evaluation of the country's sustainability in relationship with the sharing economy.

In order to normalize data, a diverse number of functions can be applied. Mazziotta and Pareto (2013) analysis methods for the construction of composite indices and researches suggest the rank, z-score or minimum–maximum data transformation for relative comparison. The literature referring to indicators' normalization analysis operates a variety of terms, such as "lager-the-better" and "smaller-the-better" (Pollesch and Dale, 2016), "direct correlation with utility" and "inverse correlation with utility" (Maxim, 2014), "positive impact" and "negative impact" (Krajnc and Glavic, 2005), "criteria is to maximize" and "criteria is to minimize" (Dias and Domingues, 2014). In this thesis, the multi-criteria evaluation is used, and the below demonstrated normalization schemes are used for data normalization. If the greater value of the indicator is considered to be better, the normalization Formula (2) is utilized. The inverse normalization Formula (3) is applied if the lower value of the indicator is considered to be superior (Dolge et al., 2020; Pollesch and Dale, 2016; Krajnc and Glavic, 2005).

$$x_i^+ = \frac{x_i^* - min_j\left\{x_j^*\right\}}{max_j\left\{x_j^*\right\} - min_j\left\{x_j^*\right\}}, \quad (2)$$

$$x_i^- = 1 - \frac{x_i^* - min_j\left\{x_j^*\right\}}{max_j\left\{x_j^*\right\} - min_j\left\{x_j^*\right\}}; \quad (3)$$

where x_i^+ is the value of a normalized indicator *i* for an object *j* with a positive impact on the country's sustainability, x_i^- – the value of a normalized indicator *i* for an object *j* with a negative impact on the country's sustainability.

In this research, the above-listed formulas are used for the research data normalization. The same scheme was employed by the researchers and practitioners for Sustainability Development Index (Pollesch and Dale, 2016) or for the sustainability aspect assessment of electricity generation-based technologies (Maxim, 2014). Therefore, the normalized values are captured with the interval [0, 1].

The weighting and aggregating scheme of the normalized indicators

Since all indicators of the index have been appropriately normalized, the next phase of the research is to determine if there are differences in weights between various indicators in terms of the overall significance of the analysis and further assign

the weights to every indicator. There is a number of options for choosing the best weighting methodology; nevertheless, there is no single most suitable weighting method because weighting is interpreted as controversial (Dolge et al., 2020; Mazziotta and Pareto, 2013).

In the sustainability and environmental issues related to research, equal weights are frequently used to reflect the significance of each factor. Moreover, equal weighting may not be adequate for more complex composite indices, as it may not account for the correlations between the sub-indicators. Other frequently used methods, such as expert weighting and the analytic hierarchy process (AHP) method, are determined by subjective weight evaluation and may generate highly sensitive and tendentious results, which may lead to incorrect analysis and research conclusions (Mazziotta and Pareto, 2013). However, in the research literature (Fernandez and Ruiz-Martos, 2020; Pollesch and Dale, 2016; Maxim, 2014), it is referred that the weight of all the indicators must be attributed to every indicator, and the total sum of the weights must be equal to 1.

$$w_i = \frac{1}{n_i}; \tag{4}$$

where w_i – the value of the determined weight of an indicator I, $0 \leq w_i < 1$ and $\sum_{i=1}^{n} w_i = 1$, n_i – the number of indicators in the research dimension.

In the research literature (Fernandez and Ruiz-Martos, 2020; Dolge et al., 2020; Maxim, 2014), it is argued that the equal weights of the indicators scheme mainly produce very similar results as optimal weighting methods. Additionally, Fernandez and Ruiz-Martos (2020) state that equal weights are preferred in situations where there is a lack of agreement regarding the allocation of weights, inadequate statistical expertise or when the need for simplicity or objectivity arises. Based on the theoretical analysis of the country's sustainability, it can be argued that there is a consensus among the researchers that all four dimensions of sustainability are significant as well as the indicators in every sustainability dimension. Thus, in this research, the equal weights method was employed based on Formula (4) that was as well used by Fernandez and Ruiz-Martos (2020), Dolge et al. (2020) and Maxim (2014). This method is commonly used in the research analysing the sustainability concept that underlines the equal significance of the indicators involved in the study. Based on the theoretical analysis, the selected indicators and the country's sustainability dimensions were assumed to have equal weights. Additionally, the main 4 country's sustainability dimensions (economic, innovation, social and environmental) equally contribute to the whole country's sustainability because all of these dimensions are interconnected and jointly create the progress of the country.

In the current research, the selection of equal weights for indicators was chosen based on the concept of Sustainable Development Index (Barrera-Roldán and Saldívar-Valdés, 2002), where construction methodology acknowledges that all factors of composite index are of equal importance.

Aggregating of the normalized indicators

Data normalization is required to eliminate the ambiguity of indicators and provide more accurate results on the research. Data normalization converts all different scales of indicators into a single common metric, making all the indicators comparable to one another. Thus, data normalization procedure allows to composite all the indicators into a general index. It is the aggregation of all component indices into one or more composite indexes (mathematical functions). Several ways of aggregation are conceivable. Most frequently employed are the additive approaches, which range from adding the unit rating for each indicator to averaging weighted transformations of the original indicators (Mazziotta and Pareto, 2013).

Additionally, and Mazziota and Pareto (2013) highlight that the theoretical part of the research (defining of the research phenomenon and selection of the indicators) is essential and does not differ from the statistical-methodological part; hence, the selection of individual indicators relates to the selection of the aggregate method.

There are many ways of aggregation that are used by the researchers and practitioners in the economic research analysis. Most frequently employed are the additive approaches, which range from summing the unit rating for each indicator to aggregating weighted and normalized original indicators.

Suganthi (2019), Mazziota and Pareto (2013) and Krajnc and Glavic (2005) note that the composite indices are clear and summarize unidimensional indicators of the research phenomenon. Easy interpreted and analysed, the methodology of the index construction based on the aggregation of the normalized and weighted indicators is used in this dissertation. According to Dolge et al. (2020), the indicators of the index are aggregated in the corresponding dimensions according to Formula (5).

$$I_{Dim} = \sum w \times x_i^+ + \sum w \times x_i^-; \quad (5)$$

where I_{Dim} is the sub-index of an appropriate dimension, w – the value of the determined weight of an indicator and calculated according Formula (4), x_i^+ and x_i^- – the value of a normalized indicator in appropriate dimension and calculated according to Formulas (2) and (3).

Hereafter, the final index is constructed based on Dolge et al. (2020) by aggregating all the sub-indices with their assigned weights. The index construction is done according to Formula (6).

$$I_{FINAL} = \sum w_{Dim} \times I_{Dim}; \quad (6)$$

where I_{FINAL} is the final composite index, w_{Dim} – the value of determined weight of a dimension (based on Formula (7), adopted according to Fernandez and Ruiz-Martos (2020), Pollesch and Dale (2016), Maxim (2014)), I_{Dim} – the sub-index of a special dimension.

$$w_{Dim} = \frac{1}{n_{Dim}}; \quad (7)$$

where w_{DIM} – the value of determined weight of a dimension, n_{Dim} – the number of the dimensions. The sum of the weights of the sub-indices must be equal to 1.

The composite indicator formula – the index for evaluating the country's sustainability

Based on the theoretical research analysis about the sharing economy and its relationship to the country's sustainability and the four main sustainability dimensions (economic, innovation, social and environmental), the structural model for the evaluation of the country's sustainability (Figure 11) in relation to the sharing economy was developed. Thus, this model provides the basis for the index construction considering the identified key steps illustrated in Figure 14 in this research work. Additionally, the integrated theoretical research analysis about the sharing economy and its impact on the country's sustainability on the main four dimensions of the sustainability enabled to propose a model of the composite indicator formula. Figure 15 demonstrates the fundamental hierarchy of the index for the evaluation of the country's sustainability in its relationship with the sharing economy (hereinafter, $I_{CountSusShE}$ index). The above-mentioned figure illustrates the $I_{CountSusShE}$ index hierarchy with its representative main four dimensions and their respective contextual indicators.

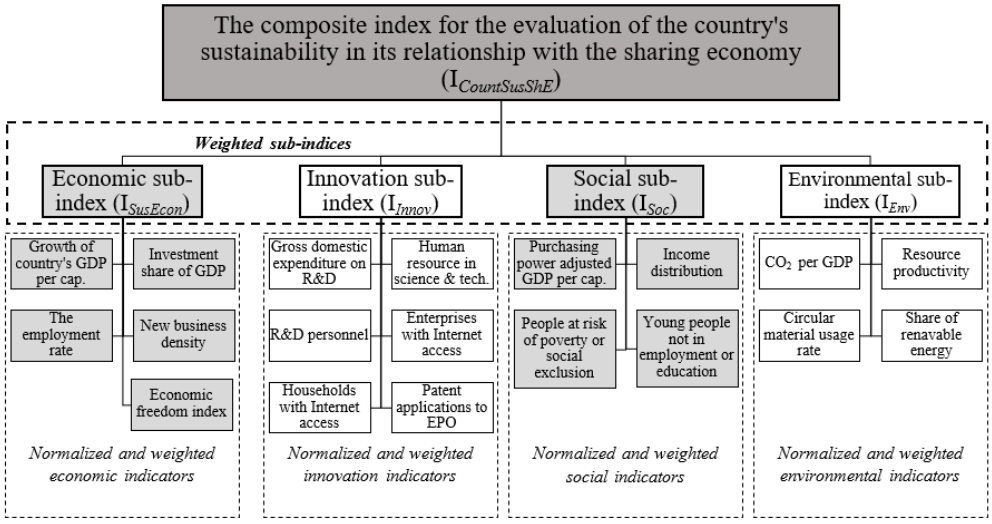


Figure 15. The fundamental hierarchy of the composite index for the evaluation of the country's sustainability in its relationship with the sharing economy (developed by the author based on Dogle et al. (2020), El-Kholy and Akal (2020), Lee and Zhong (2015), Krajnc and Glavic (2005))

The composite index for the evaluation of the country's sustainability in relationship with the sharing economy consists of four sub-indices:

- sub-index of the country's economic sustainability,
- sub-index of the country's innovation sustainability,
- sub-index of the country's social sustainability,
- sub-index of the country's environmental sustainability.

The index for the evaluation of country's sustainability in relationship with the sharing economy is constructed based on the findings in the theoretical part of the research and could be expressed in the following Formula (8):

$$I_{CountSusShE} = w_1 x\, I_{SusEcon} + w_2 x\, I_{SusInnov} + w_3 x\, I_{SusSoc} + w_4 x\, I_{SusEnv}; \quad (8)$$

where $I_{CountSusShE}$ – the index for the evaluation of the country's sustainability in relationship with the sharing economy, $I_{SusEcon}$ – sub-index of the country's economic sustainability in relationship with the sharing economy, $I_{SusInnov}$ – sub-index of the country's innovation sustainability in relationship with the sharing economy, I_{SusSoc} – sub-index of the country's social sustainability in relationship with the sharing economy, I_{SusEnv} – sub-index of the country's environmental sustainability in relationship with the sharing economy, $w_{1....}\ w_4$ – the weight coefficients of the sub-indexes. The total sum of all weights is equal to 1.

The values of the index $I_{CountSusShE}$ may be from 0 (when the country's sustainability in relationship with the sharing economy is unsustainable) to 1 (when the country's sustainability in relationship with the sharing economy is entirely sustainable). The values of the index vary depending on the impact of the sharing economy to the country's sustainability: the higher is the value of the index, the more significant is the country's sustainability in relationship with the sharing economy.

In reference to the research analysis presented in the previous sub-sections of the dissertation, the sharing economy causes an impact on the different directions of sustainability. However, most scholars agree that the main four dimensions of sustainability (economic, innovation, social and environmental) are linked to each other significantly and the relations within these dimensions are interconnected. Sometimes, the researchers refer to them as socio-economic, socio-environmental, etc.; for this reason, the weight coefficients of the sub-indexes are equal to each other, and in this case, it is equal to ¼.

$I_{CountSusShE}$ is a sum of standardized sub-indexes. The values of the sub-indexes are calculated separately.

Sub-index of the country's economic sustainability in relationship with the sharing economy ($I_{SusEcon}$)

Considering the theoretical model for the evaluation of the country's sustainability in relationship with the sharing economy (Figure 9), the sub-index of the country's economic sustainability in relationship with the sharing economy ($I_{SusEcon}$) is calculated accordingly:

$$I_{SusEcon} = c_1 x\, Grow\_of\_GDP + c_2 x\, Invest\_share + c_3 x\, Employ\_rate + c_4 x\, Econ\_freed\_index + c_5 x\, New\_business; \quad (9)$$

where $I_{SusEcon}$ – sub-index of the country's economic sustainability in relationship with the sharing economy, *Grow_of_GDP* – annual growth rate of the real GDP per capita, Invest_share – the investment share of GDP, *Employ_rate* – the employment rate, Econ_free_index – economic freedom index, *New_business* – new

business density, $c_{1....}$ c_5 – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

$$c_{indicator} = \frac{1}{n_{indicator}}; \quad (10)$$

where $c_{indicator}$ – the value of determined weight of an indicator, $n_{indicator}$ – the number of the indicators in the sub-index. The sum of the weights of the indicators must be equal to 1.

Sub-index of the country's innovation sustainability in relationship with the sharing economy ($I_{SusInnov}$)

Considering the theoretical model for the evaluation of the country's sustainability in relationship with the sharing economy (Figure 9), the sub-index of the country's innovation sustainability in relationship with the sharing economy ($I_{SusInnov}$) is calculated accordingly:

$$I_{SusInnov} = c_6 \text{ x } GDE\_on\_R\&D + c_7 \text{ x } Human\_in\_tech + c_8 \text{ x } R\&D\_personn + c_9 \text{ x } Enter\_with\_int + c_{10} \text{ x } Households\_with\_int + c_{10} \text{ x } Patent; \quad (11)$$

where $I_{SusInnov}$ – sub-index of the country's innovation sustainability in relationship with the sharing economy, *GDE_on_R&D* – gross domestic expenditure on R&D, *Human_in_tech* – human resources in science and technology, *R&D_personn* – R&D personnel, *Enter_with_int* – enterprises with Internet access, *Households_with_int* – households with connection to the Internet, *Patent* – patent applications, $c_{6....}$ c_{10} – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The sum of the weights of the sub-indices should be equal to 1, and as discussed in sub-section 2.4.5, all the weights of the sub-indices shall be equal. Therefore, the weight coefficients of each sub-index indicator are calculated according to Formula (10). Thus, the weight of each indicator is equal to 1/6 in the case of $I_{SusInnov}$ sub-index.

Sub-index of the country's social sustainability in relationship with the sharing economy (I_{SusSoc})

Considering the theoretical model for the evaluation of the country's sustainability in relationship with the sharing economy (Figure 9), the sub-index of the country's social sustainability in relationship with the sharing economy (I_{SusSoc}) is calculated accordingly:

$$I_{SusSoc} = c_{11} \text{ x } Purchase\_power + c_{12} \text{ x } Income\_dist + c_{13} \text{ x } People\_at\_risk + c_{14} \text{ x } Y\_people\_n\_empl; \quad (12)$$

where I_{SusSoc} – the sub-index of the country's social sustainability in relationship with the sharing economy, *Purchase_power* – purchasing power, *Income_dist* – income distribution, *People_at_risk* – people at risk of poverty or social exclusion, *Y_people_n_empl* – young people neither in employment nor in education and

training, $c_{11....}$ c_{14} – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The weight coefficients of each sub-index indicator are calculated according to Formula (10). The weight of each indicator is equal to 1/4 in the case of I_{SusSoc} sub-index.

Sub-index of the country's environmental sustainability in relationship with the sharing economy (I_{SusEnv})

Considering the theoretical model for the evaluation of the country's sustainability in relationship with the sharing economy (Figure 9), the sub-index of the country's environmental sustainability in relationship with the sharing economy (I_{SusEnv}) is calculated accordingly:

$$I_{SusEnv} = c_{15} \text{ x } CO_2\_emmision\_per\_GDP + c_{16} \text{ x } Resource\_prod + c_{17} \text{ x } Circular\_mater + c_{18} \text{ x } Share\_of\_renew\_energy; \quad (13)$$

where I_{SusEnv} – the sub-index of the country's environmental sustainability in relationship with the sharing economy, $CO_2\_emmision\_per\_GDP$ – carbon dioxide emission per GDP, *Resource_prod* – resource productivity and domestic material consumption, *Circular_mater* – circular material usage rate, *Share_of_renew_energy* – share of renewable energy in gross final energy consumption by sector, $c_{15....}$ c_{18} – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The weight coefficients of each sub-index indicator are calculated according to Formula 10. The weight coefficients of I_{SusEnv} sub-index indicators are equal to 1/4.

The research study has shown that the index for the country's sustainability in relationship with the sharing economy ($I_{CountSusShE}$) can be expressed by assessing and calculating 19 indicators and combining them into four sub-indices. The structure and calculation of the indicators are presented in Table 18.

Table 18. The sub-indices, indicators of $I_{CountSusShE}$ index and the weights of the sub-indices and indicators

Sub-index	The weight of the sub-index	Indicators	The weight of the indicator
Economic sub-index	1/4	Annual growth rate of the real Gross Domestic Product (GDP) per capita	1/5
		The investment share of GDP	1/5
		The employment rate	1/5
		Economic freedom index	1/5
		New business density	1/5
Innovation sub-index	1/4	Gross domestic expenditure on R&D	1/6
		Human resources in science and technology	1/6
		R&D personnel	1/6
		Patent applications to EPO	1/6

		Enterprises with Internet access	1/6
		Households with connection to the Internet	1/6
Social sub-index	1/4	Purchasing power	1/4
		Income distribution	1/4
		People at risk of poverty or social exclusion	1/4
		Young people neither in employment nor in education and training	1/4
Environmental sub-index	1/4	Carbon dioxide (CO_2) emission per GDP	1/4
		Resource productivity and domestic material consumption	1/4
		Circular material usage rate	1/4
		Share of renewable energy in gross final energy consumption by sector	1/4

Sensitivity analysis of $I_{CountSusShE}$ index

The $I_{CountSusShE}$ index is constructed based on seven fundamental assumptions (as illustrated in Figure 14), which include the definition of the phenomenon and development of conceptual model, selection of individual indicators, identification of the main groups based on the country's sustainability dimension, judgement of the impact direction of the index indicators, the normalization technique for data, the determination of weights for individual indicators and the method of final index aggregation. According to Chen and Khan (2010), Lee and Zhong (2015), in order to assess the resilience of the index, **sensitivity analysis** can be employed to examine the fluctuations in country rankings resulting from the modifications in the underlying assumptions. In this research, there the was employed a method when the calculation utilizes an average of the absolute variations among the original ranks of countries and their new ranks, considering all countries, and was calculated according to Formula (14) used by Lee and Zhong (2015):

$$Shift_{Assumption\ i} = \frac{1}{n}\sum_{c=1}^{n}\left|Rank_{Original}(c) - Rank_{New}(c)\right|; \quad (14)$$

where $Shift_{Assumption\ i}$ – the average shift resulting from an assumption i, n – the number of countries, $Rank_{Original}(c)$ – the original rank of the country c, $Rank_{New}(c)$ – the new rank of the country c.

3. THE EMPIRICAL RESEARCH OF THE SHARING ECONOMY'S IMPACT ON THE COUNTRY'S SUSTAINABILITY

The conceptual research model and the new index for measuring the country's sustainability in relationship with the sharing economy, based on an analysis of the scientific literature, are empirically employed and justified in this section. The empirical analysis of the sharing economy's impact on the country's sustainability is provided in this section of the thesis.

3.1. Methodology of the empirical study for measuring the impact of the sharing economy on the country's sustainability

The methodology of the empirical study is constructed based on the five steps illustrated in Figure 16.

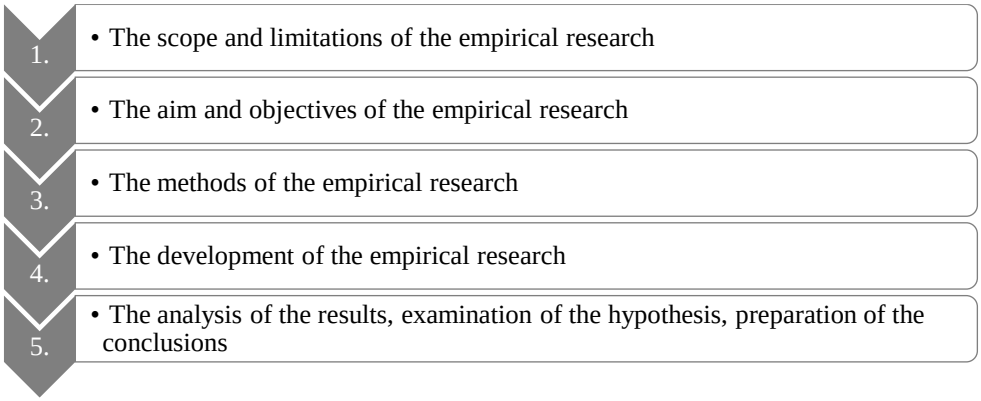


Figure 16. The plan of empirical study for measuring the impact of the sharing economy on the country's sustainability

Step 1. The scope and limitations of the empirical research

In this dissertation, the empirical research is done based on the statistical data of the European Union countries (27 countries in total excluding the United Kingdom, because it is not a member of the EU since 2020 and because of the common occurrence of the missing data of the UK from 2020 and 2021). The reason for focusing on these countries is the availability of the comparable statistical information, compiled to the common standards of the data collection as well as the need to investigate the macroeconomic impact of the sharing economy in the terms of country's sustainability.

The statistical data were collected from the databases available from the World Bank, Eurostat, The Heritage Foundation and Crunchbase database.

The theoretical study of the sharing economy impact on the country's sustainability confirmed the problem of quantitative assessment of the sharing economy, which is often encountered in the scientific literature, i.e., the statistics are collected and presented in different ways, often in microeconomic level, and the existence of different conceptions of the sharing economy further complicates the

task. As described in sub-section 2.3, EUROSTAT initiated the collection of the experimental data for the sharing economy form 2018. This and future initiatives could lead to a more detailed and systematic macroeconomic data set collection for the evaluation of the sharing economy. Thus, one of the main limitations was the statistical data of the sharing economy in macroeconomic level. In this research, the database of Crunchbase was used for the statistical annual data of the sharing economy in different countries.

The missing values for the research data were interpolated using linear trend line method (Zhang et al., 2021) based on the mathematical formula that is indicated in sub-section 2.4.1.

The empirical research involves 24 different indicators in total.

The data set includes the annual data from 2008 to 2020. The availability of statistical data limited the selection of the empirical research period.

Step 2. The aim and objectives of the empirical research

The aim of this empirical research is to carry out an empirical study employing $I_{CountSusShE}$ index for evaluating the impact of the sharing economy on the country's sustainability and compare the country's sustainability in relationship with the sharing economy in the European Union countries based on the statistical data and constructed index. The following four objectives have been set:

1. to develop a methodology for evaluating the impact of the sharing economy on the country's sustainability based on the conceptual model described in sub-section 2.2 and employing the $I_{CountSusShE}$ index.
2. to provide an estimate of the $I_{CountSusShE}$ index for each of the countries involved in the empirical research for the period 2008–2020, based on the synthesis of available statistical data.
3. to carry out a cluster analysis of the countries based on the estimates of the $I_{CountSusShE}$ index.
4. to determine the impact of the sharing economy on the country's sustainability based on the correlation and regression analysis.

Step 3. The methods of the empirical research

In this dissertation, there were employed these research methods:

- analysis of the descriptive statistics of the empirical research variables of EU-27 countries;
- normalization of the statistical data based on Formulas (1) and (2), described in the sub-section 2.4.4;
- composition of the $I_{CountSusShE}$ index based on the aggregated and normalized indicators as described in sub-section 2.4.7;
- using the ranking method and average values, the $I_{CountSusShE}$ index scores for each country in descending order. The research assigns a rank from 1 (the country with the highest scores of the $I_{CountSusShE}$) to 27 (the country with the lowest values of the $I_{CountSusShE}$) for each EU-27 country that was studied;

- cluster analysis of the $I_{CountSusShE}$ index scores based on the EU-27 countries in order to identify the disparities between the countries;
- the comparative analysis of the $I_{CountSusShE}$ index scores based on the EU-27 countries;
- the examination of the research hypothesis based on the correlation and regression analysis.

Step 4. The development of the empirical research

The development of the empirical research for the evaluation of the impact of the sharing economy on the country's sustainability is carried out in accordance with the chosen empirical research methods in order to achieve the set goal and objectives.

Step 5. The analysis of the results, examination of the hypothesis, preparation of the conclusions

The analysis of the results and examination of the hypothesis preparation are prepared based on the estimations of the index $I_{CountSusShE}$ scores for every EU-27 country and cluster analysis. The final conclusions of the research are prepared in this step.

3.2. The measuring of the country's sustainability in relationship with the sharing economy employing the composite index

According to the fundamental hierarchy of the composite index for the evaluation of the country's sustainability in relationship with the sharing economy (Figure 14), the empirical research has been developed in this dissertation. First of all, the analysis of the descriptive statistics of the variables, involved in the $I_{CountSusShE}$ index calculation based on the case of EU 27 countries in the period from 2008 to 2020, was developed in the empirical research part of this work. Further, based on the normalized statistical data, four sub-indices were calculated: economic, innovation, social and environmental, and the $I_{CountSusShE}$ indices were calculated as well.

3.2.1. The analysis of the descriptive statistics of the empirical research variables of EU-27

The descriptive statistics of the empirical research variables involved in the $I_{CountSusShE}$ index calculation for EU 27 countries in the period from 2008 to 2020 are illustrated in Annex 1. The total amount of 6,669 data is involved in the empirical research for composite index calculation assessing the country's sustainability in relationship with the sharing economy.

The descriptive statistics show that considering the economic dimension of the country's sustainability, the considerable gap is between the countries in the annual grow of the real GDP per capita (the highest percentage change on the previous data was in Ireland, in 2015 (23.20%), and the lowest – in Estonia, in 2015 (-14.50%)), and it is negatively skewed, i.e., it has a heavy tail to the left. The countries vary in the investment share of GDP substantially: the lowest rate in Greece was in 2019 (10.58%), the highest was in Ireland in 2019 (53.59%). The essential disparities between countries are in numbers of new business companies' registrations: the

minimum value was in Greece in 2008 (0.24 per 1,000 people aged 15–64), and the maximum value was in Cyprus in 2008 (32.21 per 1,000 people aged 15–64).

Descriptive statistics illustrate the significant disparities in data describing the innovation dimension of the country's sustainability. The patent application amount to EPO highly varies a lot: from 7 (Estonia in 2008) to 27.328 (Germany in 2011), it is positively skewed (3.63), and the kurtosis is equal to 13.37 (leptokurtic distribution of data), which means that in the data set, there are a lot of outliers.

The data illustrating the social pillar of the country's sustainability considerably demonstrates the disparities in the line of purchasing power data. The minimum value was in Bulgaria in 2009 (10,500.00% real expenditure per capita), the maximum value was in Luxembourg in 2019 (79,600.00% real expenditure per capita). This indicator during the period from 2008 to 2020 is positively skewed with the rate 2.17, and the kurtosis is more than normal distribution (6.09), which means that the data of this indicator has frequent outliers (leptokurtic distribution).

Hereafter, the date analysing the environmental aspect of the country's sustainability illustrates significant inequalities in carbon dioxide emission per unit divided from the total annual GDP. In 2020, Sweden was the country with the lowest indicator, i.e., 78.72 metric tons per euro of GDP, and in 2008, Bulgaria was the country with the highest indicator – 1,492.13. The above-mentioned indicator is positively skewed during the period of research, and the amount of indicator data variation is the highest (242.72) in the group of the data analysing the environmental sustainability dimension. Moreover, in 2008, Malta had the lowest (0.195%) share of the renewable energy in gross final energy consumption, while Sweden demonstrates the highest share of renewable energy in gross final energy consumption, and this country demonstrates environmentally friendly results of this indicator during the whole research period (from 43.92% in 2008 to 60.124 in 2020). This indicator is positively skewed (0.88), and the kurtosis is less than normal distribution (0.52) – platykurtic distribution, which means that the outliers are infrequent.

3.2.2. The estimations of the indices for the measurement of the country's sustainability in relationship with the sharing economy based on the EU-27 countries in the period from 2008 to 2020

Results of the sub-indices of the country's economic sustainability in relationship with the sharing economy ($I_{SusEcon}$)

Based on section 2 and the theoretical model for measuring the sharing economy's impact on the country's sustainability, $I_{SusEcon}$ sub-index is calculated based on Formula (9) and is expressed accordingly:

$$I_{SusEcon} = 1/5 \times Growth\_of\_GDP\_per\_cap + 1/5 \times Invest\_share + 1/5 \times Employ\_rate + 1/5 \times Econ\_freed\_index + 1/5 \times New\_business; \quad (15)$$

where $I_{SusEcon}$ – sub-index of the country's economic sustainability in relationship with the sharing economy, *Growth_of_GDP_per_cap* – annual growth rate of the real GDP per capita, Invest_share – the investment share of GDP, *Employ_rate* – the employment rate, Econ_free_index – economic freedom index,

New_business – new business density, $1/5$ – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

Consequently, economic, innovation, social and environmental metrics are multiple indicators of country's sustainability. Various indicators are measured in particular units, which is relevant to the metric in issue. Having a standard unit of measurement makes it easier to compare and synthesize indicators. Normalization is the process of converting unique units of measurement into standard units of measurement. Normalization of the $I_{SusEcon}$ sub-index's indicators is carried out before calculating the sub-index, and it was done based on the judgement step described in sub-section 2.4.3 (Table 17) and Formula (2). Normalized data of the $I_{SusEcon}$ sub-index's indicators are presented in the Annexes 2, 3 and 4.

SusEcon sub-index and ranking of EU-27 based on this index is illustrated in Table 19. Theoretically, $I_{SusEcon}$ sub-index could vary from 0.00 to 1.00; however, in this dissertation, the highest value of SusEcon index is 0.8930 (in Estonia in 2013) and the lowest 0.0000 (in Greece in 2011 and 2012). In Estonia, the high values resulted because of the high rates of investment share of GDP, employment rates and one of the significant rates of new business density per 1,000 people and one of the biggest rates of the economic freedom index during all research period. In Greece, the lowest values of SusEcon sub-index resulted because of the low investment rate of GDP, low employment rate during all research period and too minor rates of new business density registrations per 1,000 people. The average score of SusEcon sub-index of Lithuania was 0.5006, and the country occupied 11^{th} position based on the index ranking. Additionally, comparing Lithuania with other EU-27 countries, the rates of SusEcon sub-index is periodically growing since 2011, and it is higher than the average rate off SusEcon sub-index of all EU-27 (0.4537) during the research period (Figure 17).

Table 19. Economic ($I_{SusEcon}$) sub-index of EU-27 in the period of 2008–2020

Country	Economic sub-index ($I_{SusEcon}$ sub-index)													Average	Ranking
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Estonia	0.4807	0.4497	0.5167	0.7677	0.7783	0.8930	0.8338	0.7523	0.7690	0.8345	0.8243	0.7522	0.7722	**0.7250**	**1**
Ireland	0.3410	0.5003	0.4245	0.4429	0.4916	0.5688	0.7051	0.7500	0.6193	0.7479	0.7843	0.7488	0.7777	**0.6079**	**2**
Sweden	0.4572	0.5547	0.6514	0.6525	0.6080	0.7011	0.6672	0.6362	0.5705	0.6007	0.6246	0.5074	0.6132	**0.6034**	**3**
Denmark	0.4739	0.5585	0.5177	0.5756	0.5626	0.6323	0.5937	0.5737	0.5948	0.5635	0.5863	0.4960	0.6184	**0.5652**	**4**
Cyprus	0.6203	0.7169	0.6686	0.6452	0.5467	0.4361	0.4151	0.4367	0.6566	0.5692	0.5838	0.5569	0.4801	**0.5640**	**5**
Czechia	0.4226	0.5621	0.5605	0.5677	0.5413	0.6142	0.6107	0.5989	0.5564	0.6037	0.6267	0.5322	0.5335	**0.5639**	**6**
Luxembourg	0.3768	0.4843	0.4949	0.4964	0.6042	0.7249	0.6571	0.5644	0.5720	0.4890	0.4800	0.4614	0.5817	**0.5375**	**7**
Latvia	0.3800	0.3128	0.2711	0.5172	0.6689	0.7002	0.6228	0.5622	0.5338	0.5589	0.6248	0.5169	0.5405	**0.5239**	**8**
Netherlands	0.4685	0.5648	0.5074	0.5638	0.5218	0.5750	0.5129	0.5288	0.5000	0.5070	0.5289	0.4651	0.5329	**0.5213**	**9**
Finland	0.4376	0.4981	0.5460	0.5821	0.5396	0.5916	0.4995	0.4808	0.5132	0.5155	0.5191	0.4429	0.5515	**0.5167**	**10**
Lithuania	0.3843	0.2209	0.3298	0.4926	0.5311	0.6199	0.5806	0.4938	0.5616	0.5683	0.5989	0.5807	0.5457	**0.5006**	**11**
Malta	0.2527	0.3272	0.4143	0.3460	0.5033	0.6577	0.6322	0.6505	0.5475	0.6604	0.5816	0.5109	0.4220	**0.5005**	**12**
Germany	0.3773	0.4195	0.5021	0.5532	0.5265	0.5849	0.5490	0.4855	0.4869	0.4883	0.4832	0.4071	0.4958	**0.4892**	**13**
Romania	0.5383	0.4244	0.3421	0.4893	0.5092	0.5218	0.5368	0.4560	0.4497	0.5788	0.5553	0.4809	0.4023	**0.4835**	**14**
Austria	0.3988	0.4878	0.4797	0.5409	0.5193	0.5686	0.4960	0.4537	0.4256	0.4521	0.4886	0.3799	0.4217	**0.4702**	**15**
Hungary	0.2765	0.3710	0.3152	0.3791	0.3881	0.5232	0.5355	0.4463	0.4286	0.4719	0.5755	0.5260	0.4546	**0.4378**	**16**
Slovakia	0.3784	0.3839	0.4641	0.4777	0.4423	0.5378	0.4420	0.4555	0.4073	0.4077	0.4549	0.3668	0.3754	**0.4303**	**17**
Belgium	0.3406	0.4745	0.4341	0.4607	0.4710	0.5156	0.4755	0.4197	0.3735	0.3704	0.4014	0.3308	0.3696	**0.4183**	**18**
Bulgaria	0.4189	0.5228	0.3198	0.3581	0.3819	0.4226	0.3886	0.3864	0.3977	0.3850	0.3768	0.4533	0.3393	**0.3963**	**19**
France	0.3323	0.4234	0.3996	0.4322	0.4374	0.4999	0.4206	0.3781	0.3470	0.3788	0.3944	0.3099	0.3341	**0.3914**	**20**
Poland	0.2444	0.3721	0.2930	0.3598	0.3716	0.4258	0.4465	0.3971	0.4068	0.4081	0.4683	0.4293	0.3763	**0.3845**	**21**
Slovenia	0.3816	0.4272	0.3853	0.3746	0.3534	0.4123	0.4153	0.3234	0.3543	0.3695	0.4422	0.3777	0.3717	**0.3837**	**22**
Portugal	0.2576	0.4014	0.3487	0.3078	0.2659	0.3572	0.3262	0.3317	0.3663	0.3772	0.4057	0.3990	0.3354	**0.3446**	**23**
Spain	0.2970	0.4071	0.3263	0.3390	0.3157	0.3672	0.3420	0.3282	0.3698	0.2994	0.3179	0.2422	0.1916	**0.3187**	**24**
Croatia	0.2147	0.3100	0.1988	0.2320	0.2514	0.3600	0.2677	0.2917	0.3529	0.3169	0.3468	0.3393	0.2336	**0.2858**	**25**
Italy	0.1583	0.2413	0.2357	0.2300	0.2187	0.2742	0.2198	0.2206	0.2332	0.2326	0.2208	0.1362	0.1554	**0.2136**	**26**
Greece	0.1636	0.2895	0.0733	0.0000	0.0000	0.0861	0.0461	0.0061	0.0033	0.0510	0.0739	0.0867	0.0459	**0.0712**	**27**

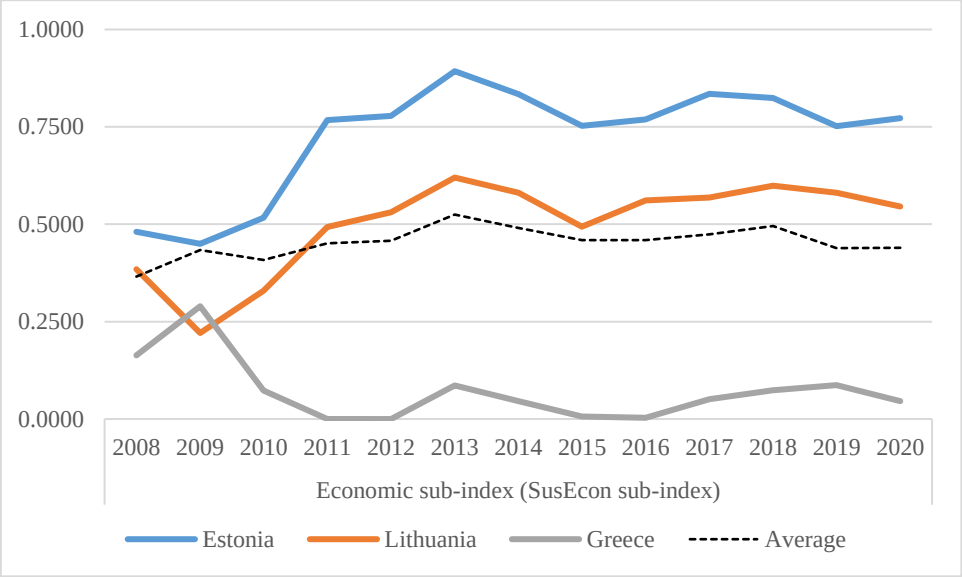


Figure 17. The $I_{SusEcon}$ sub-index of Estonia, Lithuania and Greece in the period from 2008 to 2020

Results of the sub-indices of the country's innovation sustainability in relationship with the sharing economy ($I_{SusInnov}$)

Based on section 2 and the theoretical model for measuring the country's innovation sustainability in relationship with the sharing economy, $I_{SusInnov}$ sub-index is calculated based on Formula (11) and is expressed accordingly:

$$\boldsymbol{I_{SusInnov} = 1/6 \times GDE\_on\_R\&D + 1/6 \times Human\_in\_tech + 1/6 \times R\&D\_personn + 1/6 \times Enter\_with\_int + 1/6 \times Households\_with\_int + 1/6 \times Patent}; \quad (16)$$

where $I_{SusInnov}$ – sub-index of the country's innovation sustainability in relationship with the sharing economy, *GDE_on_R&D* – gross domestic expenditure on R&D, *Human_in_tech* – human resources in science and technology, *R&D_personn* – R&D personnel, *Enter_with_int* – enterprises with Internet access, *Households_with_int* – households with connection to the Internet, *Patent* – patent applications, $1/6$ – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The normalization of the $I_{SusInnov}$ sub-index's indicators is carried out before calculating the sub-index, and it was done according to the judgement step, characterized in sub-section 2.4.3 (Table 17) and Formula (2). Normalized data of the $I_{SusInnov}$ sub-index's indicators are presented in the Annexes 5, 6 and 7.

Table 20. Innovation ($I_{SusInnov}$) sub-index of EU-27 in the period of 2008–2020

Country	Innovation sub-index ($I_{SusInnov}$ sub-index)													Average	Ranking
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Germany	0.7567	0.7534	0.7800	0.7780	0.8046	0.7967	0.7980	0.7985	0.8136	0.8178	0.8343	0.8494	0.8500	**0.8024**	**1**
Finland	0.8144	0.7984	0.7925	0.7887	0.8071	0.7793	0.7773	0.7493	0.7353	0.7535	0.7527	0.7376	0.7688	**0.7735**	**2**
Denmark	0.7622	0.7337	0.7367	0.7455	0.7587	0.7506	0.7255	0.7333	0.7805	0.7582	0.7651	0.7608	0.7589	**0.7515**	**3**
Sweden	0.7599	0.7313	0.7193	0.7252	0.7511	0.7351	0.7110	0.7055	0.7521	0.7495	0.7495	0.7788	0.7502	**0.7399**	**4**
Netherlands	0.6756	0.6360	0.6429	0.6655	0.6713	0.6930	0.7196	0.7142	0.7285	0.7550	0.7572	0.7516	0.7558	**0.7051**	**5**
Luxembourg	0.6325	0.6689	0.6568	0.6416	0.5774	0.5755	0.6882	0.6587	0.6799	0.6665	0.6512	0.6563	0.6402	**0.6457**	**6**
Austria	0.5723	0.5490	0.5738	0.5861	0.6208	0.6200	0.6416	0.6431	0.6714	0.6936	0.6958	0.6842	0.6713	**0.6325**	**7**
France	0.6329	0.6222	0.6205	0.6367	0.6591	0.6447	0.6322	0.6180	0.6229	0.6227	0.6215	0.6190	0.6510	**0.6310**	**8**
Belgium	0.5868	0.5614	0.5822	0.5929	0.5964	0.5744	0.5935	0.5896	0.6233	0.6677	0.6634	0.6858	0.7477	**0.6204**	**9**
Slovenia	0.4923	0.4874	0.5141	0.5589	0.5742	0.5509	0.5368	0.5268	0.5239	0.5297	0.5576	0.5674	0.5659	**0.5374**	**10**
Ireland	0.4472	0.4522	0.4638	0.4840	0.4839	0.4817	0.5532	0.5203	0.5573	0.5467	0.5307	0.5214	0.5438	**0.5066**	**11**
Estonia	0.4561	0.4533	0.4583	0.4978	0.5075	0.4842	0.4499	0.4670	0.4383	0.4319	0.4923	0.4909	0.4906	**0.4706**	**12**
Czechia	0.3942	0.3964	0.4082	0.4192	0.4414	0.4186	0.4685	0.4406	0.4457	0.4624	0.4885	0.4728	0.4840	**0.4416**	**13**
Spain	0.4349	0.4122	0.4276	0.4186	0.3913	0.3922	0.4047	0.4045	0.4248	0.4289	0.4435	0.4675	0.5105	**0.4278**	**14**
Italy	0.3862	0.3651	0.3859	0.3723	0.3356	0.3837	0.3963	0.3861	0.4144	0.4197	0.4355	0.4396	0.4460	**0.3974**	**15**
Lithuania	0.4372	0.4054	0.4143	0.4013	0.3692	0.3817	0.3825	0.3681	0.3799	0.3938	0.3980	0.4039	0.4025	**0.3952**	**16**
Malta	0.3249	0.3165	0.3378	0.3654	0.3756	0.3452	0.3567	0.3382	0.3242	0.3340	0.3270	0.3379	0.3705	**0.3426**	**17**
Portugal	0.3110	0.3133	0.3219	0.3344	0.3015	0.2984	0.3105	0.3213	0.3539	0.3595	0.3612	0.3539	0.3782	**0.3322**	**18**
Poland	0.2491	0.2634	0.2926	0.2931	0.2980	0.2913	0.2832	0.2758	0.3164	0.3385	0.3640	0.3810	0.4593	**0.3158**	**19**
Cyprus	0.2946	0.2877	0.3015	0.3102	0.2961	0.2528	0.2867	0.2701	0.3083	0.3150	0.3526	0.3722	0.4142	**0.3125**	**20**
Latvia	0.3075	0.2853	0.3048	0.3138	0.2818	0.2883	0.3072	0.3013	0.2975	0.3028	0.3222	0.3379	0.3813	**0.3101**	**21**
Slovakia	0.2938	0.2745	0.3086	0.3019	0.3409	0.3072	0.3259	0.3118	0.2959	0.3040	0.2763	0.2726	0.3072	**0.3016**	**22**
Hungary	0.2506	0.2577	0.2619	0.2828	0.2997	0.2780	0.2632	0.2637	0.2778	0.3152	0.3321	0.3693	0.3922	**0.2957**	**23**
Croatia	0.2403	0.2437	0.2697	0.2552	0.2453	0.2844	0.2614	0.2218	0.2552	0.2755	0.3216	0.3269	0.3138	**0.2704**	**24**
Greece	0.1816	0.1760	0.2016	0.1872	0.2044	0.1698	0.2107	0.2019	0.1957	0.1914	0.2145	0.2235	0.3375	**0.2074**	**25**
Bulgaria	0.1438	0.1330	0.1445	0.1670	0.1336	0.1364	0.1596	0.1707	0.1909	0.2057	0.2134	0.2133	0.2386	**0.1731**	**26**
Romania	0.0144	0.0031	0.0016	0.0052	0.0085	0.0157	0.0137	0.0332	0.0402	0.0381	0.0515	0.0509	0.0465	**0.0248**	**27**

$I_{SusInnov}$ sub-index and ranking of EU-27 based on this index is demonstrated in Table 20. Theoretically, $I_{SusInnov}$ sub-index could vary from 0.00 to 1.00. However, in this dissertation, the most significant country's innovation sustainability in relationship with the sharing economy ($I_{SusInnov}$ sub-index) was rather high – 0.8500 (in Germany in 2020), and the lowest score was 0.0016 (in Romania in 2010). The most developed countries such as Germany, Finland, Denmark, Sweden and the Netherlands have the highest average scores in $I_{SusInnov}$ indices during the research period (the average scores vary from 0.8024 to 0.7051). Germany significantly stands out from the other countries with the number of patent application, but the percentage rate of the households with connection to the Internet are not very high, and in 2008, it had only 55% (less than the average percentage rate (72.25%) in all EU-27 during the research period). Gross domestic expenditure on R&D in all sectors from total GDP in Germany was high and slightly increasing during all the research period.

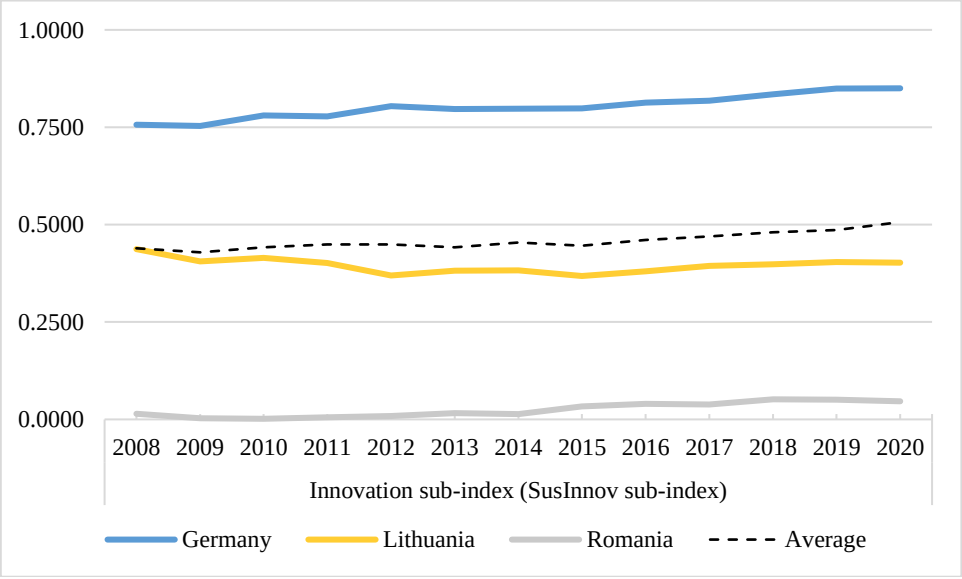


Figure 18. The $I_{SusInnov}$ sub-index of Germany, Lithuania and Romania in the period from 2008 to 2020

The dynamics of the selected countries in the period from 2008 to 2020 is presented in Figure 18. Romania is the country with the lowest scores of the sub-index evaluating the country's innovation sustainability in relationship with the sharing economy ($I_{SusInnov}$ scores) from 2008 to 2020. Thus, the average score of $I_{SusInnov}$ in Romania during all the research period is 0.0248. In Lithuania, the estimate of the $I_{SusInnov}$ sub-index has slightly varied: the lowest score 0.3681 was in 2015, and the highest score 0.4372 was in 2008, and the average score of the index is 0.3952 during all research period. However, the overall average rate of $I_{SusInnov}$ of all EU-27 is 0.45795 during the research period.

Results of the sub-indices of the country's social sustainability in relationship with the sharing economy (I_{SusSoc})

Based on section 2 and the theoretical model for measuring the country's sustainability in relationship with the sharing economy, I_{SusSoc} sub-index is calculated based on Formula (12) and is expressed accordingly:

$$\boldsymbol{I_{SusSoc} = 1/4 \times Purchase\_power + 1/4 \times Human\_in\_tech + 1/4 \times People\_at\_risk + 1/4 \times Y\_people\_n\_empl}; \quad (17)$$

where I_{SusSoc} – the sub-index of the country's social sustainability in relationship with the sharing economy, *Purchase_power* – purchasing power, *Income_dist* – income distribution, *People_at_risk* – people at risk of poverty or social exclusion, *Y_people_n_empl* – young people neither in employment nor in education and training, $1/4$ – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The weight coefficients of I_{SusSoc} sub-index indicator are calculated based on Formula (10). The weight of each indicator is equal to 1/4 in the case of SusSoc sub-index.

The normalization of the I_{SusSoc} sub-index's indicators is prepared before calculating the sub-index, and it was done according to the judgement step, characterized in sub-section 2.4.3 (Table 17) and Formulas (2) and (3). Normalized data of the I_{SusSoc} sub-index's indicators are presented in the Annexes 8 and 9.

I_{SusSoc} sub-index and ranking of EU-27 based on this index is demonstrated in Table 21. Consequently, the country's social sustainability in relationship with the sharing economy (I_{SusSoc} sub-index) varies from 0.0033 (in Bulgaria in 2011) to 0.9377 (in Luxembourg in 2011), and the average score of SusSoc sub-index is 0.5166 during the research period.

Table 21. Social (I_{SusSoc}) sub-index of EU-27 in the period of 2008–2020

Country	Social sub-index (I_{SusSoc} sub-index)													Average	Ranking
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Luxembourg	0.8736	0.8779	0.9368	0.9377	0.9076	0.8803	0.8973	0.9080	0.8727	0.8629	0.7553	0.7831	0.7618	**0.8658**	**1**
Netherlands	0.8137	0.8026	0.8303	0.8213	0.8330	0.8207	0.7883	0.8012	0.7798	0.7645	0.7331	0.7622	0.7349	**0.7912**	**2**
Sweden	0.7522	0.6993	0.7581	0.7516	0.7554	0.7610	0.7418	0.7559	0.7298	0.7229	0.6846	0.6924	0.6816	**0.7297**	**3**
Denmark	0.7956	0.7040	0.7219	0.7483	0.7505	0.7558	0.7463	0.7486	0.7412	0.7051	0.6703	0.6969	0.6838	**0.7283**	**4**
Finland	0.7201	0.6903	0.7366	0.7375	0.7428	0.7562	0.7210	0.7139	0.7068	0.7114	0.6729	0.7058	0.6691	**0.7142**	**5**
Czechia	0.6874	0.6685	0.6918	0.7032	0.7045	0.7264	0.7234	0.7264	0.7267	0.7404	0.7290	0.7376	0.7049	**0.7131**	**6**
Austria	0.6700	0.6851	0.7060	0.7236	0.7377	0.7438	0.7196	0.7444	0.7233	0.7020	0.6834	0.7034	0.6560	**0.7076**	**7**
Slovenia	0.7269	0.7144	0.7176	0.7161	0.6909	0.6648	0.6405	0.6609	0.6731	0.6969	0.6812	0.7207	0.6879	**0.6917**	**8**
Germany	0.5914	0.6165	0.6585	0.6685	0.6986	0.6870	0.6419	0.6858	0.6702	0.6787	0.6160	0.6637	0.4674	**0.6419**	**9**
Belgium	0.6111	0.6268	0.6560	0.6501	0.6453	0.6639	0.6507	0.6447	0.6427	0.6340	0.6039	0.6375	0.6194	**0.6374**	**10**
Malta	0.5778	0.5863	0.6015	0.6143	0.6271	0.6245	0.6088	0.6204	0.6517	0.6609	0.6375	0.6406	0.5750	**0.6174**	**11**
France	0.5889	0.5672	0.5962	0.5779	0.5943	0.6358	0.6329	0.6332	0.6064	0.6110	0.5730	0.5896	0.5407	**0.5959**	**12**
Slovakia	0.5533	0.5265	0.5299	0.5451	0.5686	0.5929	0.5735	0.6022	0.5906	0.5912	0.5965	0.5889	0.5972	**0.5736**	**13**
Ireland	0.5204	0.4536	0.4457	0.4124	0.4396	0.4954	0.4805	0.5996	0.6158	0.6439	0.6582	0.6978	0.6472	**0.5469**	**14**
Poland	0.3863	0.4200	0.4497	0.4375	0.4574	0.4754	0.4689	0.5096	0.5126	0.5476	0.5352	0.5541	0.5536	**0.4852**	**15**
Cyprus	0.5841	0.5820	0.5694	0.5464	0.4805	0.4271	0.3765	0.4081	0.4146	0.4527	0.4568	0.4850	0.4732	**0.4813**	**16**
Hungary	0.4547	0.4346	0.4956	0.4586	0.4426	0.4260	0.4285	0.4921	0.4977	0.4997	0.5108	0.5350	0.5153	**0.4762**	**17**
Estonia	0.5047	0.3846	0.4463	0.4480	0.4585	0.4763	0.3830	0.4702	0.4508	0.5040	0.4424	0.4873	0.4657	**0.4555**	**18**
Portugal	0.4018	0.4304	0.4690	0.4292	0.4076	0.3891	0.3747	0.4506	0.4399	0.4910	0.4944	0.5207	0.5042	**0.4464**	**19**
Croatia	0.3380	0.3435	0.3471	0.2892	0.3243	0.3330	0.3238	0.3659	0.3564	0.3830	0.3666	0.4299	0.4156	**0.3551**	**20**
Lithuania	0.3633	0.3008	0.2205	0.3286	0.4097	0.3895	0.4048	0.3666	0.3510	0.3603	0.3203	0.3762	0.3691	**0.3508**	**21**
Spain	0.4154	0.3361	0.3481	0.2899	0.2780	0.3118	0.2574	0.3208	0.3130	0.3545	0.3309	0.3629	0.3035	**0.3248**	**22**
Italy	0.3623	0.3660	0.3873	0.3132	0.3176	0.3054	0.2753	0.2967	0.2353	0.2681	0.2062	0.2521	0.1744	**0.2892**	**23**
Latvia	0.2063	0.0754	0.1617	0.1526	0.2414	0.3029	0.2856	0.3645	0.3697	0.3816	0.2888	0.3498	0.3432	**0.2710**	**24**
Greece	0.3611	0.3810	0.3790	0.2325	0.1337	0.1365	0.1203	0.1897	0.1616	0.2057	0.2010	0.2756	0.2573	**0.2335**	**25**
Romania	0.1377	0.1717	0.2075	0.1580	0.1468	0.1596	0.0929	0.1078	0.1122	0.2238	0.1352	0.1750	0.2061	**0.1565**	**26**
Bulgaria	0.0645	0.0895	0.0945	0.0033	0.0658	0.0504	0.0641	0.1089	0.0264	0.0714	0.0749	0.0833	0.0739	**0.0670**	**27**

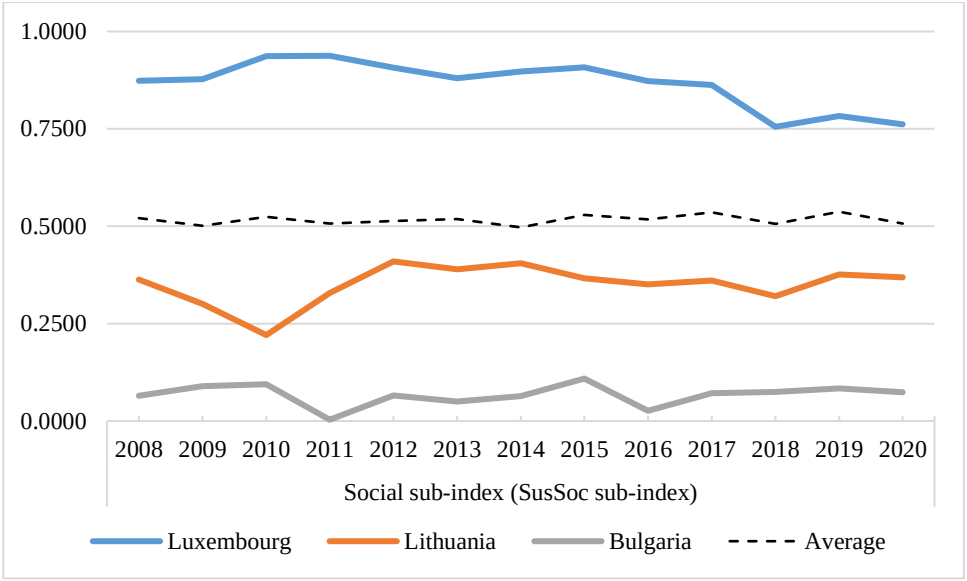


Figure 19. The I_{SusSoc} sub-index of Luxembourg, Lithuania, Bulgaria and average score of all EU-27 in the period from 2008 to 2020

The dynamics of the countries with the highest (Luxembourg), the lowest (Bulgaria) scores of I_{SusSoc}, average scores and scores of I_{SusSoc} in Lithuania are illustrated in Figure 19. Based on the empirical research, the country's social sustainability in relationship with the sharing economy is the lowest in Bulgaria and varies from 0.0645 in 2008 to 0.0739 in 2020 (average 0.0670). Such results were caused due to the highly unequal distribution of income, the amount of people at risk of poverty or social exclusion and proportion of people neither employed or engaged in education during all the research period. These indicators negatively impact social sustainability.

Results of the sub-indices of the country's environmental sustainability in relationship with the sharing economy (I_{SusEnv})

Based on section 2 and the theoretical model for measuring the country's sustainability in relationship with the sharing economy, I_{SusEnv} sub-index is calculated based on Formula (13) and is expressed accordingly:

$$\boldsymbol{I_{SusEnv} = 1/4 \times CO_2\_emmision\_per\_GDP + 1/4 \times Resource\_prod + 1/4 \times Circular\_mater + 1/4 \times Share\_of\_renew\_energy}; \quad (18)$$

where I_{SusEnv} – the sub-index of the country's environmental sustainability in relationship with the sharing economy, $CO_2\_emmision\_per\_GDP$ – carbon dioxide emission per GDP, *Resource_prod* – resource productivity and domestic material consumption, *Circular_mater* – circular material usage rate, *Share_of_renew_energy* – share of renewable energy in gross final energy consumption by sector, $1/4$ – the weight coefficients of the indicator. The total sum of all weights is equal to 1.

The weight coefficients of I_{SusEnv} sub-index indicator are calculated based on Formula (10). The weight of each indicator is equal to 1/4 in the case of SusSoc sub-index.

The normalization of the I_{SusEnv} sub-index's indicators is prepared before calculating the sub-index, and it was done according to the judgement step, characterized in sub-section 2.4.3 (Table 17) and Formulas (2) and (3). The normalized data of the I_{SusEnv} sub-index's indicators are presented in Annexes 10 and 11.

I_{SusEnv} sub-index and ranking of EU-27 based on this index is presented in Table 22. Therefore, the country's environmental sustainability in relationship with the sharing economy (I_{SusEnv} sub-index) varies from 0.0665 (in Bulgaria in 2008) to 0.7341 (in Luxembourg in 2010), and the average score of I_{SusEnv} sub-index is 0.4042 during the research period. Additionally, based on the empirical research study, five countries with the highest average scores (varying from 0.6988 to 0.5898) are the Netherlands, Sweden, France, Luxembourg and Italy.

Table 22. Environmental (I_{SusEnv}) sub-index of EU-27 in the period of 2008–2020

	Environmental sub-index (I_{SusEnv} sub-index)														
Country	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**	**Ranking**
Netherlands	0.6947	0.7020	0.6887	0.6895	0.6856	0.6938	0.6925	0.7003	0.7059	0.7066	0.7022	0.7093	0.7136	**0.6988**	**1**
Sweden	0.6734	0.6821	0.6704	0.6666	0.6703	0.6546	0.6520	0.6730	0.6565	0.6388	0.6399	0.6271	0.6329	**0.6567**	**2**
France	0.6013	0.6177	0.6266	0.5964	0.5963	0.5951	0.6106	0.6523	0.6297	0.5855	0.6042	0.5920	0.5995	**0.6082**	**3**
Luxembourg	0.6975	0.6766	0.7341	0.6959	0.6567	0.6203	0.5843	0.5658	0.5182	0.5129	0.5446	0.5067	0.5577	**0.6055**	**4**
Italy	0.5285	0.5481	0.5384	0.5245	0.5668	0.6178	0.6249	0.6666	0.6337	0.6147	0.6120	0.5961	0.5952	**0.5898**	**5**
Austria	0.5672	0.5767	0.5672	0.5533	0.5600	0.5658	0.5830	0.6076	0.5823	0.5633	0.5664	0.5488	0.5344	**0.5674**	**6**
Finland	0.5776	0.5504	0.5577	0.5650	0.5742	0.5138	0.5144	0.5168	0.4817	0.4850	0.4797	0.4869	0.4715	**0.5211**	**7**
Denmark	0.4743	0.4813	0.5128	0.4830	0.4791	0.5005	0.5326	0.5392	0.5158	0.5090	0.5070	0.4928	0.4455	**0.4979**	**8**
Germany	0.4962	0.4906	0.5011	0.4852	0.4823	0.4733	0.4836	0.5191	0.4920	0.4678	0.4842	0.4839	0.4733	**0.4871**	**9**
Spain	0.4366	0.4570	0.4890	0.4780	0.4948	0.4932	0.4847	0.4938	0.4901	0.4698	0.4580	0.4618	0.4660	**0.4748**	**10**
Latvia	0.4212	0.4356	0.3690	0.4025	0.3998	0.4198	0.4475	0.4403	0.4409	0.4246	0.4072	0.3976	0.3847	**0.4147**	**11**
Slovenia	0.4066	0.4111	0.4033	0.4195	0.4338	0.4321	0.4277	0.4359	0.4107	0.4048	0.3912	0.4006	0.3859	**0.4125**	**12**
Belgium	0.3716	0.3894	0.3923	0.3728	0.3849	0.3877	0.3999	0.4195	0.4149	0.3843	0.3754	0.3949	0.3674	**0.3888**	**13**
Portugal	0.3832	0.3768	0.3896	0.3782	0.3706	0.3840	0.3961	0.3958	0.3920	0.3693	0.3683	0.3660	0.3528	**0.3787**	**14**
Ireland	0.3215	0.3431	0.3492	0.3665	0.3564	0.3412	0.3689	0.4249	0.3902	0.3818	0.3813	0.3833	0.4202	**0.3714**	**15**
Croatia	0.3529	0.3492	0.3633	0.3589	0.3728	0.3681	0.3821	0.3863	0.3634	0.3549	0.3534	0.3424	0.3035	**0.3578**	**16**
Malta	0.3528	0.3406	0.3845	0.3256	0.3002	0.3642	0.3433	0.3509	0.3486	0.3835	0.3872	0.3871	0.3662	**0.3565**	**17**
Lithuania	0.3282	0.3236	0.3233	0.3160	0.3222	0.3110	0.3276	0.3416	0.3253	0.3126	0.2866	0.2716	0.2319	**0.3093**	**18**
Estonia	0.3136	0.2959	0.2217	0.3083	0.3432	0.2554	0.2497	0.3182	0.2749	0.2686	0.2761	0.3689	0.3752	**0.2977**	**19**
Hungary	0.2933	0.2916	0.3132	0.3133	0.3271	0.3164	0.2873	0.2940	0.2821	0.2677	0.2472	0.2456	0.2281	**0.2851**	**20**
Slovakia	0.2728	0.2710	0.2901	0.2874	0.2818	0.2759	0.2876	0.3055	0.2799	0.2589	0.2458	0.2901	0.2643	**0.2778**	**21**
Czechia	0.2636	0.2500	0.2685	0.2679	0.2749	0.2713	0.2759	0.2912	0.2711	0.2867	0.2903	0.3005	0.2933	**0.2773**	**22**
Greece	0.2816	0.2802	0.3045	0.2828	0.2737	0.2788	0.2744	0.2867	0.2721	0.2675	0.2574	0.2704	0.2614	**0.2763**	**23**
Cyprus	0.2420	0.2388	0.2565	0.2503	0.2662	0.2885	0.2796	0.2958	0.2683	0.2499	0.2661	0.2592	0.2422	**0.2618**	**24**
Romania	0.2759	0.2597	0.2940	0.2533	0.2398	0.2555	0.2614	0.2578	0.2471	0.2473	0.2302	0.2278	0.1899	**0.2492**	**25**
Poland	0.2689	0.2131	0.2386	0.2226	0.2220	0.2217	0.2444	0.2499	0.1813	0.1697	0.1692	0.1768	0.1292	**0.2083**	**26**
Bulgaria	0.0665	0.0695	0.0890	0.0683	0.0756	0.1057	0.0856	0.0848	0.0961	0.0823	0.0800	0.0831	0.0764	**0.0818**	**27**

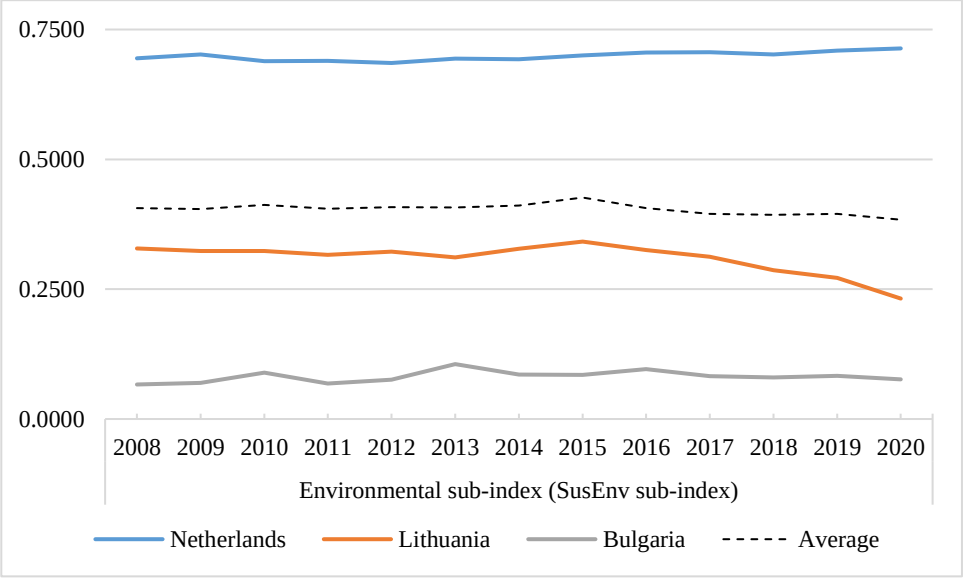


Figure 20. The I_{SusEnv} sub-index of the Netherlands, Lithuania, Bulgaria and the average score of all EU-27 in the period from 2008 to 2020

The dynamics of the countries with the highest (the Netherlands), the lowest (Bulgaria) scores of I_{SusEnv}, average scores and scores of Lithuania are illustrated in Figure 20. Based on the empirical study, in Bulgaria, the social sustainability in relationship with the sharing economy diversifies from 0.0665 in 2008 to 0.0764 in 2020 (average score of indices – 0.0818). The I_{SusEnv} sub-indices vary from 0.6947 to 0.7136 in the Netherlands with the average score of 0.6988 during the period of research. It should be noted that the significant results of I_{SusEnv} in the Netherlands were due to the highest rates of circular material usage comparing all EU-27 countries. Lithuania is ranked as 18th according to the I_{SusEnv} sub-index: average score of I_{SusEnv} is 0.3093 of Lithuania, and it is below the average score of all EU-27 (0.4042) in all period.

Additionally, when analysing the variables, involved in the I_{SusEnv} sub-index, it can be stated that the share of renewable energy in gross final energy consumption by sector plays a significant role, and the highest score of this index was in Sweden (from 43.92 to 60.12 from 2008 to 2020; then, the average score of EU-27 is 19.26 during all research period.

Results of the indices of the country's sustainability in relationship with the sharing economy ($I_{CountSusShE}$)

Finally, the estimations of the country's sustainability in relationship with the sharing economy ($I_{CountSusShE}$) were calculated based on the results of $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} and I_{SusEnv} indices. The indices of $I_{CountSusShE}$ were measured based on the guidelines in section 2, i.e., $I_{CountSusShE}$ indices are calculated based on Formula (8) and expressed accordingly:

$$I_{CountSusShE} = 1/4 \times I_{SusEcon} + 1/4 \times I_{SusInnov} + 1/4 \times I_{SusSoc} + 1/4 \times I_{SusEnv}; \quad (19)$$

where $I_{CountSusShE}$ – the index of the country's whole sustainability in relationship with the sharing economy, $I_{SusEcon}$ – sub-index of the country's economic sustainability in relationship with the sharing economy, $I_{SusInnov}$ – sub-index of the country's innovation sustainability in relationship with the sharing economy, I_{SusSoc} – sub-index of the country's social sustainability in relationship with the sharing economy, I_{SusEnv} – sub-index of the country's environmental sustainability in relationship with the sharing economy, $1/4$ – the weight coefficients of the sub-indexes. The total sum of all weights is equal to 1.

Theoretically, the values of the index $I_{CountSusShE}$ may vary from 0 (when the country's sustainability in relationship with the sharing economy is extremely low) to 1 (when the country's sustainability in relationship with the sharing economy is extremely high). In this dissertation, the benchmarking of the index $I_{CountSusShE}$ is used, which is constructed based on the methodology of indices construction used by the other researchers (Pollesch and Dale, 2016; Pinar et al., 2014). During the benchmarking process, the values of the indices are theoretically assigned to some groups with interpretation based on the research field. According to Pinar et al. (2014), the benchmarking procedure typically determines binary values, i.e., specifically, 1 and 0, based on whether a specific indicator (benchmark) satisfies the specified reference stage or not. According to Pollesch and Dale (2016), the corresponding benchmarking is established to assign a standardized value for each indicator (and index), taking into consideration its degree of sustainability. The interpretation of the values of the index $I_{CountSusShE}$ is demonstrated in Table 23.

Table 23. The interpretation (benchmarking) of the values of the index $I_{CountSusShE}$

Values of the index	Interpretation
0.0000–0.2500	Low sustainability
0.2501–0.5000	Satisfactory sustainability (below average, but higher than the low level)
0.5001–0.7500	Upper sustainability (more than satisfactory level)
0.7501–1.0000	High (significant) sustainability

The values of the index $I_{CountSusShE}$, based on the cases of EU-27 in the time period of 2008–2020 are demonstrated in Table 24, and the descriptive statistics of the indices are illustrated in Annex 12. The values of the index $I_{CountSusShE}$ vary depending on the level of the country's sustainability: the higher is the value of the index, the more significant level of the country's sustainability in relationship with sharing economy is generated.

Table 24. The $I_{CountSusShE}$ index scores and ranking of EU-27 countries for the period from 2008 to 2020

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	Ranking
Sweden	0.6607	0.6669	0.6998	0.6990	0.6962	0.7129	0.6930	0.6927	0.6772	0.6780	0.6747	0.6514	0.6695	**0.6825**	**1**
Netherlands	0.6631	0.6764	0.6673	0.6850	0.6779	0.6956	0.6783	0.6861	0.6785	0.6833	0.6803	0.6721	0.6843	**0.6791**	**2**
Luxembourg	0.6451	0.6769	0.7056	0.6929	0.6865	0.7002	0.7067	0.6742	0.6607	0.6329	0.6078	0.6019	0.6354	**0.6636**	**3**
Denmark	0.6265	0.6194	0.6223	0.6381	0.6377	0.6598	0.6495	0.6487	0.6581	0.6340	0.6322	0.6116	0.6266	**0.6357**	**4**
Finland	0.6374	0.6343	0.6582	0.6683	0.6659	0.6602	0.6280	0.6152	0.6093	0.6164	0.6061	0.5933	0.6152	**0.6314**	**5**
Germany	0.5554	0.5700	0.6104	0.6212	0.6280	0.6355	0.6181	0.6222	0.6157	0.6132	0.6044	0.6010	0.5716	**0.6051**	**6**
Austria	0.5521	0.5747	0.5817	0.6010	0.6095	0.6245	0.6100	0.6122	0.6007	0.6028	0.6086	0.5791	0.5708	**0.5944**	**7**
France	0.5389	0.5576	0.5607	0.5608	0.5718	0.5939	0.5741	0.5704	0.5515	0.5495	0.5483	0.5276	0.5313	**0.5566**	**8**
Belgium	0.4775	0.5130	0.5161	0.5191	0.5244	0.5354	0.5299	0.5184	0.5136	0.5141	0.5110	0.5122	0.5260	**0.5162**	**9**
Ireland	0.4075	0.4373	0.4208	0.4264	0.4429	0.4718	0.5269	0.5737	0.5457	0.5801	0.5886	0.5878	0.5972	**0.5082**	**10**
Slovenia	0.5018	0.5100	0.5051	0.5173	0.5130	0.5150	0.5051	0.4867	0.4905	0.5002	0.5180	0.5166	0.5028	**0.5063**	**11**
Czechia	0.4420	0.4693	0.4823	0.4895	0.4905	0.5076	0.5196	0.5142	0.5000	0.5233	0.5336	0.5108	0.5039	**0.4990**	**12**
Estonia	0.4388	0.3959	0.4108	0.5055	0.5219	0.5272	0.4791	0.5020	0.4832	0.5098	0.5088	0.5248	0.5259	**0.4872**	**13**
Malta	0.3770	0.3926	0.4345	0.4128	0.4515	0.4979	0.4853	0.4900	0.4680	0.5097	0.4833	0.4691	0.4334	**0.4542**	**14**
Cyprus	0.4352	0.4564	0.4490	0.4380	0.3974	0.3511	0.3395	0.3527	0.4119	0.3967	0.4148	0.4183	0.4024	**0.4049**	**15**
Slovakia	0.3746	0.3640	0.3982	0.4030	0.4084	0.4285	0.4072	0.4187	0.3934	0.3905	0.3934	0.3796	0.3860	**0.3958**	**16**
Lithuania	0.3782	0.3127	0.3220	0.3846	0.4081	0.4255	0.4239	0.3925	0.4044	0.4088	0.4009	0.4081	0.3873	**0.3890**	**17**
Spain	0.3960	0.4031	0.3978	0.3814	0.3699	0.3911	0.3722	0.3868	0.3994	0.3881	0.3876	0.3836	0.3679	**0.3865**	**18**
Latvia	0.3288	0.2773	0.2767	0.3465	0.3980	0.4278	0.4158	0.4171	0.4105	0.4170	0.4107	0.4006	0.4124	**0.3799**	**19**
Portugal	0.3384	0.3805	0.3823	0.3624	0.3364	0.3572	0.3519	0.3748	0.3880	0.3993	0.4074	0.4099	0.3927	**0.3755**	**20**
Hungary	0.3188	0.3387	0.3465	0.3584	0.3643	0.3859	0.3786	0.3740	0.3716	0.3886	0.4164	0.4190	0.3975	**0.3737**	**21**
Italy	0.3588	0.3801	0.3868	0.3600	0.3597	0.3953	0.3791	0.3925	0.3791	0.3838	0.3686	0.3560	0.3428	**0.3725**	**22**
Poland	0.2871	0.3171	0.3185	0.3282	0.3372	0.3536	0.3608	0.3581	0.3543	0.3660	0.3842	0.3853	0.3796	**0.3485**	**23**
Croatia	0.2865	0.3116	0.2947	0.2838	0.2985	0.3364	0.3087	0.3164	0.3320	0.3326	0.3471	0.3596	0.3166	**0.3173**	**24**
Romania	0.2416	0.2147	0.2113	0.2264	0.2261	0.2382	0.2262	0.2137	0.2123	0.2720	0.2431	0.2336	0.2112	**0.2285**	**25**
Greece	0.2469	0.2817	0.2396	0.1756	0.1530	0.1678	0.1629	0.1711	0.1582	0.1789	0.1867	0.2141	0.2255	**0.1971**	**26**
Bulgaria	0.1734	0.2037	0.1620	0.1492	0.1642	0.1788	0.1745	0.1877	0.1778	0.1861	0.1863	0.2082	0.1820	**0.1795**	**27**

Furthermore, the overall average score of the country's whole sustainability in relationship with the sharing economy (values of $I_{CountSusShE}$) varies from 0.6825 in Sweden to 0.1795 in Bulgaria. Based on the "benchmarking" methodology, described above, there were no countries with theoretically "high" level (with values from 0.7501 to 1.0000) of country's sustainability. Based on the empirical research, the "upper" level (at meaning interval from 0.5001 to 0.7500) of average values of the $I_{CountSusShE}$ were in these countries: Sweden, the Netherlands, Luxembourg, Denmark, Finland, Germany, Austria, France, Belgium, Ireland, Slovenia in the research period of 2008–2020. In most EU-27 countries, the sustainability level was in the "satisfactory" level (at $I_{CountSusShE}$ meaning interval from 0.2501 to 0.5000). These cases were in Czechia, Estonia, Malta, Cyprus, Slovakia, Lithuania, Hungary, Spain, Latvia, Portugal, Hungary, Italy, Poland and Croatia. The "low" level of sustainability in the aspect of sharing economy (at meaning interval of $I_{CountSusShE}$ from 0.0000 to 0.2500) was in three countries: Romania, Greece and Bulgaria. Summarizing, it can be assumed that more developed countries with higher income level have greater attitude in employing innovative economic models, for instance, the sharing economy, and these countries are more oriented towards the country's sustainability approaches in the dimensions of economic, innovation, social and environmental sustainability.

The average scores of the index $I_{CountSusShE}$ in EU-27 in the period from 2008 to 2020 are illustrated in Figure 21.

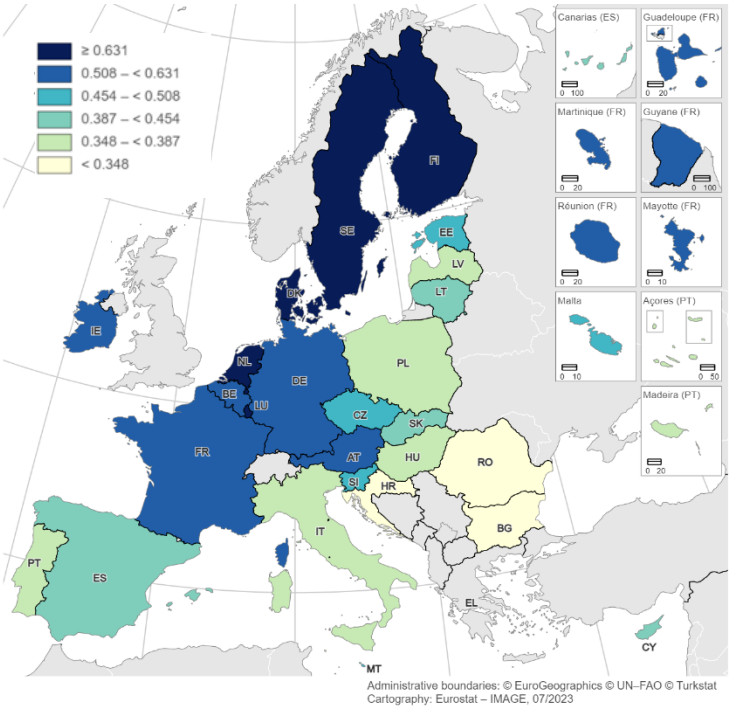


Figure 21. The average scores of the index $I_{CountSusShE}$ in EU-27 in the period from 2008 to 2020 (developed by the author using the following tool: https://ec.europa.eu/eurostat/web/gisco/gisco-activities/map-generator)

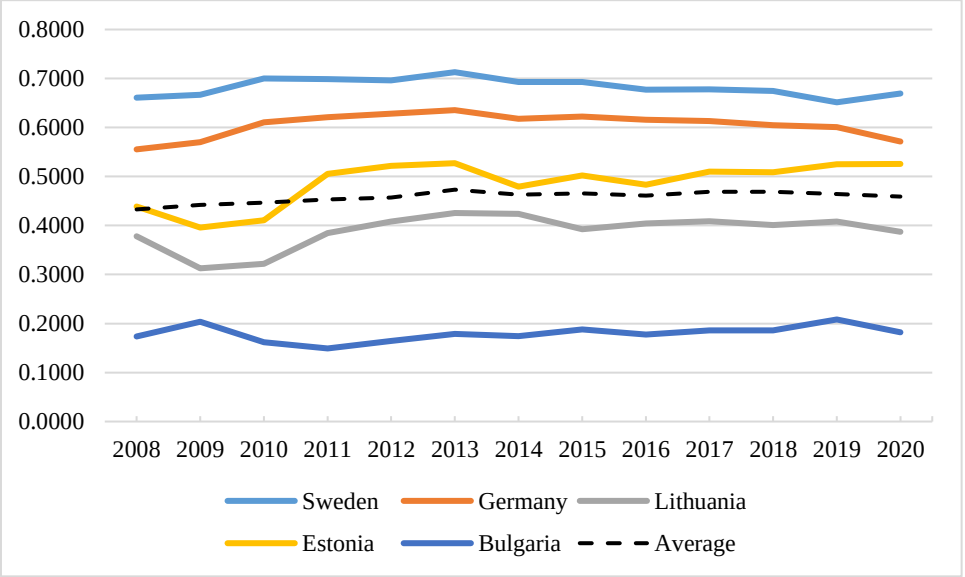


Figure 22. The dynamics of $I_{CountSusShE}$ of Sweden, Germany, Lithuania, Estonia, Bulgaria and average score of all EU-27 in the period from 2008 to 2020

The dynamics of the selected countries (Sweden, Germany, Lithuania, Estonia, and Bulgaria) sustainability based on $I_{CountSusShE}$ scores and average scores of all EU-27 countries in the period from 2008 to 2020 are demonstrated in Figure 22. Based on the above-mentioned figure, the greatest variation during the research period was in the case of Estonia, as the range measuring the spread of the $I_{CountSusShE}$ scores is 0.1314 (the minimum value is 0.3959, the maximum – 0.5272).

The lowest diversity is in the cases of Sweden (diversity range – 0.0615) and Bulgaria (diversity range – 0.0591). Summarizing these results, it can be stated that the sustainability level in relationship with the sharing economy has irrelevant diversity during the period of 2008–2020 in the nations of Sweden and Bulgaria. Respectively, in Sweden, the sustainability level was the most significant during the entire period of this research. Bulgaria has experienced the lowest sustainability level, which has remained consistent throughout the whole research period.

Results of the sensitivity analysis of $I_{CountSusShE}$ index

In this research, the sensitivity analysis of the empirical calculations of $I_{CountSusShE}$ index was performed according to Lee and Zhong (2015) evaluating the fluctuations in country's index ranking that occur as a result of modifications to the primary presumptions as described in sub-section 2.4.6. The examination of average changes in country ranking is conducted to assess the movement of every nation under the $I_{CountSusShE}$ framework in response to the determination of weights for individual sub-indices. The author of this research considered four alternatives and assumed the conditional weights of the sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc}, I_{SusE}), which are equal to:

1. 0.55 x $I_{SusEcon}$, 0.15 x $I_{SusInnov}$, 0.15 x I_{SusSoc}, 0.15 x I_{SusEnv};
2. 0.15 x $I_{SusEcon}$, 0.55 x $I_{SusInnov}$, 0.15 x I_{SusSoc}, 0.15 x I_{SusEnv};
3. 0.15 x $I_{SusEcon}$, 0.15 x $I_{SusInnov}$, 0.55 x I_{SusSoc}, 0.15 x I_{SusEnv};
4. 0.15 x $I_{SusEcon}$, 0.15 x $I_{SusInnov}$, 0.15 x I_{SusSoc}, 0.55 x I_{SusEnv}.

The results of the calculations of sensitivity analysis, examining the fluctuations in country ranking, were done based on Formula (14) and are presented in Table 25.

Table 25. Sensitivity analysis of $I_{CountSusShE}$ index assuming the conditional weights of sub-indices for the periods from 2008 to 2020

Country	Original rank	New rank (1)	Shift (1)	New rank (2)	Shift (2)	New rank (3)	Shift (3)	New rank (4)	Shift (4)
Sweden	**1**	1	0	1	0	3	2	2	1
Netherlands	**2**	2	0	2	0	2	0	1	1
Luxembourg	**3**	3	0	6	3	1	2	3	0
Denmark	**4**	4	0	5	1	4	0	6	2
Finland	**5**	5	0	3	2	5	0	4	1
Germany	**6**	7	1	4	2	7	1	8	2
Austria	**7**	9	2	7	0	6	1	5	2
France	**8**	11	3	8	0	10	2	7	1
Belgium	**9**	12	3	9	0	11	2	10	1
Ireland	**10**	8	2	11	1	12	2	12	2
Slovenia	**11**	15	4	10	1	9	2	9	2
Czechia	**12**	10	2	13	1	8	4	16	4
Estonia	**13**	6	7	12	1	14	1	15	2
Malta	**14**	13	1	14	0	13	1	14	0
Cyprus	**15**	14	1	18	3	16	1	21	6
Slovakia	**16**	18	2	20	4	15	1	20	4
Lithuania	**17**	17	0	16	1	20	3	19	2
Spain	**18**	22	4	15	3	21	3	13	5
Latvia	**19**	16	3	21	2	23	4	17	2
Portugal	**20**	20	0	19	1	18	2	18	2
Hungary	**21**	19	2	22	1	17	4	22	1
Italy	**22**	24	2	17	5	22	0	11	11
Poland	**23**	21	2	23	0	19	4	24	1
Croatia	**24**	25	1	24	0	24	0	23	1
Romania	**25**	23	2	27	2	26	1	25	0
Greece	**26**	27	1	25	1	25	1	26	0
Bulgaria	**27**	26	1	26	1	27	0	27	0
		Average	**1.7037**	**Average**	**1.3333**	**Average**	**1.6296**	**Average**	**2.0774**

In total, four alternative scenarios were analysed, and the average shift assumptions of all four alternatives are equal to 1.686. Therefore, according to research methodology, used by Lee and Zhong (2015), the general resilience robustness of $I_{CountSusShE}$ index is strong enough when confronted with conditional variations of sub-indices weights.

3.3. Cluster analysis of $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} and I_{SusEnv} sub-indices

In this sub-section, the cluster analysis of $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} and I_{SusEnv} sub-indices scores based on the EU-27 countries was developed in order to identify the disparities between the countries and compare the EU-27 countries sustainability in relationship with the sharing economy. The cluster analysis was developed based on

the data of 2008 and then based on the data of 2020 in order to identify the disparities between clusters comparing different years.

The data clustering is a data exploration technique that has numerous applications in data mining. The data clustering and the number of clusters were analysed using a clustering data mining technique based on scheme, which is illustrated in Table 25. Two clustering algorithms, hierarchical cluster analysis and K-means clustering were used in this dissertation to acquire more significant results with enhanced visualization (Syakur et al., 2018; Murthy et al., 2010). In the research, the "factoextra" of R Studio software library was used to extract and visualize the outcomes of multivariate data analyses.

Table 25. 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 BIC scores (model-based: Gaussian mixture model) methods → K-means cluster centroid analysis

Numerous methods have been proposed to enhance the performance of the K-means algorithm, which is one of the most well-known data mining techniques that divides the dataset into groups of patterns (Syakur et al., 2018; Mohamad and Dauda, 2013). The dendrograms of cluster analysis were generated using the hierarchical clustering approach and the Ward method, followed by K-means clustering. The K-means algorithm is one of the most well-known data mining techniques that divides the dataset into the groups of patterns. The traditional clustering techniques, such as hierarchical and K-means algorithms, are heuristic-based techniques that derive clusters directly from the data rather than assigning a probability measure to the cluster assignments (Boehmke and Greenwell, 2019). Among the numerous cluster analysis algorithms, the Ward method, as well known as the minimum variance method (Ward, 1963), and the K-means method, another prominent cluster analysis algorithm, were chosen. The outcomes of the chosen cluster numbers were compared with the results of model-based cluster method (Fraley et al., 2012), computed in R software, using Gaussian finite mixture model. The model-based algorithm seeks to organize "soft assignments", in which the observations can be allocated to every cluster (Boehmke and Greenwell, 2019; Fraley et al., 2012). In addition, the model-based method provides a solution with added value by calculating the optimal number of clusters. Nonetheless, the final results of cluster analysis were evaluated using K-means cluster analysis, one of the most widely used clustering techniques according to numerous research studies (Murthy et al., 2010). K-means clustering categorizes the research observations into predominantly exclusive clusters with the aim to generate clusters with the most similar observations feasible.

The clusters were contrasted based on their relevance to the research question. The clustering results vary based on the number of clusters, and the optimal number of clusters was identified and represented using the Elbow and model-based (using Bayesian information criterion, BIC) methods. Combining the K-means algorithm

with Elbow and model-based methods increases the K-means assignment's sufficiency (Syakur et al., 2018; Fraley et al., 2012). In addition, the centroids of K-means clusters were analysed in this dissertation. The cluster centroid represents the cluster's centre. It is a vector consisting of one number for each of the variables with each number representing the mean of the variable for the observations in that cluster.

The cluster analysis of the $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} sub-indices scores based on EU-27 countries in 2008

The first type of cluster analysis utilized in this dissertation was hierarchical clustering based on the Ward method, which revealed four clusters (Annex 13) of EU-27 countries based on the sub-indices of countries' four sustainability dimensions (economic, innovation, social and environmental) in relationship with the sharing economy in 2008. Some of the identified clusters could conceivably be divided into two separated clusters, but the further analysis of the optimal number of clusters based on the Elbow method (Annex 14) and model-based method using BIC scores (Figure 23) revealed that four clusters is the most appropriate number in this research. The model-based algorithm was used as well in this analysis for illustrating the clusters (Annex 15).

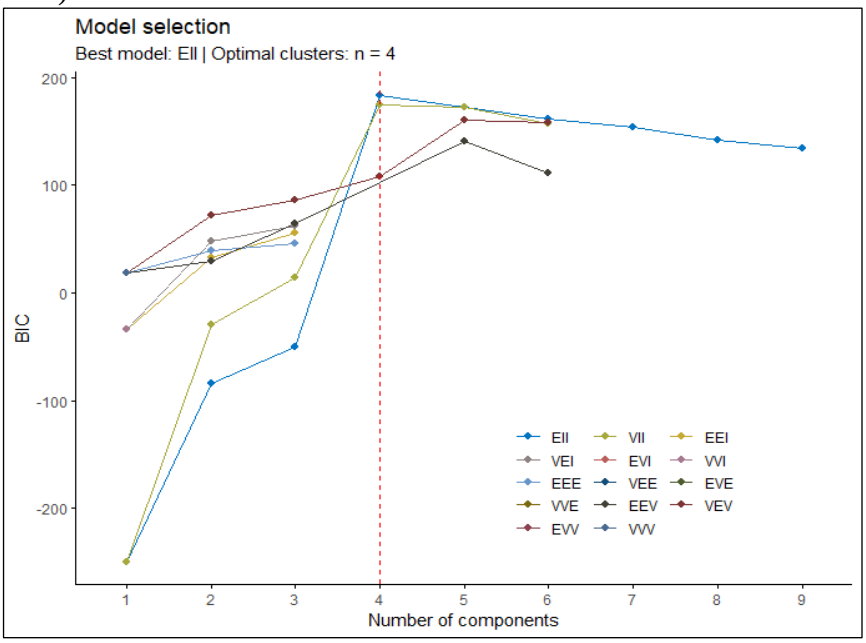


Figure 23. Number of clusters using BIC scores (model-based method) in 2008

However, the final results of cluster analysis of 2008 were examined using K-means cluster analysis (Figure 24), which is one of the most commonly employed clustering methods according to numerous research studies.

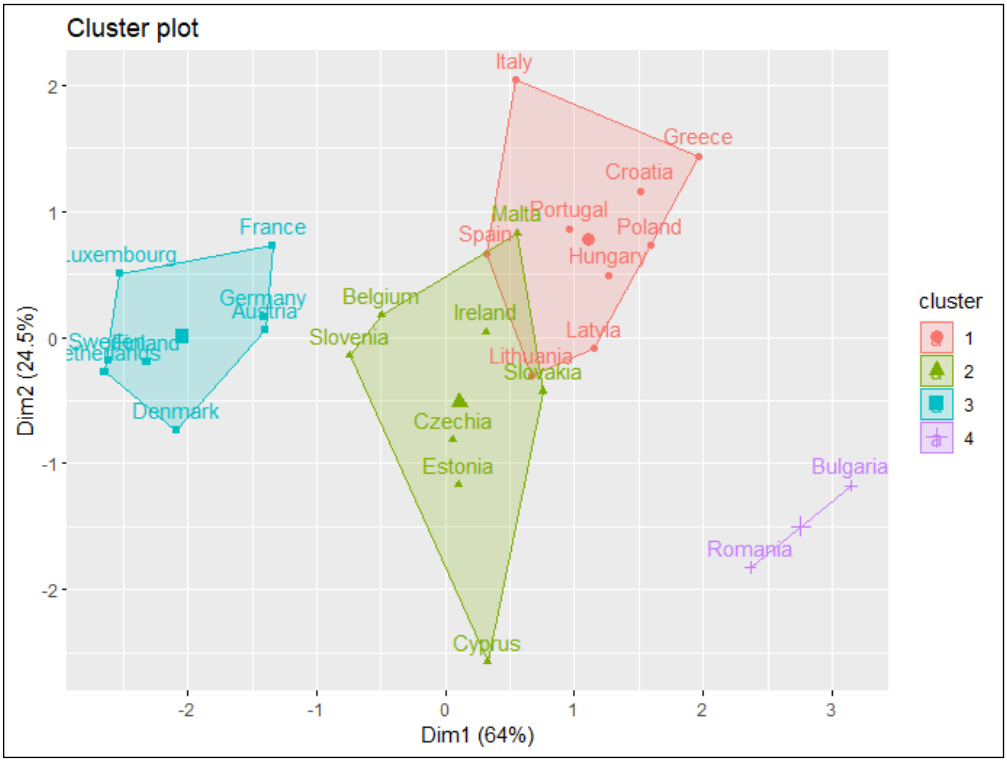


Figure 24. The cluster analysis of sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc}, I_{SusEnv}) in 2008 based on K-means algorithm

In 2008, the first cluster identifies (Figure 24) a group of 9 countries: Croatia, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal and Spain, with average centroids of K-means clusters – 0.3266.

The second cluster: Belgium, Cyprus, Czechia, Estonia, Ireland, Malta, Slovakia and Slovenia, has the average centroid of K-means clusters – 0.4318.

The third cluster: Austria, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, Sweden, could be called "the top developed countries" and has an average centroid of K-means clusters of 0.6099. Based on the "benchmarking" described in sub-section 3.2.2, there was no cluster identified with a high or upper level of sustainability according to $I_{CountSusShE}$, and one cluster (second) was with the low performance level and three other clusters with a satisfactory level in 2008.

The fourth cluster, consisting of Bulgaria and Romania, represents the countries with the lowest average centroids of K-means, i.e., 0.2075, as these countries have the lowest sub-indices of countries' four sustainability dimensions (economic, innovation, social and environmental) in relationship with the sharing economy. These two countries could be identified as the outliers in this dissertation, as their data differ significantly from those of other clusters. Romania and Bulgaria were the countries with the lowest scores of innovation and social sub-indices and among the countries having the lowest environmental indices.

The cluster analysis of the $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} and I_{SusEnv} sub-indices scores based on the EU-27 countries in 2020

The hierarchical clustering based on the Ward method displays four clusters (Annex 16) of EU-27 countries based on countries' four sustainability dimensions (economic, innovation, social and environmental) in relationship with the sharing economy. The optimal number of clusters based on the Elbow method (Annex 17) and model-based method using BIC scores (Figure 25) illustrated that four clusters is the most suitable number in this research. In the analysis of data corresponding to 2020, the model-based algorithm was used as well to check and illustrate the clusters (Annex 20). Afterwards, the results of K-means cluster analysis (Figure 26) were analysed and accepted as the final result.

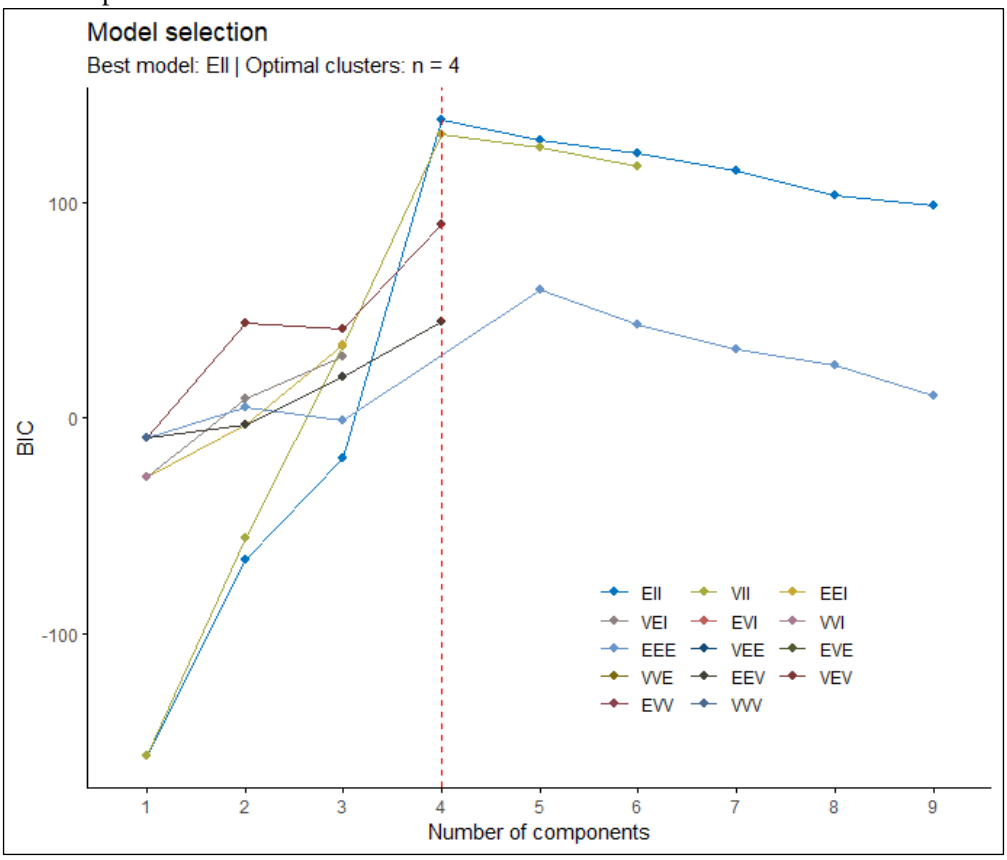


Figure 25. Number of clusters using BIC scores (model-based method) in 2020

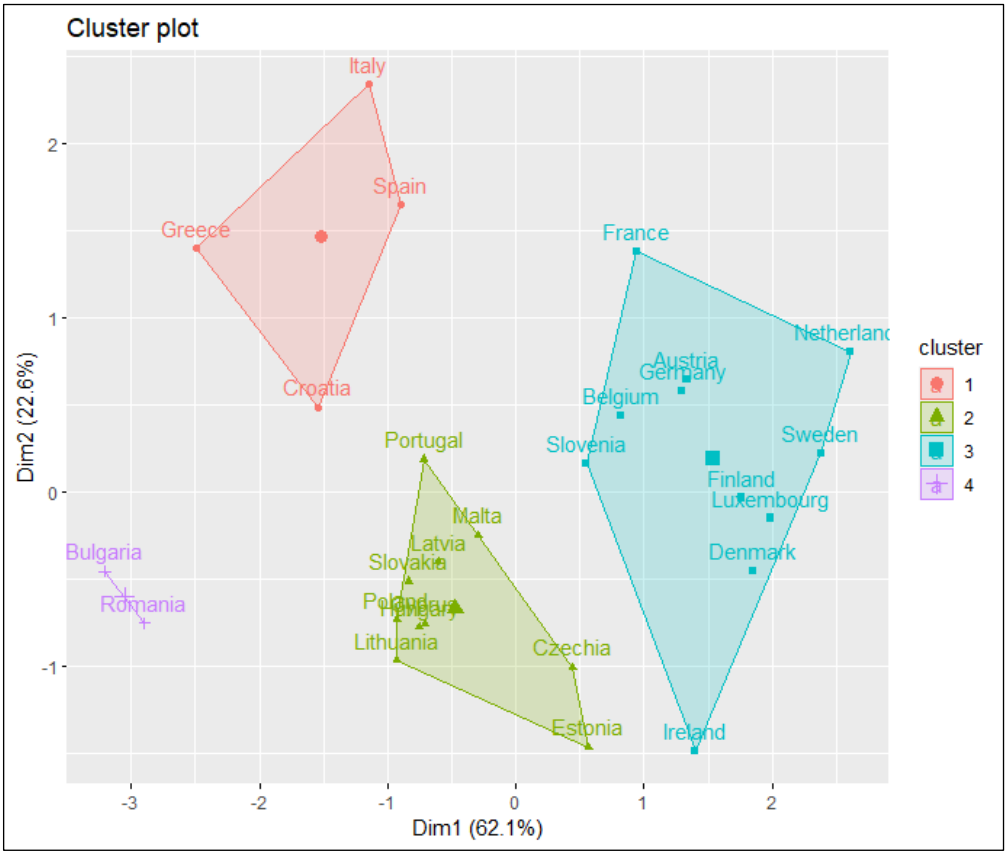


Figure 26. The cluster analysis of sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc}, I_{SusEnv}) in 2020 based on K-means algorithm

In 2020, the first cluster (Figure 26) is represented by the following countries: Croatia, Greece, Italy and Spain, as the group with average K-means cluster centroids of 0.3132.

The second cluster with the group of ten countries, i.e., Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Portugal and Slovakia, has the average centroid of K-means equal to 0.4221. The above-mentioned countries' economic sustainability in relationship with the sharing economy ($I_{SusEcon}$ average score – 0.4836) was higher than the average score (0.4397) of all EU-27 countries, and Estonia was the country with the highest $I_{SusEcon}$ score (0.7722) in 2020. However, the $I_{SusInnov}$ and I_{susEnv} of these nations were low (the average scores of $I_{SusInnov}$ were 0.1951 and I_{susEnv} 0.2868, respectively).

The third cluster represents the most developed countries, and it consists of Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Slovenia, Sweden. The average score of all the sub-indices in this cluster is 0.5937 in 2020. In the third cluster, the lowest scores of $I_{CountSusShE}$ had Slovenia (0.5028), and it was mainly because of the lower scores of the country's economic

sustainability in relationship with the sharing economy ($I_{susEcon}$ 0.3717) and environmental sustainability (I_{susEnv} 0.3859).

Bulgaria and Romania represent the fourth cluster, i.e., the countries with the lowest average K-means centroids of 0.1966. Romania had the lowest sub-indices of the country's innovation sustainability in relationship with the sharing economy ($I_{susInnov}$ – 0.0248 , while the highest $I_{susInnov}$ score was 0.8024 in Germany). Bulgaria had the lowest sub-indices of the country's social and environmental sustainability in relationship with the sharing economy (I_{susSoc} – 0.0739 and I_{susEnv} –0.0764, while the highest score of I_{SusSoc} was 0.7618 in Luxembourg, and the highest score of I_{SusEnv} was 0.7136 in the Netherlands). According to the "benchmarking" methodology, outlined in sub-section 3.2.2, there was no cluster to represent a "high" level of sustainability as per the $I_{CountSusShE}$ metric in 2008. One cluster, namely the third cluster, demonstrated an "upper" level of performance, while the first and second clusters exhibited a "satisfactory" level of sustainability, and the fourth cluster – "low" level of sustainability.

Table 26. The clusters based on K-means and K-means average centroids analysis in 2008 and 2020

Clusters in 2020				**Clusters in 2008**			
1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Croatia	Cyprus	Austria	Bulgaria	Croatia	**Belgium**	Austria	Bulgaria
Greece	Czechia	**Belgium**	Romania	Greece	Cyprus	Denmark	Romania
Italy	Estonia	Denmark		**Hungary**	Czechia	Finland	
Spain	**Hungary**	Finland		Italy	Estonia	France	
	Latvia	France		**Latvia**	**Ireland**	Germany	
	Lithuania	Germany		**Lithuania**	Malta	Luxembourg	
	Malta	**Ireland**		**Poland**	Slovakia	Netherlands	
	Poland	Luxembourg		**Portugal**	**Slovenia**	Sweden	
	Portugal	Netherlands		Spain			
	Slovakia	**Slovenia**					
		Sweden					
Number of countries in cluster							
4	10	11	2	9	8	8	2
Average centroids of the sub-indices							
0.3132	0.4221	0.5937	0.1966	0.3266	0.4318	0.6099	0.2075
The level of $I_{CountSusShE}$ index score based on the benchmarking							
Satisfac-tory	Satisfactory	Upper	Low	Satisfactory	Satisfac-tory	Upper	Low

The comparative cluster analysis of 2008 and 2020 data (Table 26) demonstrates the progress of some EU-27 countries sustainability in relationship with the sharing economy.

The countries, such as Hungary, Latvia, Lithuania, Poland and Portugal (highlighted in bold text in Table 26), demonstrate a higher level of the country's sustainability in its relationship with the sharing economy based on $I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc}, I_{SusEnv} analysis. Comparing 2008 with 2020, the above-mentioned countries moved from the first cluster (where the average score was 0.3266) in 2008 to the second cluster (with the average centroids score of 0.4221) in 2020. These countries demonstrate higher scores of the country's sustainability in its relationship with the

sharing economy (the average score of the above-mentioned countries is 0.4505 in 2020 and 0.3086 in 2008) comparing 2008 with 2020. Additionally, the previously mentioned nations moved to the second cluster where the level of the country's social sustainability in its relationship with the sharing economy was at the upper level (average score – 0.5101), but the level of the country's environmental sustainability in its relationship with the sharing economy was quite low (average score – 0.2868).

Comparing the results of 2008 with 2020, the results of the cluster analysis demonstrate that Greece, Croatia, Italy and Spain remain in the first cluster with an average centroids score of 0.3132 in 2020 and do not demonstrate meaningful progress of the country's sustainability, as the average centroids score was 0.326 in 2008.

The third cluster does not present the progress of the country's sustainability in its relationship with the sharing economy and stays mainly on the same level as the average centroids scores were 0.5937 in 2020 and 0.6099 in 2008. Although the level of $I_{CountSusShE}$ index score based on the benchmarking is at the upper level, i.e., more than satisfactory level, but still does not reach the target. However, in countries such as Belgium, Ireland and Slovenia (highlighted in bold in Table 26), the country's sustainability in its relationship with the sharing economy became more significant as these countries moved from the second cluster (average score of the 2nd cluster in 2008 – 0.4318) to the third cluster (average score of the 3rd cluster in 2020 – 0.5937). All the countries (except for Ireland and Luxembourg) in the third cluster in 2020 differed from the other cluster because of the biggest values of the gross domestic expenditure on R&D from total GDP (3.52% in Belgium, 3.51% in Sweden, 3.14% in Germany), human resources in science and technology from active population aged 25–64 in the country (2.12% in Denmark, 2.05% in Belgium, 2.01% in Finland). Additionally, the third cluster significantly presents the high level of the nation's social sustainability in its relationship with the sharing economy (average score in 2008 – 0.7257, in 2020 – 0.6500) and important level of the country's innovation sustainability (average score in 2008 – 0.7008 and in 2020 – 0.7003).

Romania and Bulgaria (the fourth clusters in 2008 and 2020) vary from the other clusters: Romania has the lowest scores of the $I_{SusInnov}$ sub-indices (0.0144 in 2008 and 0.0465 in 2020), Bulgaria has the lowest scores of the I_{SusSoc} sub-indices (0.0645 in 2008, 0.0739 in 2020) and the lowest scores of the I_{SusEnv} sub-indices (0.0665 in 2008, 0.0764 in 2020).

The cluster analysis illustrated that the sharing economy on the country's sustainability causes more significant level in more developed countries with meaningful annual growth rate of GDP per capita, the investment share of GDP, higher gross domestic expenditures on R&D, human resources in science and technology, R&D personnel, patent application amount in country, amount of enterprises with Internet, purchasing power of adjusted GDP per capita, resource productivity and material consumption and circular material usage rate. The lowest values of these indicators mainly impacted the division of countries in the cluster analysis.

3.4. The evaluation of the impact of the sharing economy on the country's sustainability by applying the correlation and OLS regression methods

In this dissertation, the sharing economy is analysed at the macroeconomic level as an economic phenomenon that affects the sustainability of the country. Thus, it is relevant to analyse the impact of the sharing economy on the country's sustainability applying the correlation and OLS regression methods. The correlation analysis was carried out to assess whether the sharing economy contributes significantly to the country's level of sustainability. Pearson correlation, which measures a linear dependence between two variables (x and y), i.e., the independent variable – the sharing economy's companies' density rate in the country (see sub-section 2.3 and Table 9) and the dependent variable – $I_{CountSusShE}$ index, demonstrates that the correlation coefficient value (R) is equal to 0.3271. The correlation coefficient indicates positive weak correlation, as the linear correlation coefficients based on the theory (Balaboniene et al., 2013) are interpreted according to the explanations listed in Table 27.

Table 27. The empirical evaluations of the linear correlation (Balaboniene et al., 2013)

The value of the correlation coefficient	Interpretation
From 0.9 to 1; (-1; -0.9)	Very strong positive (negative) linear correlation
From 0.7 to 0.9; (-0.9; -0.7)	Strong positive (negative) linear correlation
From 0.5 to 0.7; (-0.7; -0.5)	Average positive (negative) linear correlation
From 0.3 to 0.5; (-0.5; -0.3)	Weak positive (negative) linear correlation
From -0.3 to 0.3; (-0.3; 0.3)	Very weak positive (negative) linear correlation or there is no correlation between the variables

The results of Pearson correlation measuring dependences between the sharing economy's companies' density rate in the country and $I_{CountSusShE}$ indices in 2008–2020 are illustrated in Figure 27. The sharing economy's companies' density rate in the country and the index $I_{CountSusShE}$ are correlated with the correlation coefficient 0.3256 and p-value equal to 4.13511E-10. According to the Pearson correlation analysis, at the 95% confidence level, the confidence interval is from 0.2286827 to 0.4160696. This means that the confidence interval of [0.2286827 to 0.4160696] has a 95% probability of containing the actual population correlation coefficient between the sharing economy's companies' density rate and $I_{CountSusShE}$ index.

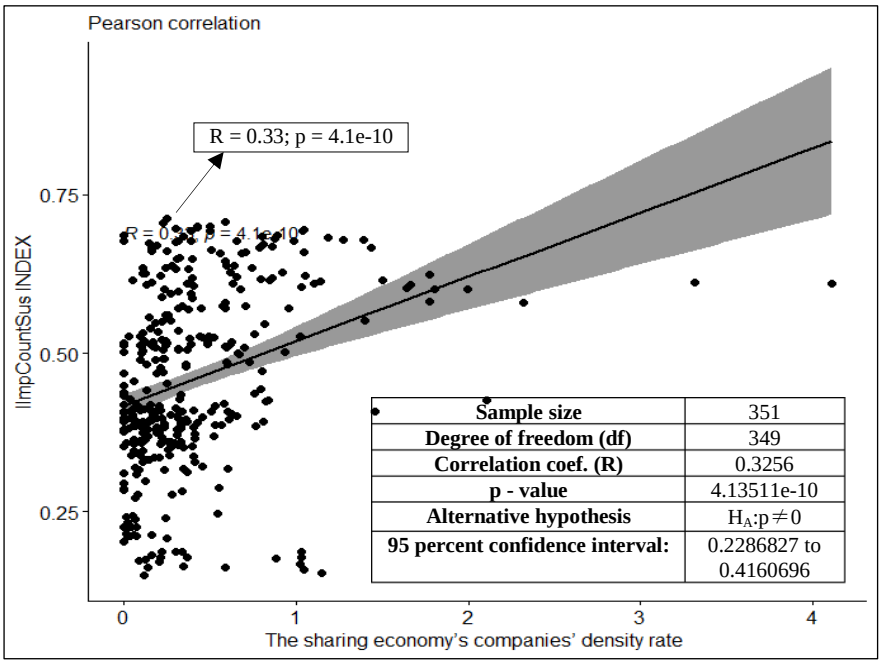


Figure 27. Results of the Pearson correlation measuring dependences between the sharing economy's companies' density rate and $I_{CountSusShE}$ indices in 2008–2020

The results of the OLS regression analysis are demonstrated in Table 28, and the determination coefficient (R-squared) is equal to 0.1060. This means that 10.6% of the variation in $I_{CountSusShE}$ indices (dependent variable) is explained by the sharing economy's companies' density rate (independent variable).

Table 28. The results of OLS regression analysis of the sharing economy's companies' density rate and $I_{CountSusShE}$ indices of EU-27 countries in 2008–2020

Regression Statistics					
Multiple R	0.3256				
R Square	**0.1060**				
Adjusted R Square	0.1034				
Standard Error	0.1367				
Observations	351				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.7736	0.7736	41.3783	4.13511E-10
Residual	349	6.5247	0.0187		
Total	350	7.2983			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	

Intercept	0.4169	0.0097	42.9278	2.6E-141
SE_density_rate	**0.1018**	0.0158	6.4326	4.14E-10

Further on, the ANOVA test (Table 28) demonstrates that the regression model is statistically significant as Significance F (4.13511E-10) is less than based on the econometric theory selected significance level α (α = 0.05). Additionally, the p-value of the t-test (Prob > |r| under H0: Rho = 0) is 4.13511E -10, which is less than the significance level α = 0.05. OLS regression analysis indicates that an increase of the sharing economy's companies' density by 1 would impact the country's sustainability in the increasement of $I_{CountSusShE}$ by 0.1018.

The results of the above-described Pearson correlation analysis (Figure 27) and OLS regression analysis (Table 28) allow to accept the first hypothesis (H1) of this dissertation, i.e., there is a positive direct relationship between the sharing economy and the country's sustainability. This confirms that the sharing economy is one of the significant conditions taking the country towards the sustainability. Current research contributes and supplements the statements of scholars (Yin et al., 2021; Boar et al., 2020; Curtis and Mont, 2020; Curtis and Lehner, 2019; Ritter and Schanz, 2019; Li et al., 2019; Mi and Coffman, 2019) that the sharing economy assists in achieving sustainable development goals and has a beneficial impact on the sustainability of the nations.

In order to test the second hypothesis (H2) of this dissertation, the correlation of all the four sub-indices and the sharing economy's companies' density are tested based on the Pearson linear correlation method. The results of the correlation are illustrated in Annexes 19–22 and Table 29.

Table 29. The coefficients of the linear correlation and P-values of all the four sub-indices and the sharing economy's companies' density

The tested correlations based on the Pearson linear correlation between:	**The value of the correlation coefficient and P-value**
The $I_{SusInnov}$ and the sharing economy's companies' density rate	**0.3650**
Prob > |r| under H0: Rho = 0	1.7E-12
The I_{SusEnv} and the sharing economy's companies' density rate	0.3015
Prob > |r| under H0: Rho = 0	8.3E-09
The I_{SusSoc} and the sharing economy's companies' density rate	0.2417
Prob > |r| under H0: Rho = 0	4.7E-06
The $I_{SusEcon}$ and the sharing economy's companies' density rate	0.1119
Prob > |r| under H0: Rho = 0	0.036

According to the estimation results in Table 29, the second hypothesis (H2) of this dissertation could be accepted as the relationship between the $I_{SusInnov}$, and the sharing economy's companies' density rate is the highest (R = 0.3650; P-value = 1.7E-12) comparing with the relationships between the sharing economy's companies' density rate and other three sub-indices (I_{SusEnv}, I_{SusSoc}, $I_{SusEcon}$). Summarizing, there is a weak positive linear correlation between the $I_{SusInnov}$ and the sharing economy's companies' density rate. The lowest positive correlation (R = 0.1119, P-value = 0.036) is between the $I_{SusEcon}$ and the sharing economy's companies' density rate. This result goes in line with Rojanakit et al. (2022), Maier et al. (2020), Curtis and Lehner (2019), as they demonstrate the theoretical significance of the innovation sustainability pillar encouraging the country's sustainability.

Based on the theoretical analysis (Marvin et al., 2021; Aldieri et al., 2021; Henry et al., 2021; Yin et al., 2012) of the sharing economy, it is meaningful to highlight, that the sharing economy was examined several times as a phenomenon having potential theoretical connections with the circular economy. Thus, it is valuable to examine the links of the sharing economy and circular economy based on the empirical research. The third hypothesis (H3) studies the relationship between the circular material usage rate (one of the key indicators of the circular economy) and the sharing economy variable, i.e., the sharing economy's companies' density rate in the countries. In order to investigate the above-mentioned relationship, Pearson correlation analysis was used (Figure 28).

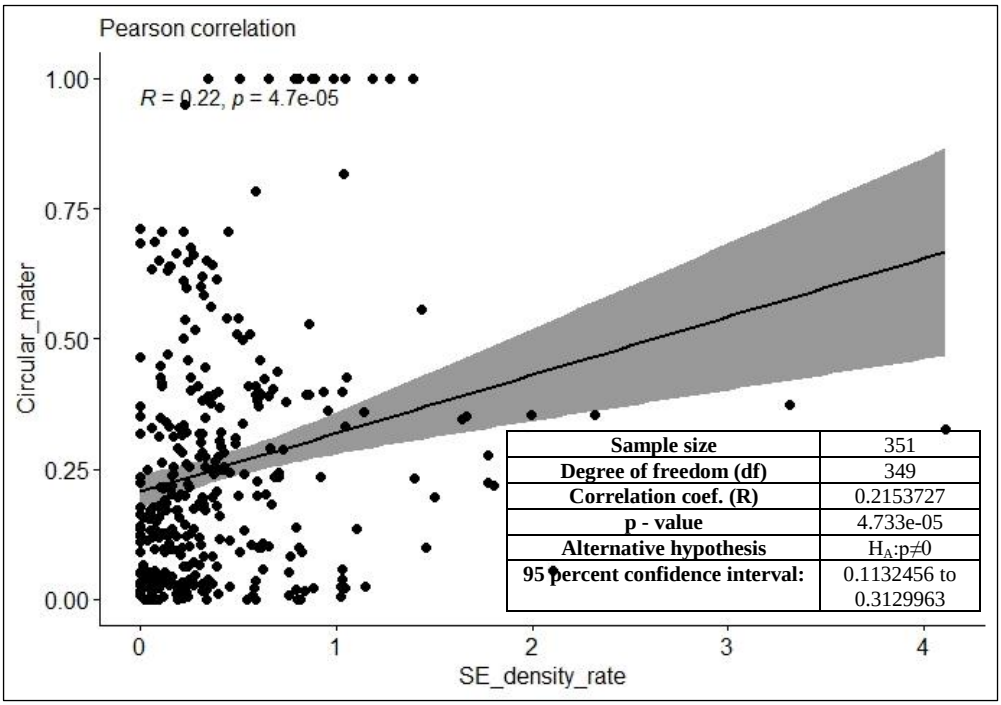


Figure 28. Results of Pearson correlation measuring dependences between the sharing economy's companies' density rate and circular economy usage rates in EU-27 countries in 2008–2020

The investigation, illustrated in the above-mentioned Figure 28, allows to admit the third hypothesis (H3) of this dissertation, i.e., there is a positive weak linear correlation (R = 0.22; P-value = 4.73E-05) between the sharing economy's companies' density rate and the circular material usage rate, which links to the circular economy. Additionally, the current research complements the previous theoretical researches (Marvin et al., 2021; Aldieri et al., 2021; Henry et al., 2021; Yin et al., 2012). The aforementioned findings have the potential to contribute to the advancement of the existing knowledge base. Furthermore, they can facilitate productive discussions between the scholars in the fields of circular economy and sharing economy with the aim of enhancing future policies and business practices.

4. CONCLUSIONS

After the theoretical analysis of the sharing economy, the country's sustainability and the theoretical relationships between them and the empirical research of the evaluation of the impact of the sharing economy on the country's sustainability, the following conclusions are formulated:

1. The comprehensive **definition of the sharing economy was clarified** based on the performed theoretical analysis of the previous research studies that concern the sharing economy. The sharing economy is an economic model that operates on these essential bases: (1) *access-based economy*, (2) *IT platform-based economy* and (3) *community-based economy*, where underutilized assets **are shared among individuals and/or companies** for a fee or for free. Furthermore, the primary actors of the sharing economy are the individuals who provide the shared goods or services and the users who consume these goods and services. These main actors engage with digital platforms or information technology (IT) in order to enable their participation in the sharing economy.

2. Close, effective and regular interconnection among four key pillars of sustainability (economic, innovation, environmental and social) generates the country's sustainability. Additionally, **this research specifies the country's sustainability (in relationship with the sharing economy), as a result of four P (4Ps)**: economic sustainability for ***p****rosperity*; innovation sustainability for ***p****rogress*; environmental sustainability for the ***p****lanet* and social sustainability for ***p****eople*.

3. The sharing economy is widely spread to various sectors of the nations' economies, impacting the country's sustainability. The theoretical analysis demonstrates that the sharing economy facilitates a more sustainable pattern of consumption, curtails the production of disposable goods, offers a means of repurposing idle assets (such as a cottage or vehicle) and provides value to the items that might otherwise be deemed worthless. It is noteworthy to highlight these conclusions:

3.1 According to this research study, the concept of country's sustainability, encompassing its primary pillars of economic, innovation, social and environmental dimensions, can be advanced through the sharing economy. This is achieved by promoting the more efficient utilization of materials and resources, fostering innovation progress, establishing networks of individuals and enhancing social and economic welfare. These examinations confirm the theoretical **relationships between the sharing economy and the country's sustainability**; additionally, these relationships have close linkages and importance for the development and prosperity of each other.

3.2 When analysing the sharing economy in the context of the country's sustainability, there should be explored four main dimensions of the country's sustainability (economic, innovation, social, environmental). The sharing economy is a subject to the substantial influence from the

technological advancements and is facilitated by the information technology platforms. Additionally, the country's sustainability is generated through the tight and efficient long-term interconnection and interaction between the four key pillars of sustainability (economic, innovation, social, environmental). **This research complements** the previous research studies, estimating only three pillars of sustainability (economic, social, environmental) **and demonstrates the significance of innovation sustainability pillar enhancing the country's sustainability**.

4. The theoretical analysis of the concepts of the sharing economy and country's sustainability and the relationship within these two phenomena enabled to develop the methodology for evaluating the impact of the sharing economy on the country's sustainability. It was prepared and illustrated using these essential stages:

4.1 **The composite index ($I_{CountSusShE}$)** facilitates the comprehensive assessment of the country's sustainability in its relationship with the sharing economy, allowing for the analysis of the key dimensions of the country's sustainability based on the selected variables and variable groups;

4.2 The identified **variables of the sharing economy enable to assess this phenomenon in the macroeconomic approach** within different countries and time periods;

4.3 The correlation between the index for the evaluation of the country's sustainability in its relationship with the sharing economy ($I_{CountSusShE}$) and the sharing economy's companies' density rate in the country **enables to estimate the impact of the sharing economy on the country's sustainability.**

5. The research employs **the composite index construction** theoretical technique and:

5.1 The construction of the $I_{CountSusShE}$ index consists of the key steps: definition of the research phenomenon, research data collection, identification of the groups based on four main country's sustainability dimensions, judgement of the impact of the index indicators using the rule of thumb, normalization values of the data, weighting of the indicators, composition of the sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusEnv}, I_{SusSoc}) and index ($I_{CountSusShE}$), the sensitivity analysis of the index ($I_{CountSusShE}$);

5.2 In the constructing of the $I_{CountSusShE}$ index, there were employed 19 variables based on the main pillars of the country's sustainability: economic sustainability (annual growth rate of the real gross domestic product per capita, the investment share of GDP, the employment rate, economic freedom index, new business density), innovation sustainability (gross domestic expenditure on R&D, human resources in science and technology, R&D personnel, patent application to EPO, enterprises with Internet access, households with connection to Internet),

social sustainability (purchasing power, income distribution, people at risk and poverty or social exclusion, young people neither in employment nor in education and training), environmental sustainability (CO_2 emission per GDP, resource productivity and domestic material consumption, circular material usage rate, share of the renewable energy in gross final energy consumption by sector);

5.3 **The index $I_{CountSusShE}$ can be adopted for the further research in any country in any research period**. Additionally, the sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusEnv}, I_{SusSoc}) were constructed in the approaches of the country's economic, innovation, social and environmental sustainability dimensions. The indices can be practically employed by the researchers, politicians, practitioners or entrepreneurs as a tool for evaluating the country's sustainability in its relationship with the sharing economy.

6. **After the empirical research**, based on the data of EU-27 countries in the period from 2008 to 2020, employing the proposed conceptual model for evaluating the impact of the sharing economy on the country's sustainability, it has been found that:

6.1 The highest **average values of the $I_{CountSusShE}$** indices were in these countries: Sweden (0.6825), the Netherlands (0.6791), Luxembourg (0.6636), Denmark (0.6357), Finland (0.6314) and Germany (0.6051). Based on the "benchmarking" methodology of indices, none of them were ranked as having "high sustainability" level of the country's sustainability in its relationship with the sharing economy. Thus, eleven countries (Sweden, the Netherlands, Luxembourg, Denmark, Finland, Germany, Austria, France, Belgium, Ireland and Slovenia), based on the "benchmarking" methodology, have "upper" (from 0.5001 to 0.7500) level of countries sustainability in its relationship with the sharing economy. Furthermore, the $I_{CountSusShE}$ indices results of another group of eleven countries (Czechia, Estonia, Malta, Cyprus, Slovakia, Lithuania, Spain, Latvia, Portugal, Hungary, Italy, Poland, Croatia) demonstrate "satisfactory" level of countries sustainability (values from 0.2501 to 0.5000). Romania (0.2283), Greece (0.1971), Bulgaria (0.1795) are the countries with "low" sustainability level in their relationship with the sharing economy (values from 0.0000 to 0.2500). This highlights the greater preference towards fostering sustainability within more developed countries.

6.2 The diversity of the sub-indices ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusEnv}, I_{SusSoc}) in the case of EU-27 countries was demonstrated through the utilization of hierarchical, Ward's, K-means **clustering** in multivariate statistical analysis. The cluster analysis was conducted by utilizing data for both 2008 and 2020 to identify disparities between clusters of EU-27 countries across 2008 and 2020 years.

The findings of the cluster analysis confirm that the $I_{CountSusShE}$ indices for the evaluation of the country's sustainability in its relationship with the sharing economy are higher in more advanced nations (for instance, in

Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Slovenia and Sweden). These countries have a strong focus on promoting innovation (e.g., number of patents filed, R&D expenditure as a share of GDP) and addressing social welfare and environmental issues (e.g., reducing CO_2 emissions as a share of GDP, increasing resource productivity and domestic material consumption). This highlights the importance of all four dimensions of the country's sustainability (economic, innovation, social and environmental). Additionally, it supports the theoretical country's sustainability conception, determined in this research, stating that the country's sustainability generates economic sustainability for profit, environmental sustainability for prosperity, innovation sustainability leading to progress and social sustainability, for people's well-being.

6.3 The results of Pearson correlation indicate that the sharing economy's companies' density rate in the country and the index $I_{CountSusShE}$ are positively correlated with the correlation coefficient 0.3256 and p-value equal to 4.13511E-10.

6.4 The results of the regression analysis revealed that it is possible to predict the changes in the country's sustainability ($I_{CountSusShE}$) index using the macroeconomic data of the sharing economy (for instance, the sharing economy's companies' density rate). An increase of the sharing economy's companies' density rate by 1 would increase the country's sustainability in its relationship with the sharing economy ($I_{CountSusShE}$) by 0.1018. Hence, the sharing economy indicators can be practically used as a supporting tool for predicting the sustainability of specific countries.

6.5 The results of the correlation analysis highlight that the most significant relationship is between the country's innovation sustainability ($I_{SusInnov}$) and the sharing economy's companies' density rate, comparing the correlation with the other country's sustainability dimensions ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusEnv}, I_{SusSoc}). This is a valuable finding of the research, as it supports several previous theoretical research results and emphasizes the importance of the country's innovation sustainability dimension and not only economic, social and environmental. Additionally, this confirms that the sharing economy is built on three essential pillars, one of which is IT platform-based economy (the other two are access-based economy and community-based economy).

6.6 The methodology, developed in this research and the assessment of the impact of the sharing economy on the country's sustainability can be used in further empirical studies, which could lead to the development of country sustainability, sharing economy development guidelines or other policy implications.

5. SANTRAUKA

Temos aktualumas

Pastarąjį dešimtmetį dalijimosi ekonomikos kaip verslo modelio plėtra ir šio ekonomikos fenomeno aktualumas tarp mokslininkų (Daglis, 2022; Yin ir kt., 2021; Hossain, 2020; Schor, 2020; Zhang ir kt. 2019; Godelnik, 2017; Sundararajan, 2016), verslo atstovų bei praktikų (PwC, 2018; Wallenstein ir Shelat, 2017; Thomas ir kt., 2017; PwC, 2014; PwC, 2013) politikos formuotojų (Europos Komisija, 2021; Europos Komisija, 2019; Codagnone ir Martens, 2016; Europos Komisija, 2012), piliečių ar kitų suinteresuotųjų šalių rodo šio reiškinio pasaulinę socialinę ir ekonominę svarbą. Dalijimosi ekonomika, kuri apima turto ar paslaugų dalijimąsi tarp asmenų ar įmonių, labai išpopuliarėjo kaip verslo modelis.

Moksliniai tyrimai rodo, kad dalijimosi ekonomika suteikia galimybes naujų verslų plėtrai veikiančių informacinių technologijų ir internetinių bendradarbiavimo platformų pagrindu (Hossain, 2020; Geissigner ir kt., 2019; Zhang ir kt., 2018; Frenken 2017; Belk, 2014). Dalijimosi ekonomika leidžia efektyviau ir tvariau naudoti nepakankamai išnaudojamus išteklius bei riboti perteklinį vartojimą (Laukkanen ir Tura, 2020; Seegebarth, 2016). Be to, ekonominiai tyrimai ir statistiniai duomenys rodo, kad dalijimosi ekonomika sukuria reikšmingą ekonominę vertę įvairioms veiklos sritims, o ypač didelį poveikį daro apgyvendinimo ir transporto sektoriams (PwC, 2018; Godelnik, 2017). Dalijimosi ekonomika tampa vis aktualesniu verslo modeliu ne tik dėl savo ekonominės naudos, bet ir dėl potencialo puoselėti socialinius ryšius ir skatinti aplinką tausojantį elgesį. Analizuojant teorinius ir empirinius mokslinius tyrimus vis labiau akcentuojama dalijimosi ekonomikos svarba šalies tvarumui (Curtis ir Mont, 2020; Laukkanen ir Tura, 2020; Mi ir Coffman, 2019; Leung ir kt., 2019; Retamal, 2019; Curtis ir Lehner, 2019; Geissigner ir kt., 2019; Ritter ir Schanz, 2019; Plewnia ir Guenther, 2018; Martin, 2016) ir teigiama, kad dalijimosi ekonomika sukuria pranašumą ekonominiu, socialiniu, aplinkosaugos ir inovacijų tvarumo aspektu. Yin ir kt. (2021) savo moksliniuose darbuose akcentuoja, kad dalijimosi ekonomika siūlo tvarų požiūrį, integruodama aplinkos, socialinius ir ekonominius aspektus, ir prisideda sprendžiant išteklių vartojimo problemą, suteikdama laikiną nuosavybės teisę naudotis prekėmis ar paslaugomis, užuot prekes įsigijus. Tačiau kiekybiškai įvertinti dalijimosi ekonomikos poveikį makroekonominiu lygiu ir ypač dalijimosi ekonomikos įtaką šalies tvarumui yra sudėtinga.

Mokslinėje literatūroje (Kauffman irNaldi, 2020; Kathan ir kt., 2016; Demailly ir Novel, 2014) akcentuojama dalijimosi ekonomikos, kaip ekonomikos reiškinio, skatinančio tvarios vertės kūrimą, svarba. Taip pabrėžiama dalijimosi ekonomikos daromas poveikis įvairių išteklių vartojimo mažinimui, todėl ji turi potencialo teigiamai prisidėti prie šalies tvarumo vystymo.

Remiantis Laukkanen ir Tura (2020), Curtis ir Mont (2020) literatūros analizės rezultatais, galima teigti, kad dalijimosi ekonomika yra reikšminga šalies tvarumui ir kuria jį ekonominiu, inovacijų, socialiniu ir aplinkos aspektais. Yin ir kt. (2021) papildo aukščiau minėtus mokslininkų teiginius akcentuodama, kad dalijimosi ekonomika yra svarbus reiškinys ne tik dėl kuriamos ekonominės pridėtinės vertės,

bet ir dėl potencialo skatinti inovacijų plėtrą, visuomenės socialinius ryšius bei šalies tvarumo praktiką aplinkosaugos aspektu. Taigi, dalijimosi ekonomika pristato tvarų požiūrį, konsoliduodama aplinkosaugos, socialinę, inovacijų ir ekonominę dimensijas. Šis ekonomikos modelis prisideda prie išteklių vartojimo problemos sprendimo, nes suteikia laikinas prieigas prie produkto ar paslaugos. Apibendrinant galima teigti, kad dalijimosi ekonomikos poveikis šalies tvarumui yra svarbus klausimas, todėl yra aktualu įvertinti dalijimosi ekonomikos daromą poveikį šalies tvarumui makroekonominiu požiūriu ir jos indėlį į šalies tvarumą.

Mokslinė problema ir jos ištyrimo lygis

Nepaisant to, kad dalijimosi ekonomikai mokslininkai pastaruoju laiku skyrė nemažai dėmesio, išsamių tyrimų, analizuojančių dalijimosi ekonomikos ir šalies tvarumo ryšius ir ypač dalijimosi ekonomikos poveikio šalies tvarumui makroekonominiu lygmeniu vis dar pasigendama.

Dažniausiai pasitaikantys moksliniai tyrimai analizuoja dalijimosi ekonomikos poveikį aplinkai akcentuojant konkrečius ekonomikos sektorius (pvz., apgyvendinimo paslaugų (Enochsson ir kt., 2021; pavėžėjimo paslaugų atvejus (Lanamaki ir Tuvikene, 2021); dalijimąsi automobiliais (Ramos ir kt., 2020; Münzel ir kt., 2019); dalijimąsi dviračiais (Yijie ir Dan Shen, 2019); dalijimąsi įranga ar įrankiais statybų pramonėje (Li ir kt., 2019)), taip pat analizuojami konkrečių valstybių ar geografinių regionų atvejai (Dabbous ir Tarhini, 2021 EBPO šalyse; Retamal, 2019 Pietryčių Azijos miestuose). Verta paminėti, kad dalijimosi ekonomika apima platesnį prekių ar paslaugų spektrą, o ne tik dalijimąsi transporto ar apgyvenimo paslaugomis. Dalijimosi ekonomikoje gali būti dalijamasi darbo ar kita erdve, darbo ar finansiniais ištekliais, įvairiais įrankiais, vartojimo prekėmis ir paslaugomis.

Analizuojant dalijimosi ekonomikos ir šalies tvarumo sąsajas kyla klausimas, kaip tinkamai įvertinti dalijimosi ekonomikos poveikį šalies tvarumui. Be to, dauguma su dalijimosi ekonomika susijusių mokslinių tyrimų yra orientuoti į mikroekonominį lygmenį, o empiriniai tyrimai daugiausia grindžiami dalijimosi ekonomikos vartotojų apklausų duomenimis arba konkrečių įmonių pavyzdžiais (Chi ir kt., 2020; Zhang ir kt., 2019; Bocker ir Meelen, 2016 ir kt.). Minėtų tyrimų nepakanka, norint kompleksiškai išanalizuoti dalijimosi ekonomikos plėtrą makroekonominiu aspektu ir įvertinti jos poveikį šalies tvarumui.

Be to, mokslininkai (Hossain, 2020; Kauffman ir Naldi, 2020) akcentuoja ne tik mokslinių tyrimų, bet ir praktinių priemonių, metodikų ar gairių, leidžiančių įvertinti dalijimosi ekonomikos poveikį šalies tvarumui, poreikį. Šiuo tyrimu siekiama užpildyti minėtą spragą ir tikima, kad šis tyrimas bus naudingas politikos formuotojams, antrepreneriams ir mokslininkams, kurie vykdys ateities tyrimus dalijimosi ekonomikos tematika.

Yin ir kt. (2021) nagrinėjo dalijimosi ekonomiką ir jos poveikį šalies aplinkos tvarumo aspektu. Tačiau minėtas tyrimas nevertino kitų šalies tvarumo aspektų (ekonominio, socialinio ir inovacijų), o atlikto tyrimo imties laikotarpis apsiribojo tik 2018 metais. Verta paminėti, kad Yin ir kt. (2021) tyrimas buvo sudarytas remiantis

2018 m. paskelbtu Timbro dalijimosi ekonomikos indeksu (TSEI) (Bergh ir kt., 2018). TSEI sukūrė Stokholmo mokslininkai, kurie siekė sukurti pasaulinį dalijimosi ekonomikos indeksą. Indekso tikslas buvo kiekybiškai įvertinti dalijimosi ekonomikos veiklos mastą pasauliniu mastu ir palengvinti dalijimosi ekonomikos palyginimus tarp šalių. TSEI sudarytas remiantis 2018 m. 165 šalių duomenimis, tad yra ribotas dėl tyrimo laiko. Tą taip pat pabrėžia ir Yin ir kt. (2021). Papildomai Leung ir kt. (2019) akcentuoja, kad, vertinant dalijimosi ekonomiką šalies tvarumo kontekste, reikėtų laikytis labiau holistinio požiūrio, neapsiriboti vien tik kai kuriais ekonomikos sektoriais, kaip, tarkime, apgyvendinimo ar transporto. Geissigner ir kt. (2019) pritaria teiginiui, kad dalijimosi ekonomika prisideda prie šalies tvarumo plėtros, todėl reikia išsamesnių tyrimų atsižvelgiant į minėtą aspektą.

Apibendrinant minėtus teiginius ir klausimus, iškeliamus moksliniame diskurse apie dalijimosi ekonomikos sąsajas su šalies tvarumu, galima teigti, kad yra pagrįstas poreikis sukurti dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologiją bei įvertinti ir palyginti skirtingų šalių dalijimosi ekonomikos įtaką šalių tvarumui.

Mokslinė darbo problema – kaip įvertinti dalijimosi ekonomikos poveikį šalies tvarumui.

Mokslinio tyrimo objektas – dalijimosi ekonomikos poveikis šalies tvarumui.

Mokslinio tyrimo tikslas – sukurti dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologiją ir ją empiriškai patikrinti Europos Sąjungos šalių atveju.

Mokslinio tyrimo uždaviniai:

1. identifikuoti visapusišką, teorinių tyrimų pagrindu pagrįstą dalijimosi ekonomikos sąvoką, išskirti dalijimosi ekonomikos varomąsias jėgas ir pagrindinius dalijimosi ekonomikos verslo modelius;
2. patikslinti visapusišką šalies tvarumo sampratą pagal šalies tvarumo dimensijas ir jų vertinimo aspektus;
3. išnagrinėti ir iliustruoti dalijimosi ekonomikos ryšį su šalies tvarumu;
4. parengti dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologiją;
5. nustatyti pagrindinius šalies tvarumo dalijimosi ekonomikos kontekste sudėtinio indekso ($I_{\text{CountSusShE}}$) sudarymo etapus;
6. empiriškai patikrinti dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologiją Europos Sąjungos šalių atveju.

Mokslinio tyrimo metodai ir naudota programinė įranga

- Mokslinėje literatūroje paskelbtų koncepcijų, tyrimų ir išvadų dalijimosi ekonomikos, šalies tvarumo ir jų sąsajų tematikomis sisteminimas, lyginimas, klasifikavimas ir loginė analizė. Remiantis teorinių mokslinių

tyrimų analize buvo apibendrintas ryšys tarp dalijimosi ekonomikos ir šalies tvarumo.

- Siekiant sudaryti indeksą $I_{\text{CountSusShE}}$, taikytas sudėtinio indekso konstravimo metodas.
- Siekiant palyginti tyrimo duomenis, taikyta daugiamatė statistinė analizė; klasterinė analizė atlikta taikant hierarchinį, Ward metodą, K-vidurkių analizę ir modeliu pagrįstą klasterizaciją. Visi klasterinės analizės skaičiavimai atlikti naudojant programinę įrangą R 4.0.3.
- Dalijimosi ekonomikos ir šalies tvarumo sąsajoms tirti taikyti koreliacijos ir OLS regresijos metodai. Skaičiavimai atlikti naudojant programinę įrangą R 4.0.3. ir Microsoft Excel.

Mokslinio tyrimo naujumas ir pritaikomumas

- Įvertinus pagrindines dalijimosi ekonomikos charakteristikas ir tai, kad dalijimosi ekonomikoje dalyvauja tiek pavieniai asmenys, tiek įmonės, buvo patikslinta dalijimosi ekonomikos sąvoka. Taip pat buvo aprašytas ir iliustruotas dalijimosi ekonomikos evoliucijos procesas, kuris papildo ankstesnius teorinius aprašus apie dalijimosi ekonomiką. Be to, buvo sukurta išplėstinė dalijimosi ekonomikos matrica, įvertinant dalijimosi ekonomikoje dalyvaujančias šalis ir dalijimosi ekonomikos daiktų ar paslaugų apčiuopiamumą, ir pagal skirtingus dalijimosi ekonomikos verslo modelių tipus. Minėta matrica koncentruotai iliustruoja dažniausius dalijimosi ekonomikos verslo modelius.
- Disertacijoje aprašyti ir iliustruotai pateikti dalijimosi ekonomikos ir šalies tvarumo ryšiai makroekonominiu aspektu. Moksliniame darbe pasiūlyta minėtų ryšių koncepcija galėtų būti naudojama kaip pagalbinė priemonė rengiant šalių tvarumo gaires šalių politikos formuotojams, taip pat tai galėtų būti pagrindas būsimiems moksliniams tyrimams analizuojant dalijimosi ekonomiką makroekonominiu aspektu.
- Tyrimo metu sukurtas konceptualusis dalijimosi ekonomikos poveikio šalies tvarumui vertinimo modelis papildo ankstesnius mokslinius darbus, pateikdamas holistinį požiūrį į dalijimosi ekonomiką ir šalies tvarumą, nes apima keturis pagrindinius tvarumo aspektus: ekonominį, inovacijų, socialinį ir aplinkosaugos. Moksliniame darbe įtraukiama inovacijų dimensija kaip atskiras aspektas, reikšmingai prisidedantis prie šalies tvarumo stiprinimo. Šis mokslinis darbas patvirtina teigiamą dalijimosi ekonomikos ir šalies tvarumo ryšį inovacijų atžvilgiu, o daugelyje ankstesnių mokslinių tyrimų didžiausias dėmesys buvo skiriamas aplinkosauginiam dalijimosi ekonomikos požiūriui arba daugiausia orientuojamasi į konkretų dalijimosi ekonomikos sektorių, pavyzdžiui, transporto ar apgyvendinimo. Sudarytas konceptualusis modelis patvirtina, kad dalijimosi ekonomikos plėtra daro teigiamą poveikį šalies tvarumui, skatina žaliosios ekonomikos plėtrą ir tvarios bei atsakingos visuomenės vystymąsi.

- Indeksas $I_{CountSusShE}$ gali būti naudojamas kaip išsamus, įvairioms šalims ar regionams pritaikomas bei lengvai tarp skirtingų šalių palyginamas šalių tvarumo lygio analizavimo būdas. Taigi šalies politikos formuotojai, tyrėjai ir mokslininkai galėtų naudoti šį indeksą kaip vieną iš įrankių šalies tvarumo lygiui dalijimosi ekonomikos aspektu tirti.
- Parengta dalijimosi ekonomikos poveikio šalies tvarumui metodologija ir sukonstruotas sudėtinis indeksas leidžia įvertinti dalijimosi ekonomikos poveikį šalies tvarumui. Be to, tai leidžia įvertinti atskirus indekso kintamuosius, darančius teigiamą arba neigiamą poveikį šalies tvarumui. Šią metodologiją mokslininkai galėtų taikyti ir naudoti tolesniuose moksliniuose tyrimuose. Be to, šią metodologiją praktiškai galėtų pritaikyti ir naudoti įvairios agentūros, vyriausybinės organizacijos ar kitos institucijos kaip pagalbinę priemonę, leidžiančią stebėti ir vertinti šalies tvarumo pažangą, grindžiamą ryšiais su dalijimosi ekonomika. Taip pat svarbu paminėti, kad sukurtą metodologiją galima naudoti empiriniuose tyrimuose tiek su šiame tyrime naudotais šalių dalijimosi ekonomikos rodikliais, tiek lengvai pritaikyti įvertinant kitus dalijimosi ekonomikos makroekonominius duomenis šalių ar regionų lygmeniu.

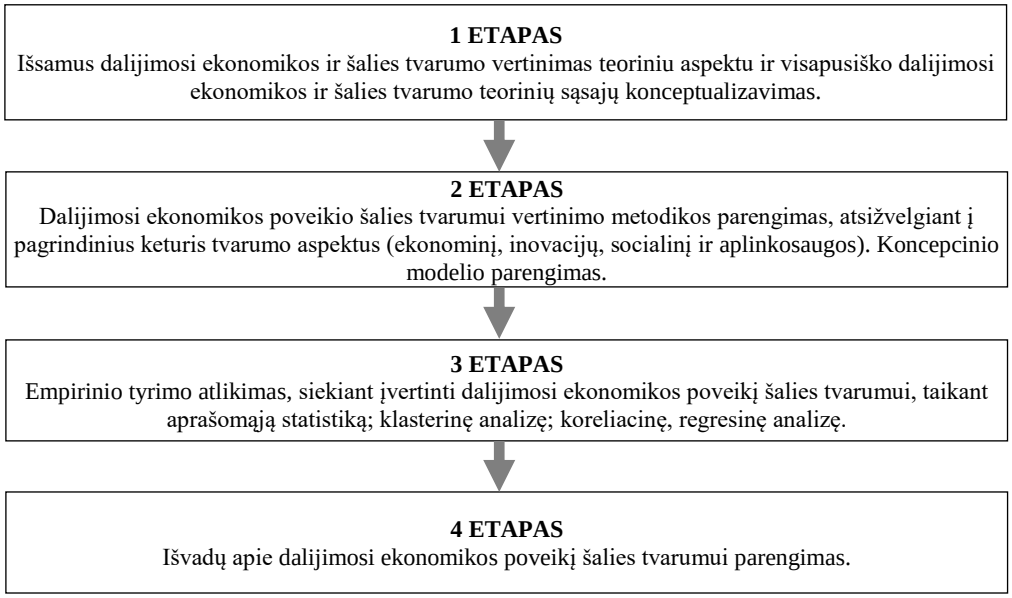
Mokslinio tyrimo apribojimai

Vienas iš pagrindinių tyrimo apribojimų yra susijęs su dalijimosi ekonomikos kiekybiniais statistiniais duomenimis makroekonominiu lygmeniu. Minėtų duomenų atvirai prieinamose statistinių duomenų bazėse tiesiog nėra, arba duomenys pateikiami labai ribotoje laiko imtyje. Europos Sąjungos statistikos tarnyba (EUROSTAT) pateikė duomenis, susijusius su apgyvendinimo ir transporto dalijimosi ekonomika, tačiau tik 2017–2019 m. laikotarpiu ir vėlgi tai buvo duomenys, analizuojantys tik konkrečius sektorius. Taip pat EUROSTAT nuo 2018 m. renka vadinamuosius eksperimentinius duomenis, susijusius su apgyvendinimo dalijimosi ekonomika (nakvynių trumpalaikio apgyvendinimo įstaigose skaičius). Akivaizdu, kad šie duomenys susiję tik su kai kuriais dalijimosi ekonomikos verslo modeliais, neįvertinant kitų (dalijimosi prekėmis, darbo vietomis, dalijimosi žiniomis ir kt.). Šiame tyrime naudota Crunchbase duomenų bazė, kurios pagrindu rinkti statistiniai metiniai duomenys, susiję su dalijimosi ekonomika įvairiose šalyse analizuojamuoju laikotarpiu (2008–2020 m.). Rengiant disertaciją nebuvo žinoma apie kito patikimo informacijos šaltinio, sisteminančio istorinius duomenis apie dalijimosi ekonomiką makroekonominiu lygmeniu pagal atskiras šalis, egzistavimą arba prieinamumą. Statistinių duomenų apie dalijimosi ekonomiką makroekonominiu lygmeniu prieinamumas vertinamas kaip galimas mokslinio tyrimo apribojimas. Tyrimo duomenys apsiriboja 2008–2020 m. laikotarpiu, nes naujesni duomenys tyrimo rengimo laikotarpiu dar nebuvo pasiekiami.

Darbo struktūra ir apimtis

Tyrimo struktūra sudaryta remiantis šioje disertacijoje iškeltais tikslais. Disertaciją sudaro kelios pagrindinės dalys: įvadas, trys skyriai, išvados, literatūros sąrašas ir priedai. Disertaciją sudaro 151 puslapis, 29 lentelės, 28 paveikslai ir 22

priedai. Šioje disertacijoje iš viso panaudoti 167 mokslinės literatūros šaltiniai. 5.1. pav. schematiškai pavaizduoti šios disertacijos rengimo etapai.



5.1 pav. Disertacijos rengimo etapai

5.1. DALIJIMOSI EKONOMIKOS IR ŠALIES TVARUMO TEORINĖ KONCEPCIJA

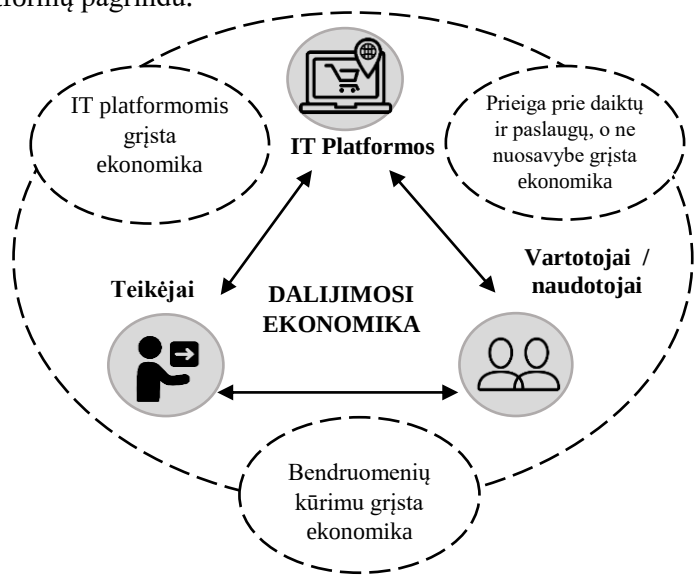
Šioje disertacijos dalyje analizuojamos dažniausiai moksliniuose tyrimuose apibrėžiamos dalijimosi ekonomikos sampratos, dalijimosi ekonomikos istorinė raida; nagrinėjamos pagrindinės dalijimosi ekonomikos varomosios jėgos; aprašomi ir pavaizduojami teorine analize pagrįsti dalijimosi ekonomikos verslo modeliai. Taip pat šiame skyriuje pristatoma šalies tvarumo teorinė samprata ir šalies tvarumo vertinimas pagal mokslinėje literatūroje analizuojamus pagrindinius aspektus: ekonominį, inovacijų, aplinkos apsaugos ir socialinį tvarumą.

Dalijimosi ekonomika tampa vis svarbesniu praktinių ir teorinių tyrimų objektu (Kauffman ir Naldi, 2020; Hossain, 2020; Ritter ir Schanz, 2019; Zhang ir kt., 2019; Geissiner ir kt., 2019; Habi ir kt. 2017; Aloni, 2016; Barnes, Mattsson, 2016, ir t. t.) dėl itin sparčios technologijų ir inovacijų plėtros visame pasaulyje. Dalijimosi ekonomiką ir jos perspektyvas analizuojantys moksliniai tyrimai (Hossain, 2020; Schor, 2020, Zhang ir kt., 2019; Godelnik, 2017; Sundararajan, 2016; PwC, 2015, ir t. t.) patvirtina, kad dalijimosi ekonomika daro pastebimą ekonominį, socialinį, aplinkosauginį ir inovacijų poveikį pramonei pasauliniu mastu.

Per pastarąjį dešimtmetį dalijimosi ekonomikos reiškinys buvo apibrėžiamas įvairiais terminais, pavyzdžiui, „tinklelis“ (Gansky, 2010), „prieiga grindžiamas vartojimas“ (Bardhi ir Eckhardt, 2012), „vartojimas bendradarbiaujant“ (Botsman ir

Rogers, 2011), „žiniatinklio platformose vykdomi tarpusavio mainai“ (Aloni, 2016), „santalkos kapitalizmas“ (angl. *crowd-based capitalism*, Sundararajan, 2016), „prieiga grindžiamas produktų ir paslaugų vartojimas, kuris gali būti internetinis ir neinternetinis“ (Barnes ir Mattson, 2016) ir pan.

Vadovaujantis mokslinės literatūros analize, galima teigti, kad dalijimosi ekonomika apibūdinama kaip verslo modelis, kurio **veikla yra orientuota į prekių ar paslaugų prieinamumą** (angl. *access-based*), bet ne į įsigijimą, kuris **veikia informacinių technologijų (toliau – IT) platformų pagrindu** (angl. *IT platform based*) ir kurio veikla yra paremta tam tikrų **bendruomenių kūrimo** (angl. *community-based*) pagrindu (5.1.1 pav.). Be to, pagrindiniai dalijimosi ekonomikos dalyviai yra dalijimosi daiktų arba paslaugų teikėjai (pavyzdžiui, Airbnb šeimininkai, Uber vairuotojai) ir naudotojai (vartotojai arba paslaugų gavėjai, pavyzdžiui, Airbnb svečiai, Uber keleiviai), kurių bendradarbiavimas vyksta IT arba skaitmeninių platformų pagrindu.



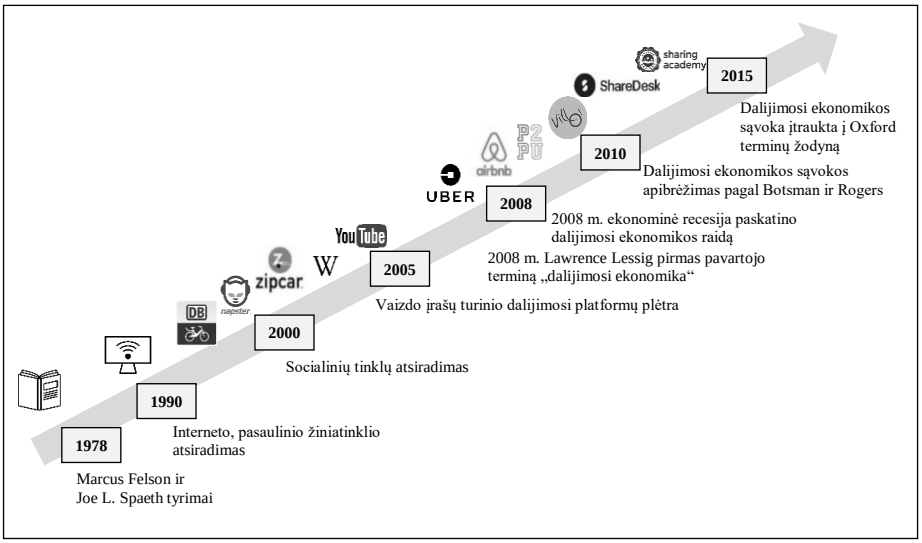
5.1.1 pav. Dalijimosi ekonomikos teorinė koncepcija.
Šaltinis: Karoblienė ir Pilinkienė (2021)

Dalijimosi ekonomika yra būdinga beveik visiems ekonomikos sektoriams, tačiau ji labiausiai paplitusi transporto ir apgyvendinimo srityse (Hossain, 2017). Pasak Daglis (2022), dalijimosi praktika dažniausiai pasitaiko dalijantis apgyvenimo ar kitos paskirties erdve, kai prekių ar paslaugų teikėjai įvairiose dalijimosi ekonomikos internetinėse platformose siūlo apgyvendinimo paslaugas ar erdves, skirtas kitai veiklai (pvz., darbo ir pan.), o šių paslaugų ar prekių naudotojai tam tikru laikotarpiu naudojasi paslaugomis ar prekėmis.

Pasak Frenken ir Schor (2017), dalijimosi ekonomika gali būti apibrėžiama kaip vartotojų laikina prieiga prie fizinio turto, kurio savininkai laikinai tuo turtu nesinaudoja, bet mainais gauna piniginę kompensaciją. Toks aiškinimas leidžia teigti, kad dalijimosi ekonomika egzistavo per visą žmonijos istoriją. Marcus Felson ir Joe

L. Spaeth (1978) atlikti moksliniai tyrimai apie bendruomenišką vartojimą plačiai laikomi esminiu darbu, padėjusiu pagrindus dalijimosi ekonomikos teorijai. Dalijimosi ekonomikos raida pagal pagrindines dalijimosi ekonomikos įmones ir esminius dalijimosi ekonomikos aspektus pavaizduota 5.1.2 paveiksle.

Pasak Karoblienės ir kt. (2019), dalijimosi ekonomikos atsiradimą XXI a. pradžioje paskatino šiuolaikinių technologijų pažanga. Socialinių tinklų naudojimas ir keitimasis duomenimis padidino pasitikėjimą tarp nepažįstamų asmenų, taip skatindamas dalijimąsi daiktais ir paslaugomis.

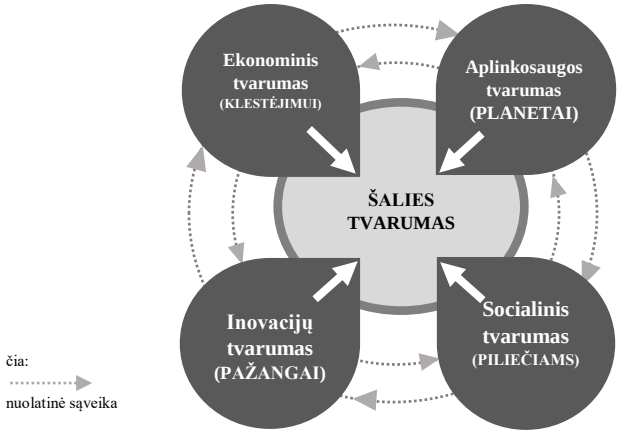


5.1.2 pav. Dalijimosi ekonomikos raida. Sudaryta pagal Karoblienė ir kt., 2019, naudojant atitinkamų įmonių logotipus ir ikonas iš https://thenounproject.com/

Nepaisant mokslininkų nesutarimų dėl dalijimosi ekonomikos sampratos, 2015 m. dalijimosi ekonomikos sąvoka buvo oficialiai pripažinta ir įtraukta į Oksfordo žodyną, o šis reiškinys apibūdinamas taip: „ekonominė sistema, kurioje turtu ar paslaugomis privatūs asmenys dalijasi nemokamai arba už tam tikrą mokestį, paprastai naudodamiesi internetu“.

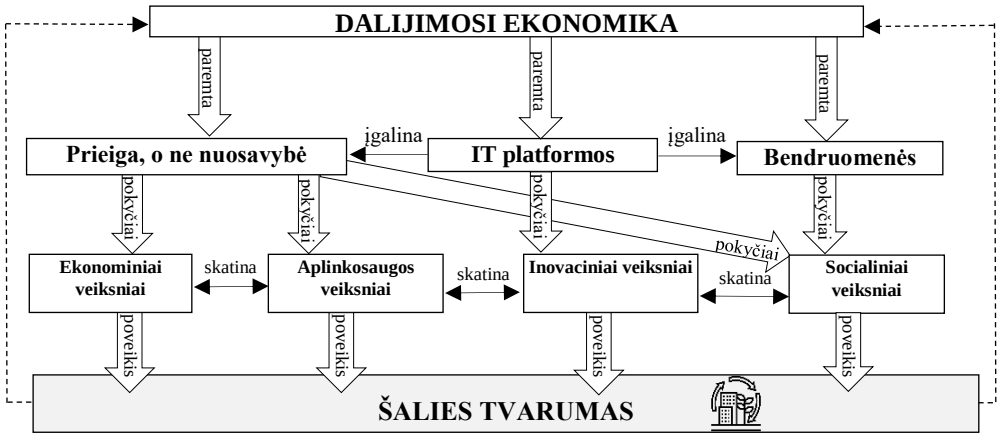
Tvarus vystymasis mokslinėje literatūroje dažniausiai įvardijamas kaip „žaliasis augimas“ ir svarbus aspektas šalies ekonomikos augimui, inovacijų plėtrai ir pakartotiniam išteklių naudojimui, lemiančiam klimato požiūriu neutralią ekonomiką (Egenolf ir Bringezu, 2019). 1987 m. Pasaulinė aplinkos ir vystymosi komisija (WCED) pateikė išsamų tvaraus vystymosi apibrėžimą: „dabartinės kartos gebėjimas patenkinti savo poreikius nepakenkiant būsimų kartų galimybėms patenkinti savo poreikius“ (WCED, 1987). Remiantis mokslinės literatūros analize, šalies tvarumą galima apibūdinti kaip atsparią, mažai anglies dioksido į aplinką išskiriančią veiklą, veiksmingą gamybą, pagrįstą socialiniais tarpusavio ryšiais (Staniškis ir kt., 2022), arba sąvoką, apimančią ekonominę, aplinkosauginę ir socialinę visuomenės gerovę laikui bėgant (Lozano, 2008). Disertacijoje šalies tvarus vystymasis pristatomas kaip dėsningas procesas, apimantis keturis skirtingus šalies tvarumo aspektus: ekonominį,

inovacijų, socialinį ir aplinkosaugos (5.1.3 pav.). Be to, glaudus ir veiksmingas šių keturių pagrindinių tvarumo ramsčių tarpusavio ryšys ir sąveika kuria bendrą šalies tvarumą.



5.1.3 pav. Šalies tvarumo struktūra. (Pagal Pieloch-Babiarz ir kt., 2021; Rahdari ir Rostamy, 2015; Bruno ir Tirca, 2019; Suganthi, 2019; Lopes, 2012; Barbieri ir kt., 2010)

Teorinės dalijimosi ekonomikos ir šalies tvarumo sąsajos grafiškai pavaizduotos 5.1.4 paveiksle. Remiantis moksliniais tyrimais (Belk, 2014; Curtis ir Mont, 2020), dalijimosi ekonomika apibūdinama kaip prieigos, IT platformų ir bendruomenių ekonomika. Šis mokslinis darbas prisideda prie minėtų dalijimosi ekonomikos charakteristikų ir parodo jos svarbą šalies tvarumui. 5.1.4 pav. punktyrinėmis linijomis parodytas grįžtamasis ryšys, kurį sukuria šalies tvarumas dalijimosi ekonomikai. Tačiau šie ryšiai disertacijoje nebus išsamiau tiriami, nes tai nėra pagrindinis šio darbo objektas.



5.1.4 pav. Dalijimosi ekonomikos ir šalies tvarumo sąsajų teorinė schema

Mokslinėje literatūroje pateiktų tyrimų rezultatai rodo, kad dalijimosi ekonomika grindžiama prieiga, o ne nuosavybe, ir tai rodo didelį dalijimosi ekonomikos poveikį šalies tvarumui visais keturiais pagrindiniais tvarumo aspektais. Dalijimosi ekonomika mažina socialinę nelygybę, nes suteikia pranašumą naudotis daiktais toms socialinėms grupėms, kurios dėl ribotų finansinių išteklių negali nuosavybės teise įsigyti daiktų. Dalijimosi ekonomika skatina didinti išteklių naudojimo efektyvumą, kuria naują vertę, skatina inovacijų plėtrą, verslumo kūrimą, mažina vartojimą, mažina atliekų kiekį ir kt. Be to, dalijimosi ekonomika pastebimai aktuali miestuose. Šiuo požiūriu daugybė miestų tampa „natūralia dalijimosi ekonomikos aplinka“, nes juose daugėja prekių bei paslaugų vartotojų, taip pat ir dalijimosi prekių bei paslaugų įvairovė. Tokie miestai mokslinėje literatūroje vadinami „išmaniaisiais miestais“ (Daglis, 2022).

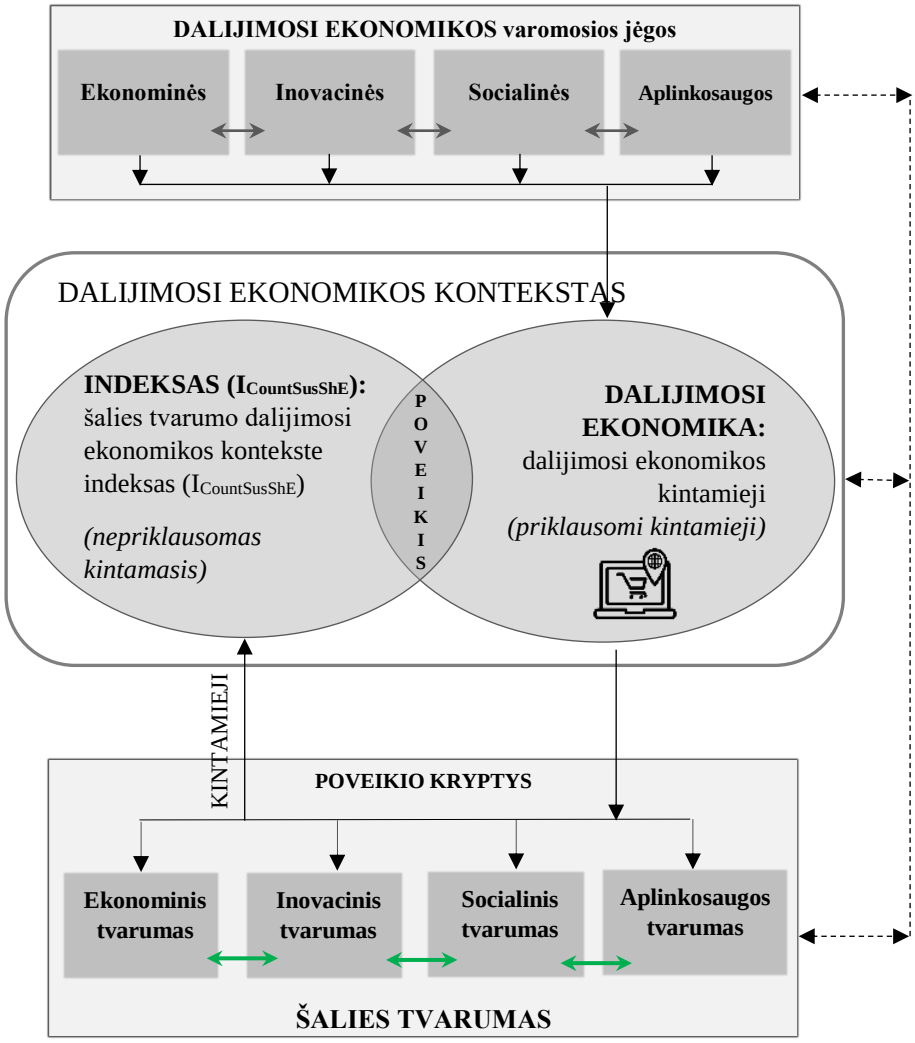
5.2. DALIJIMOSI EKONOMIKOS POVEIKIO ŠALIES TVARUMUI VERTINIMO METODOLIGIJA

Šiame disertacijos skyriuje, remiantis teorine analize, suformuluota tinkamiausia dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologija ir apžvelgiami esami dalijimosi ekonomiką analizuojantys indeksai, taip pat konstruojamas konceptualusis modelis, kuriame akcentuojami pagrindiniai teoriniai dalijimosi ekonomikos aspektai ir jos sąsajos su šalies tvarumu, atsižvelgiant į 4 pagrindines dimensijas: ekonominį tvarumą, inovacijų tvarumą, aplinkosauginį tvarumą ir socialinį tvarumą. Siekiant empiriškai įvertinti dalijimosi ekonomikos poveikį šalies tvarumui, sudarytas šalies tvarumo dalijimosi ekonomikos kontekste indeksas ($I_{\text{CountSusShE}}$), kuriuo nustatomas dalijimosi ekonomikos poveikis šalies tvarumui.

Iš teorinės perspektyvos dalijimosi ekonomikos poveikio šalies tvarumui kryptys gali būti tokios:

- *ekonominis poveikis*, lemiantis šalies ekonominį tvarumą. Dalijimosi ekonomika daro įtaką darbo vietų kūrimui ir užimtumo lygiui šalyje, skatina verslumą, naujų verslo vienetų augimą šalyje ir potencialiai skatina pradedančiųjų įmonių kūrimąsi (Kathan ir kt., 2016), apskritai didina BVP, investicijų kiekį šalyje (investicijų dalis BVP, proc.);
- *inovacinis poveikis*, lemiantis šalies inovacijų tvarumą. Dalijimosi ekonomikos plėtra skatina mokslinių tyrimų ir eksperimentinės plėtros (toliau – MTEP) veiklos intensyvumą šalyje, žmogiškųjų išteklių kiekį su mokslu ir technologijomis susijusiose veiklose, patentinių paraiškų kiekį šalyje, prisideda prie šalies pozicijos Europos inovacijų švieslentėje ir kt.;
- *socialinis poveikis*, lemiantis šalies socialinį tvarumą. Dalijimosi ekonomiką ir jos poveikį socialiniu aspektu nagrinėję mokslininkai teigia, kad dalijimosi ekonomika sukuria įvairių teigiamų socialinių naudų. Šis reiškinys kuria naujus socialinius tinklus, santykius tarp bendraminčių, „kuria socialinį ryšį tarp dalyvių“ (Hossain, 2020), prisideda prie sąlygų kuriant socialinę lygybę šalies viduje ir tarp skirtingų šalių. Be to, dalijimasis žiniomis daro svarbų socialinį poveikį, skatindamas visuomenę kurti konkurencingesnes, labiau išsilavinusias šalies bendruomenes;
- *poveikis aplinkai*, lemiantis aplinkos tvarumą. Šalies gyventojų tvarus vartojimas, tvarus vystymasis, tvarus išteklių naudojimas yra itin svarbūs teigiami poveikiai, kuriuos skatina dalijimosi ekonomika (Yin ir kt., 2021; Chi ir kt., 2020; Hossain, 2020; Acquier ir kt., 2017).

Dalijimosi ekonomikos poveikio šalies tvarumui vertinimo konceptualusis modelis, paremtas naujausios teorinės mokslinės literatūros analize, pateiktas 5.2.1 paveiksle.



5.2.1 pav. Pagrindinės konceptualiojo modelio dalys vertinant dalijimosi ekonomikos poveikį šalies tvarumui

Pagrindinės dalijimosi ekonomikos varomosios jėgos sąveikauja tarpusavyje ir palaiko pagrindinius dalijimosi ekonomikos ramsčius (prieiga, bet ne nuosavybe grindžiamą ekonomiką; IT platformomis grindžiamą ekonomiką ir bendruomenėmis grindžiamą ekonomiką), kurių pagrindu bendradarbiauja pagrindiniai dalijimosi ekonomikos dalyviai – paslaugų teikėjai ir naudotojai.

Konceptualiojo modelio apatinėje dalyje (5.2.1 pav.) žalios rodyklės rodo keturių pagrindinių šalies tvarumo aspektų (ekonominio, inovacijų, socialinio ir aplinkosaugos) tarpusavio ryšius. Šie keturi pagrindiniai šalies tvarumo aspektai yra

glaudžiai tarpusavyje susiję ilgalaikiais ryšiais, kaip aprašyta disertacijos pagrindinės dalies 1.5 skirsnyje.

Juodos punktyrinės rodyklės pateiktame modelyje (5.2.1 pav.) iliustruoja abipusius šalies tvarumo, dalijimosi ekonomikos bei dalijimosi ekonomikos varomųjų jėgų ryšius. Šie ryšiai šiame tyrime nebus išsamiau nagrinėjami, nes tai nėra pagrindinis šio darbo objektas.

Konceptualiojo modelio (5.2.1 pav.) vidurinėje dalyje ekonomikos poveikis šalies tvarumui iliustruojamas kaip ryšys tarp indekso $I_{\text{CountSusShE}}$ (indeksas, skirtas šalies tvarumo sąsajoms su dalijimosi ekonomika įvertinti) ir dalijimosi ekonomikos kintamųjų.

Šiame tyrime, apibrėžiant dalijimosi ekonomikos indėlį ir poveikio kryptis šalies tvarumui, keliamos tokios tyrimo hipotezės:

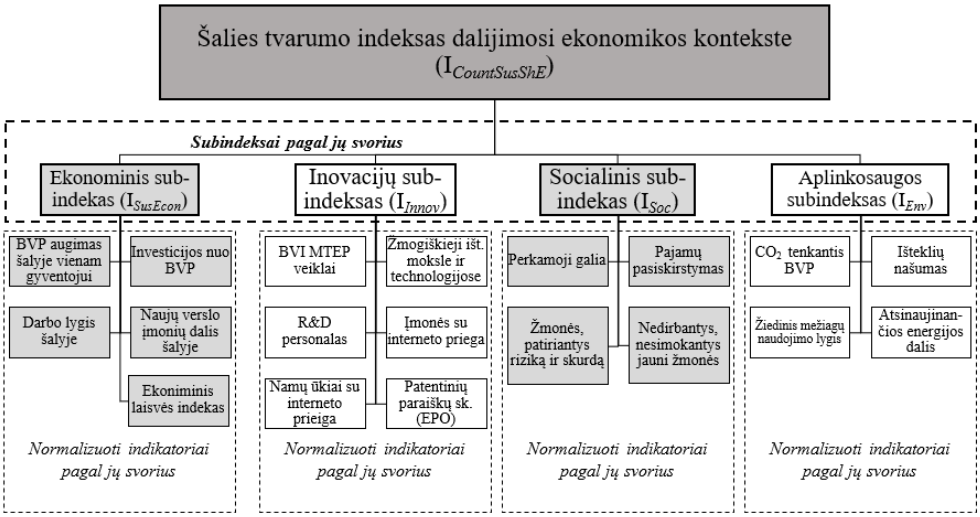
H1: *dalijimosi ekonomika daro teigiamą bendrą poveikį šalies tvarumui – egzistuoja teigiamas tiesioginis ryšys tarp dalijimosi ekonomikos ir šalies tvarumo.* Tačiau kai kurie tyrėjai (Schor, 2020; Giesel ir Nobis, 2016) akcentuoja, kad dalijimosi ekonomika kuria ne tik teigiamą, bet ir neigiamą poveikį. Remiantis minėtais tyrėjais, dalijimosi ekonomika apgyvendinimo ir transporto sektoriuose gali taip pat daryti neigiamą poveikį, t. y. eikvoti aplinką, sunaudoti daugiau gamtinių išteklių ir sukelti įvairių nepalankių padarinių, pavyzdžiui, eismo spūsčių, padidinti išmetamą CO_2 kiekį ir bendrą oro taršą. Todėl šiame darbe buvo iškelta **H1**, siekiant ištirti bendrą dalijimosi ekonomikos ir šalies tvarumo ryšio kryptį.

H2: *dalijimosi ekonomika daro didžiausią poveikį šalies inovacijų tvarumo dimensijai, palyginti su kitomis šalies tvarumo dimensijomis: ekonomine, socialine ir aplinkosaugos.* Remiantis teoriniais tyrimais (Rojanakit ir kt. 2022; Curtis ir Lehner, 2019; Acquier ir kt. 2017), dalijimosi ekonomikos vystymąsi ypač skatina šalių technologinė plėtra, IT platformų vystymasis ir paplitimas. Taigi, inovacijų aspektas turėtų būti vienas iš esminių, atsižvelgiant į šalių tvarumą, sąsajoje su dalijimosi ekonomika. Tačiau kai kurie tyrėjai (Hossain, 2020; Plepys ir Singh, 2020; Li ir kt., 2019) daugiausia dėmesio skiria ekonominiam, socialiniam ir aplinkosaugos aspektams ir analizuojant šalies tvarumą neišskiria inovacijų aspekto. Šiame darbe **H2** buvo iškelta siekiant patikrinti šalies inovacinio tvarumo reikšmę dalijimosi ekonomikai.

H3: *egzistuoja tiesioginis teigiamas ryšys tarp žiedinio medžiagų naudojimo lygio ir dalijimosi ekonomikos.* Keletas tyrėjų (Henry ir kt., 2021; Aldieri ir kt. 2021; Yin ir kt., 2012) teigia, kad yra svarbu nustatyti žiedinės ekonomikos ir dalijimosi ekonomikos sąsajas. Tačiau šios sąsajos daugiausia tiriamos teoriniu požiūriu, todėl aktualu empiriškai ištirti šių dviejų reiškinių sąsajas. Šiuo tyrimu siekta ištirti žiedinio medžiagų naudojimo, kaip vieno iš pagrindinių žiedinės ekonomikos rodiklių, ir dalijimosi ekonomikos sąsajas. Šiam tikslui pasiekti buvo suformuluota ir patikrinta tyrimo hipotezė **H3**.

Remiantis teorine dalijimosi ekonomikos ir jos sąsajų su šalies tvarumu analize bei keturiomis pagrindinėmis tvarumo dimensijomis (ekonomine, inovacine, socialine

ir aplinkosaugos), sudaryta šalies tvarumo dalijimosi ekonomikos kontekste indekso ($I_{\text{CountSusShE}}$) (toliau – $I_{\text{CountSusShE}}$ indeksas) hierarchija (5.2.2 pav.). 5.2.2 pav. pavaizduota $I_{\text{CountSusShE}}$ indekso struktūra su jo keturiais subindeksais ir jų rodikliais.



5.2.2 pav. Šalies tvarumo indeksas dalijimosi ekonomikos kontekste.
Sudaryta pagal Dogle ir kt. (2020), El-Kholy ir Akal (2020), Krajnc ir Glavic (2005)

Šalies tvarumo indeksas dalijimosi ekonomikos kontekste sudarytas remiantis teorinės tyrimo dalies išvadomis ir gali būti išreikštas tokia formule (5.1):

$$\boldsymbol{I_{\text{CountSusShE}} = w_1 \text{ x } I_{\text{SusEcon}} + w_2 \text{ x } I_{\text{SusInnov}} + w_3 \text{ x } I_{\text{SusSoc}} + w_4 \text{ x } I_{\text{SusEnv}},} \quad (5.1)$$

čia

$I_{\text{CountSusShE}}$ – šalies tvarumo indeksas dalijimosi ekonomikos kontekste;

I_{SusEcon} – šalies ekonominio tvarumo subindeksas dalijimosi ekonomikos kontekste;

I_{SusInnov} – šalies inovacijų tvarumo subindeksas dalijimosi ekonomikos kontekste;

I_{SusSoc} – šalies socialinio tvarumo subindeksas dalijimosi ekonomikos kontekste;

I_{SusEnv} – šalies aplinkosaugos tvarumo subindeksas dalijimosi ekonomikos kontekste;

w_1.... w_4 – subindeksų svorio koeficientai. Bendra visų svorių suma lygi 1.

5.3. DALIJIMOSI EKONOMIKOS POVEIKIO ŠALIES TVARUMUI EMPIRINIS TYRIMAS

Šiame skyriuje empirinių tyrimų būdu yra patikrinama mokslinės literatūros pagrindu sukurta dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologija Europos Sąjungos dvidešimt septynių (toliau – ES 27) šalių atveju 2008–2020 m. laikotarpiu.

Empirinio tyrimo metu buvo parengta kintamųjų, vertinamų skaičiuojant $I_{\text{CountSusShE}}$ indeksą, aprašomosios statistikos analizė remiantis ES 27 šalių atveju 2008–2020 m. laikotarpiu. Toliau, atlikus statistinių duomenų normalizavimą ir pagal normalizuotų statistinių duomenų vertes, buvo apskaičiuoti keturi subindeksai: ekonominis, inovacijų, socialinis ir aplinkosaugos, taip pat apskaičiuoti analizuojamų šalių $I_{\text{CountSusShE}}$ indeksai.

Teoriškai indekso $I_{\text{CountSusShE}}$ reikšmės gali svyruoti nuo 0 (kai šalies tvarumo lygis dalijimosi ekonomikos kontekste yra ypač žemas) iki 1 (kai šalies tvarumo lygis dalijimosi ekonomikos kontekste yra ypač aukštas). Šiame darbe naudojamas indekso $I_{\text{CountSusShE}}$ įverčių lyginamasis interpretavimas, kuris sudarytas remiantis kitų tyrėjų (Pollesch ir Dale, 2016; Pinar ir kt., 2014) taikyta metodika. Atliekant lyginamąjį interpretavimą indeksų reikšmės teoriškai priskiriamos tam tikroms grupėms. Indekso $I_{\text{CountSusShE}}$ reikšmių teorinė interpretacija pateikta 5.3.1 lentelėje.

5.3.1 lentelė. Indekso I_{CountShE} įverčių lyginamasis interpretavimas

Indekso reikšmės	Interpretavimas
0,0000–0,2500	Žemas tvarumo lygis
0,2501–0,5000	Patenkinamas tvarumo lygis (žemiau vidutinio, bet aukščiau nei žemas)
0,5001–0,7500	Aukštesnis tvarumo lygis (aukštesnis nei pakankamas)
0,7501–1,0000	Aukštas (reikšmingas) tvarumo lygis

Įvertinus empirinio tyrimo rezultatus galima teigti, kad bendras vidutinis šalių tvarumo lygis ($I_{\text{CountSusShE}}$ reikšmės) analizuojamuoju periodu (2008–2020 m.) svyruoja nuo 0,6825 (Švedijoje) iki 0,1795 (Bulgarijoje). Remiantis pirmiau aprašytu $I_{\text{CountSusShE}}$ įverčių lyginamuoju interpretavimu, nebuvo šalių, kuriose šalių tvarumo lygis dalijimosi ekonomikos kontekste būtų „aukštas“ (reikšmės nuo 0,7501 iki 1,0000). Remiantis empiriniu tyrimu „aukštesnio“ lygio (reikšmių nuo 0,5001 iki 0,7500) 2008–2020 m. vidutinis šalių tvarumo lygis dalijimosi ekonomikos kontekste buvo šiose šalyse: Švedijoje, Olandijoje, Liuksemburge, Danijoje, Suomijoje, Vokietijoje, Austrijoje, Prancūzijoje, Belgijoje, Airijoje ir Slovėnijoje. Daugumos ES 27 šalių tvarumo lygis dalijimosi ekonomikos kontekste buvo „patenkinamas“ ($I_{\text{CountSusShE}}$ reikšmės nuo 0,2501 iki 0,5000). Tokie atvejai buvo Čekijoje, Estijoje, Maltoje, Kipre, Slovakijoje, Lietuvoje, Ispanijoje, Latvijoje, Portugalijoje, Vengrijoje, Italijoje, Lenkijoje ir Kroatijoje. „Žemas“ šalių tvarumo lygis dalijimosi ekonomikos kontekste ($I_{\text{CountSusShE}}$ reikšmės nuo 0,0000 iki 0,2500) buvo Rumunijoje, Graikijoje ir Bulgarijoje.

Disertacijoje toliau buvo atliekama klasterinė analizė pagal ES 27 šalių subindeksų ($I_{SusEcon}$, $I_{SusInnov}$, I_{SusSoc} ir I_{SusEnv}) įverčius, siekiant išryškinti skirtumus ir pokyčius tarp atskirų šalių lyginant 2008 m. ir 2020 m. rezultatus. Lyginamosios 2008 m. ir 2020 m. duomenų klasterinės analizės rezultatai pagal K-vidurkių centroidus (5.3.2 lentelė) rodo kai kurių 27 ES šalių (Belgijos, Airijos, Slovėnjos, Vengrijos, Latvijos, Lietuvos, Lenkijos ir Portugalijos) pažangą, susijusią su šalių tvarumo lygiu dalijimosi ekonomikos kontekste.

5.3.2 lentelė. Lyginamosios 2008 m. ir 2020 m. duomenų klasterinės analizės rezultatai pagal K-vidurkių centroidus

2020 m. klasteriai				**2008 m. klasteriai**			
1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Kroatija	Kipras	Austrija	Bulgarija	Kroatija	**Belgija**	Austrija	Bulgarija
Graikija	Čekija	**Belgija**	Rumunija	Graikija	Kipras	Danija	Rumunija
Italija	Estija	Danija		**Vengrija**	Čekija	Suomija	
Ispanija	**Vengrija**	Suomija		Italija	Estija	Prancūzija	
	Latvija	Prancūzija		**Latvija**	**Airija**	Vokietija	
	Lietuva	Vokietija		**Lietuva**	Malta	Liuksemburgas	
	Malta	**Airija**		**Lenkija**	Slovakija	Olandija	
	Lenkija	Liuksemburgas		**Portugalija**	**Slovėnija**	Švedija	
	Portugalija	Olandija		Ispanija			
	Slovakija	**Slovėnija**					
		Švedija					
Šalių skaičius klasteryje							
4	10	11	2	9	8	8	2
Subindeksų vidutiniai centroidai							
0,3132	0,4221	0,5937	0,1966	0,3266	0,4318	0,6099	0,2075
Indeksų $I_{CountShE}$ įverčių lyginamasis interpretavimas							
Patenkinamas	Patenkinamas	Aukštesnis	Žemas	Patenkinamas	Patenkinamas	Aukštesnis	Žemas

Siekiant pagrįsti arba paneigti disertacijoje iškeltas mokslines hipotezes, buvo atliekamos koreliacinės ir regresinės analizės.

Šiame darbe dalijimosi ekonomika analizuojama makroekonominiu lygmeniu kaip ekonominis reiškinys, darantis poveikį šalies tvarumui. Pearsono koreliacijos analizės rezultatai leido patvirtinti **pirmąją disertacijos hipotezę (H1), kad** egzistuoja teigiamas tiesioginis ryšys tarp dalijimosi ekonomikos ir šalies tvarumo. Tai reiškia, kad šalies tvarumas priklauso nuo dalijimosi ekonomikos plėtros šalyje.

Antroji disertacijos hipotezė (H2) buvo patvirtinta, nes ryšys tarp $I_{SusInnov}$ ir dalijimosi ekonomikos įmonių tankumo rodiklio buvo didžiausias (R = 0,3650; *P-value* = 1,7E-12), palyginti su kitų trijų subindeksų ($I_{SusEcon}$, I_{SusSoc} ir I_{SusEnv}) ryšiais su dalijimosi ekonomikos įmonių tankumo rodikliu. Tarp $I_{SusInnov}$ ir dalijimosi ekonomikos įmonių tankumo rodiklio yra teigiamas tiesinis ryšys (R = 0,3650). Mažiausia teigiama koreliacija (R = 0,1119; *P-value* = 0,036) yra tarp $I_{SusEcon}$ ir dalijimosi ekonomikos įmonių tankio rodiklio.

Trečioji disertacijos hipotezė (H3) taip pat patvirtinama: egzistuoja teigiamas silpnas tiesinis ryšys (R = 0,22; P reikšmė = 4,73E-05) tarp dalijimosi ekonomikos

įmonių tankumo rodiklio ir žiedinio medžiagų naudojimo rodiklio, kuris turi teorinių sąsajų su žiedine ekonomika.

IŠVADOS

Atlikus teorinę dalijimosi ekonomikos, šalies tvarumo ir jų tarpusavio sąsajų analizę, suformulavus metodologiją ir atlikus dalijimosi ekonomikos poveikio šalies tvarumui vertinimo empirinį tyrimą, formuluojamos šios išvados:

1. Vadovaujantis ankstesniais moksliniais teoriniais tyrimais buvo **patikslinta dalijimosi ekonomikos koncepcija**. Dalijimosi ekonomika – tai verslo modelis, kurio pagrindas yra trys ramsčiai: (1) prieiga grindžiama ekonomika, (2) IT platformomis grindžiama ekonomika ir (3) bendruomenių kūrimu grindžiama ekonomika. Šioje ekonomikoje turtu, ištekliais, prekėmis ar paslaugomis už mokestį arba nemokamai **dalijasi asmenys ir (arba) įmonės**. Be to, pagrindiniai dalijimosi ekonomikos dalyviai yra asmenys, kurie teikia dalijimosi prekes ar paslaugas, ir vartotojai, kurie vartoja šias prekes ir paslaugas. Šie pagrindiniai dalyviai naudojasi skaitmeninėmis platformomis arba informacinėmis technologijomis (IT), kad galėtų dalyvauti dalijimosi ekonomikoje.
2. Glaudus, veiksmingas ir reguliarus keturių pagrindinių tvarumo ramsčių (ekonominio, inovacijų, aplinkos ir socialinio) tarpusavio ryšys užtikrina šalies tvarumą. Be to, šiame tyrime **šalies tvarumas dalijimosi ekonomikos kontekste konceptualizuojamas kaip keturių P (4P) rezultatas:** ekonominis tvarumas – *klestėjimui (*angl. ***p****rosperity)*; inovacijų tvarumas – *pažangai (*angl. ***p****rogress)*; aplinkosaugos tvarumas – *planetai* (angl. ***p****lanet*) ir socialinis tvarumas – *piliečiams (*angl. ***p****eople)*.
3. Dalijimosi ekonomika plačiai paplitusi įvairiuose šalių ekonomikos sektoriuose ir daro poveikį šalių tvarumui. Teorinė analizė rodo, kad dalijimosi ekonomika palengvina tvaresnį prekių ar paslaugų vartojimo modelį, apriboja vienkartinių prekių gamybą, suteikia galimybę pakeisti nenaudojamo turto (pvz., namo ar transporto priemonės) paskirtį ir suteikia vertę daiktams, kurie kitu atveju galėtų būti laikomi beverčiais dėl jų nenaudojimo. Verta pabrėžti šiuos aspektus:
   3.1. remiantis šiuo tyrimu, šalies tvarumą, apimantį pagrindinius ekonominius, inovacijų, socialinius ir aplinkosaugos aspektus, galima plėtoti pasitelkiant dalijimosi ekonomiką. Tai pasiekiama skatinant efektyvesnį medžiagų ir išteklių naudojimą, skatinant inovacijų pažangą, kuriant asmenų bendradarbiavimo tinklus ir didinant socialinę bei ekonominę gerovę. Atlikti **tyrimai patvirtina teorinius dalijimosi ekonomikos ir šalies tvarumo ryšius**, be to, šie ryšiai yra glaudžiai susiję ir svarbūs vienas kito vystymuisi ir bendros gerovės kūrimui šalyje;
   3.2. analizuojant dalijimosi ekonomiką šalies tvarumo kontekste, reikėtų išnagrinėti keturis pagrindinius šalies tvarumo aspektus (ekonominį, inovacijų, socialinį, aplinkosaugos). Dalijimosi ekonomikai didelę įtaką daro technologinė pažanga, ir dalijimosi ekonomikos veiklą įgalina informacinių technologijų platformos. Be to, šalies tvarumą sukuria glaudus ir veiksmingas ilgalaikis ryšys bei sąveika tarp keturių

pagrindinių tvarumo ramsčių (ekonominio, inovacijų, socialinio, aplinkosaugos). **Šis tyrimas papildo** ankstesnius mokslinius tyrimus, kuriuose buvo vertinami tik trys tvarumo ramsčiai (ekonominis, socialinis, aplinkosaugos), **ir parodo inovacijų tvarumo ramsčio, stiprinančio šalies tvarumą, svarbą**.

4. Teorinė dalijimosi ekonomikos ir šalies tvarumo bei šių dviejų reiškinių sąsajų analizė leido sukurti dalijimosi ekonomikos poveikio šalies tvarumui vertinimo metodologiją. Ji buvo parengta ir iliustruota naudojant šiuos esminius etapus:
   4.1. **Sudėtinis indeksas ($I_{\mathbf{CountSusShE}}$)** palengvina išsamų šalies tvarumo lygio dalijimosi ekonomikos kontekste vertinimą; leidžia analizuoti pagrindines šalies tvarumo dimensijas pagal pasirinktus kintamuosius ir kintamųjų grupes;
   4.2. tyrimo metu nustatyti **dalijimosi ekonomikos kintamieji leidžia įvertinti šį reiškinį makroekonominiu požiūriu** skirtingose šalyse ir skirtingais laikotarpiais;
   4.3. koreliacinė ir regresinė analizė tarp indekso ($I_{\mathrm{CountSusShE}}$, šalies tvarumas dalijimosi ekonomikos kontekste) ir tarp rodiklio (dalijimosi ekonomikos įmonių tankumo rodiklio šalyje) leidžia **įvertinti dalijimosi ekonomikos poveikį šalies tvarumui**.
5. Tyrime naudojamas **sudėtinio indekso konstravimo teorinis būdas**:
   5.1. $I_{\mathrm{CountSusShE}}$ sudėtinio indekso sudarymą sudaro šie pagrindiniai etapai: tyrimo reiškinio apibrėžimas; tyrimo duomenų rinkimas; kintamųjų grupių nustatymas pagal keturias pagrindines šalies tvarumo dimensijas; indekso rodiklių poveikio krypties vertinimas pagal nykščio (angl. *thumb*) taisyklę; duomenų normalizavimas; rodiklių svorių nustatymas; subindeksų (I_{SusEcon}, I_{SusInnov}, I_{SusEnv}, I_{SusSoc}) ir indekso ($I_{\mathrm{CountSusShE}}$) konstravimas; indekso ($I_{\mathrm{CountSusShE}}$) jautrumo analizė;
   5.2. sudarant sudėtinį $I_{\mathrm{CountSusShE}}$ indeksą buvo naudota 19 tyrime identifikuotų kintamųjų, kurie buvo suskirstyti pagal pagrindinius šalies tvarumo ramsčius: ekonominio tvarumo kintamųjų grupė (metinis bendrojo vidaus produkto vienam gyventojui augimo tempas; investicijų dalis BVP; užimtumo lygis; ekonominės laisvės indeksas; naujų įmonių tankis); inovacijų tvarumo kintamųjų grupė (bendrosios vidaus išlaidos moksliniams tyrimams ir plėtrai; žmogiškieji ištekliai mokslo ir technologijų srityje; mokslinių tyrimų ir plėtros personalas; patentų paraiškos Europos patentų biurui; įmonės, turinčios interneto prieigą; namų ūkiai, turintys interneto prieigą); socialinio tvarumo kintamųjų grupė (gyventojų perkamoji galia; pajamų pasiskirstymas; žmonės, patiriantys riziką ir skurdą arba socialinę atskirtį; nedirbantis, nesimokantis ir mokymuose nedalyvaujantis jaunimas); aplinkosauginio tvarumo kintamųjų grupė (išmetamo CO_2 kiekis, tenkantis BVP; išteklių našumas ir vidaus medžiagų suvartojimas; žiedinio medžiagų naudojimo lygis;

atsinaujinančiosios energijos dalis vertinant bendrą galutinį energijos suvartojimą pagal sektorius);

5.3. **indeksas $I_{\mathbf{CountSusShE}}$ gali būti pritaikomas tolesniems bet kurios šalies ir bet kurio tiriamojo laikotarpio tyrimams.** Be to, subindeksai (I_{SusEcon}, I_{SusInnov}, I_{SusEnv}, I_{SusSoc}) buvo sudaryti pagal šalies ekonominio, inovacijų, socialinio ir aplinkos tvarumo dimensijų požiūrius. Šiuos indeksus gali praktiškai naudoti mokslininkai, politikai, praktikai ar verslininkai kaip įrankius šalies tvarumui vertinti santykyje su dalijimosi ekonomika.

6. **Atlikus empirinį tyrimą**, kurio metu taikomas tyrime pasiūlytas konceptualusis dalijimosi ekonomikos poveikio šalies tvarumui vertinimo modelis pagal ES-27 2008–2020 m. duomenis, nustatyta, kad:

6.1. aukščiausios vidutinės $I_{\mathrm{CountSusShE}}$ indeksų reikšmės buvo šiose šalyse: Švedijoje (0,6825); Nyderlanduose (0,6791); Liuksemburge (0,6636); Danijoje (0,6357); Suomijoje (0,6314) ir Vokietijoje (0,6051). Remiantis „lyginamosios analizės“ indeksų metodika, nė viena šalis nebuvo įvertinta kaip turinti „aukštą tvarumo“ lygį dalijimosi ekonomika kontekste. Vienuolika ES šalių (Švedija, Nyderlandai, Liuksemburgas, Danija, Suomija, Vokietija, Austrija, Prancūzija, Belgija, Airija ir Slovėnija), remiantis lyginamosios analizės metodika, turi „aukštesnį“ (nuo 0,5001 iki 0,7500) šalių tvarumo lygį dalijimosi ekonomikos kontekste. Be to, likusių vienuolikos šalių (Čekijos, Estijos, Maltos, Kipro, Slovakijos, Lietuvos, Ispanijos, Latvijos, Portugalijos, Vengrijos, Italijos, Lenkijos, Kroatijos, Latvijos, Vengrijos, Italijos, Lenkijos) $I_{\mathrm{CountSusShE}}$ indeksų rezultatai rodo „patenkinamą“ šalių tvarumo lygį (reikšmės nuo 0,2501 iki 0,5000). Rumunijos (0,2283); Graikijos (0,1971); Bulgarijos (0,1795) $I_{\mathrm{CountSusShE}}$ indeksų rezultatai rodo, jog šalių tvarumo lygis dalijimosi ekonomikos kontekste yra „žemas“ (reikšmės nuo 0,0000 iki 0,2500). Taigi galima daryti išvadą, kad labiau išsivysčiusiose šalyse šalių tvarumas yra labiau plėtojamas.

6.2. subindeksų (I_{SusEcon}, I_{SusInnov}, I_{SusEnv}, I_{SusSoc}) reikšmių įvairovė ES-27 šalių atveju buvo pademonstruota taikant hierarchinį, Ward, K-vidurkių klasterizavimo daugiamatėje statistinėje analizėje metodus. Klasterinė analizė atlikta naudojant 2008 ir 2020 ,m. duomenis, siekiant nustatyti ES-27 šalių klasterių skirtumus tarp dviejų lyginamųjų metų (2008 ir 2020 m.).

Klasterinės analizės išvados patvirtina, kad $I_{\mathrm{CountSusShE}}$ indeksai, kuriais vertinamas šalies tvarumas dalijimosi ekonomika aspektu, yra aukštesni labiau pažengusiose šalyse (pavyzdžiui, Airijoje, Austrijoje, Belgijoje, Danijoje, Danijoje, Airijoje, Liuksemburge, Nyderlanduose, Prancūzijoje, Slovėnijoje, Suomijoje, Švedijoje ir Vokietijoje). Šios šalys daug dėmesio skiria inovacijų skatinimui (pavyzdžiui, Europos patentų biurui pateiktų patentų skaičius, bendrosios vidaus išlaidos moksliniams tyrimams ir eksperimentinei

plėtrai), socialinės gerovės ir aplinkosaugos klausimų sprendimui (pavyzdžiui, išmetamo CO_2 kiekio, palyginti su BVP dalimi, mažinimas; išteklių našumo ir vidaus medžiagų suvartojimo didinimas). Tai rodo visų keturių šalies tvarumo aspektų (ekonominio, inovacijų, socialinio ir aplinkosaugos) svarbą. Be to, tai patvirtina šiame tyrime nustatytą teorinę šalies tvarumo koncepciją, teigiančią, kad šalies tvarumas sukuria ekonominį tvarumą siekiant šalies klestėjimo, aplinkosauginį tvarumą tausojant planetą, inovacijų tvarumą, lemiantį šalies pažangą, ir socialinį tvarumą siekiant piliečių gerovės.

6.3. Pearsono koreliacijos rezultatai rodo, kad tarp dalijimosi ekonomikos įmonių tankio šalyje ir indekso $I_{\text{CountSusShE}}$ yra teigiama statistiškai reikšminga koreliacija. Koreliacijos koeficientas 0,3256, o *p* reikšmė lygi 4,13511E-10.

6.4. Regresinės analizės rezultatai atskleidžia, kad šalies tvarumo indekso ($I_{\text{CountSusShE}}$) pokyčius galima prognozuoti naudojant dalijimosi ekonomikos makroekonominius rodiklius (pavyzdžiui, dalijimosi ekonomikos įmonių tankumą). Tyrimo rezultatai parodė, kad, dalijimosi ekonomikos įmonių tankio rodikliui padidėjus 1, šalies tvarumas dalijimosi ekonomikos aspektu ($I_{\text{CountSusShE}}$) padidėtų 0,1018. Taigi dalijimosi ekonomikos rodikliai gali būti praktiškai naudojami kaip pagalbinė priemonė prognozuojant konkrečių šalių tvarumą.

6.5. Koreliacinės analizės rezultatai rodo, kad reikšmingiausias ryšys yra tarp šalies inovacijų tvarumo (I_{SusInnov}) ir dalijimosi ekonomikos įmonių tankumo rodiklio, palyginti su koreliacija su kitomis šalies tvarumo dimensijomis (I_{SusEcon}, I_{SusInnov}, I_{SusEnv}, I_{SusSoc}). Tai vertinga tyrimo išvada, nes ji patvirtina keletą ankstesnių teorinių tyrimų ir pabrėžia ne tik ekonominio, socialinio ir aplinkosaugos, bet ir šalies inovacijų tvarumo dimensijos svarbą. Be to, tai patvirtina, kad dalijimosi ekonomika remiasi trimis esminiais ramsčiais: IT platformomis grindžiama ekonomika, prieiga grindžiama ekonomika ir bendruomenėmis grindžiama ekonomika.

6.6. Šiame tyrime sukurtas konceptualusis modelis ir dalijimosi ekonomikos poveikio šalies tvarumui vertinimas, remiantis sudarytu indeksu, gali būti naudojami tolesniuose empiriniuose tyrimuose, kurie galėtų padėti parengti šalių tvarumo, dalijimosi ekonomikos plėtros gaires ar kitus politinius instrumentus.

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CURRICULUM VITAE

Education

2018–2023	**PhD studies in Economics,** **Kaunas University of Technology**
2002–2004	Master's Degree of Economics (with honours) Kaunas University of Technology Economics
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Work experience

2017–till now	**Kaunas University of Technology** **Head of Research and Innovation Projects Centre**
2019/2020 **(Autumn semester)**	Kaunas University of Technology , Lecturer, Project of the Semester (PR00B108)
2015–2017	Kaunas University of Technology, National Innovation and Entrepreneurship Centre, Projects Manager
2007–2015	Kaunas University of Technology, E. Learning Technology Centre, Projects Analyst
2002–2006	JSC "Takioji Neris", Marketing Manager

LIST OF AUTHOR'S PUBLICATIONS AND CONFERENCES

Articles in peer-reviewed scientific publicationsIn Q1-Q3 quartile journals indexed in the Web of Science or Scopus (JCR SSCI / SNIP)

Foreign publishers

1. Karobliene, Vilma; Pilinkiene, Vaida. The sharing economy in the framework of sustainable development goals: case of European union countries // Sustainability. Basel : MDPI. ISSN 2071-1050. 2021, vol. 13, iss. 15, art. no. 8312, p. 1-26. DOI: 10.3390/su13158312. [Social Sciences Citation Index (Web of Science); Scopus; DOAJ] [IF: 3,889; AIF: 4,719; IF/AIF: 0,824; Q2 (2021, InCites JCR SSCI)] [CiteScore: 5,00; SNIP: 1,310; SJR: 0,664; Q1 (2021, Scopus Sources)] [Field: S 004] [Input: 0,500]

In peer-reviewed scientific publications referred in other international databases

Foreign publishers

2. Karobliene, Vilma; Pilinkiene, Vaida; Feruś, Anna. Impact of the sharing economy on future business models // Sociálno-ekonomická revue = Social and economic revue. Trenčin : Alexander Dubček University of Trenčin. ISSN 1336-3727. eISSN 2585-9358. 2019, vol. 17, iss. 3, p. 64-74. [Index Copernicus; Business Source Complete] [Field: S 004] [Input: 0,334]

Presentation of research results at the conferences

3. Karobliene, Vilma; Pilinkiene, Vaida. The sharing economy in the framework of the sustainable development goals: case of the European Union countries // 34th EBES conference, 6-8, January 2021, Athens, Greece (online/virtual presentation only): program and abstract book. Istanbul : EBES Publications, 2021. ISBN 9786058004245. p. 67. [Field: S 003]

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Annex 1. Descriptive statistics of variables (EU-27, 2008–2020) involved in the $I_{CountSusShE}$ index calculation

Variable	nbr. null	min	max	range	median	mean	SE.mean	CI mean	std.dev	coef. var	skew	kurtosis
Growth_of_GDP_per_cap	7	-14.50	23.20	37.70	1.30	0.83	0.21	0.42	3.97	4.81	-0.38	3.86
Invest_share	0	10.58	53.59	43.01	21.10	21.33	0.23	0.45	4.27	0.20	1.56	10.24
Employ_rate	0	52.90	82.40	29.50	70.60	70.06	0.33	0.64	6.11	0.09	-0.26	-0.64
Economic_freedom_index	0	53.20	82.50	29.30	69.10	69.04	0.30	0.60	5.70	0.08	-0.20	-0.42
New_business	0	0.24	32.21	31.97	4.02	5.69	0.28	0.55	5.22	0.92	1.94	3.92
GDE_on_R&D	0	0.38	3.73	3.35	1.33	1.59	0.05	0.09	0.89	0.56	0.62	-0.80
Human_in_tech	0	23.00	65.00	42.00	43.80	43.82	0.48	0.95	9.09	0.21	-0.02	-0.72
R&D_personn	0	0.29	2.22	1.93	0.99	1.13	0.03	0.05	0.51	0.45	0.32	-0.98
Patent	0	7.00	27,328.00	27,321.00	189.00	2,306.50	278.48	547.70	5,217.29	2.26	3.63	13.37
Enterpr_with_int	0	79.00	100.00	21.00	97.11	96.07	0.22	0.43	4.07	0.04	-1.81	3.03
Household_with_int	0	13.00	98.00	85.00	76.00	72.25	0.89	1.75	16.67	0.23	-0.93	0.55
Purchase_power	0	10,500.00	79,600.00	69,100.00	25,100.00	27,390.31	656.78	1,291.73	12,304.80	0.45	2.17	6.09
Income_dist	0	3.03	8.32	5.29	4.48	4.86	0.06	0.12	1.16	0.24	0.72	-0.38
People_at_risk	0	11.90	49.30	37.40	21.60	23.83	0.39	0.77	7.37	0.31	1.07	0.95
Y_people_n_empl	0	5.00	28.50	23.50	13.00	13.77	0.27	0.52	4.98	0.36	0.52	-0.38
Resource_prod	0	0.28	4.97	4.69	1.33	1.70	0.06	0.11	1.04	0.61	0.87	0.13
CO2_emmision_per_GDP	0	78.72	1,492.13	1,413.42	333.61	394.99	12.96	25.48	242.72	0.61	1.72	3.32
Circular_mater	0	1.20	30.90	29.70	6.50	8.00	0.33	0.65	6.18	0.77	1.41	1.89
Share_of_renew_energy	0	0.20	60.12	59.93	16.74	19.26	0.62	1.21	11.54	0.60	0.88	0.52

Annex 2. Normalized data of the $I_{SusEcon}$ sub-index's indicators: annual growth rate of the real GDP per capita and the investment share of DGP, EU-27, 2008–2020

EU-27	Growth_of_GDP_per_cap													Aver-	Invest_share												Aver-
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	age
Austria	0.4318	0.6402	0.5950	0.6811	0.4533	0.5273	0.0805	0.0000	0.1290	0.2577	0.3291	0.1915	0.2899	0.3544	0.1878	0.4539	0.4759	0.6482	0.6553	0.7167	0.8020	0.7565	0.4875	0.5517	0.7572	0.3343	0.4850	0.5625
Belgium	0.3523	0.7134	0.6198	0.5622	0.4467	0.5818	0.2184	0.0647	0.1452	0.2165	0.2532	0.3191	0.3550	0.3729	0.2365	0.4910	0.5250	0.6881	0.6735	0.6640	0.8122	0.7730	0.4948	0.5354	0.7279	0.3155	0.4379	0.5673
Bulgaria	0.7443	0.7073	0.6446	0.7946	0.5267	0.5818	0.2644	0.1767	0.6290	0.4536	0.5190	0.9787	0.4970	0.5783	0.7525	1.0000	0.5335	0.5339	0.5734	0.6059	0.6949	0.6493	0.3048	0.3136	0.2757	0.0945	0.0630	0.4919
Cyprus	0.4318	0.6037	0.4298	0.4270	0.1133	0.0000	0.0115	0.1724	1.0000	0.5876	0.6456	0.8298	0.3787	0.4332	0.4139	0.5571	0.5562	0.3953	0.2345	0.1762	0.1702	0.1338	0.2867	0.4226	0.4500	0.1916	0.2973	0.3296
Croatia	0.4830	0.4512	0.3802	0.5514	0.3067	0.5727	0.0920	0.1379	0.7258	0.5567	0.5696	0.8085	0.2189	0.4503	0.4603	0.7164	0.4202	0.4653	0.4620	0.4976	0.5559	0.5409	0.3540	0.3681	0.5231	0.2541	0.3801	0.4614
Czechia	0.4602	0.5671	0.6446	0.6486	0.3800	0.5727	0.3333	0.2241	0.3871	0.5979	0.4557	0.5106	0.3550	0.4721	0.5339	0.9749	1.0000	0.9639	0.8621	0.8571	0.9878	1.0000	0.5617	0.6118	0.8871	0.3834	0.5207	0.7803
Denmark	0.3068	0.5549	0.5785	0.5892	0.4333	0.6273	0.2184	0.0690	0.4032	0.3196	0.2785	0.1915	0.5680	0.3952	0.1681	0.2295	0.1464	0.3304	0.4272	0.4752	0.5647	0.5758	0.4036	0.4399	0.6191	0.2492	0.3822	0.3855
Estonia	0.0966	0.0000	0.6777	0.9514	0.6800	0.7455	0.4828	0.0862	0.5000	0.6907	0.5316	0.6596	0.6450	0.5190	0.6406	0.4679	0.4249	0.9248	1.0000	1.0000	1.0000	0.8592	0.5331	0.6109	0.7858	0.3634	0.4699	0.6985
Finland	0.3864	0.3659	0.6860	0.6541	0.3133	0.4545	0.0000	0.0086	0.4194	0.4021	0.2152	0.1915	0.5503	0.3575	0.2580	0.5080	0.5420	0.6593	0.6806	0.6544	0.7214	0.6633	0.4730	0.5387	0.7554	0.3060	0.4472	0.5544
France	0.3523	0.6768	0.5785	0.6324	0.4267	0.5909	0.1494	0.0302	0.1290	0.2887	0.2658	0.2553	0.2189	0.3535	0.2064	0.4198	0.5241	0.6445	0.6441	0.6562	0.7451	0.6804	0.4359	0.4991	0.6870	0.2999	0.4033	0.5266
Germany	0.4375	0.5549	0.8264	0.7514	0.4533	0.6000	0.2989	0.0259	0.2419	0.3299	0.1772	0.1277	0.4734	0.4076	0.0151	0.1393	0.2814	0.4934	0.5180	0.5266	0.6244	0.5866	0.3746	0.4017	0.5799	0.2509	0.3637	0.3966
Greece	0.3352	0.6037	0.0000	0.0000	0.0000	0.4182	0.2184	0.0216	0.0000	0.2268	0.3291	0.3830	0.1775	0.2087	0.2186	0.2916	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0392
Hungary	0.4375	0.4878	0.5702	0.6595	0.3933	0.7727	0.6092	0.1724	0.4194	0.5567	0.7848	1.0000	0.4438	0.5621	0.1913	0.4760	0.3305	0.4314	0.4484	0.5805	0.7573	0.7229	0.3419	0.4823	0.7946	0.3836	0.5400	0.4985
Ireland	0.0000	0.5183	0.5620	0.5622	0.4133	0.6364	1.0000	1.0000	0.1613	0.8969	1.0000	0.8085	1.0000	0.6584	0.2783	0.3287	0.0963	0.2220	0.4738	0.4473	0.6644	0.8453	1.0000	1.0000	1.0000	1.0000	1.0000	0.6428
Italy	0.2727	0.5305	0.5702	0.5622	0.2267	0.4000	0.0920	0.0388	0.2581	0.2887	0.2278	0.1064	0.1953	0.2899	0.0719	0.2234	0.3267	0.4447	0.3995	0.3632	0.3993	0.3912	0.2484	0.2651	0.3920	0.1704	0.2181	0.3011
Latvia	0.2443	0.1037	0.2645	0.7838	1.0000	0.8636	0.4253	0.2069	0.5484	0.5361	0.6962	0.6596	0.6036	0.5335	0.6852	0.4359	0.2351	0.6873	0.8544	0.7918	0.8115	0.7032	0.3347	0.4105	0.6419	0.2927	0.4568	0.5647
Lithuania	0.5795	0.0366	0.7769	1.0000	0.7867	1.0000	0.5977	0.1293	0.6290	0.6907	0.7215	1.0000	0.6982	0.6651	0.3496	0.0000	0.0283	0.3525	0.3412	0.4370	0.5451	0.5606	0.3569	0.3877	0.5728	0.2527	0.3351	0.3477
Luxembourg	0.2557	0.5793	0.6198	0.4703	0.3933	0.6364	0.1149	0.0129	0.3871	0.0000	0.0000	0.0000	0.5621	0.3101	0.0058	0.0140	0.0246	0.4078	0.4508	0.4389	0.5641	0.4147	0.2528	0.2805	0.2996	0.1623	0.1834	0.2692
Malta	0.5511	0.7683	0.8760	0.5405	0.6533	0.9455	0.7241	0.3017	0.1774	0.8969	0.4051	0.5745	0.0710	0.5758	0.0000	0.0401	0.4183	0.3304	0.3583	0.3220	0.3953	0.8516	0.5351	0.4627	0.5851	0.2506	0.3572	0.3774
Netherlands	0.4716	0.6280	0.5289	0.6000	0.3467	0.5455	0.2184	0.0647	0.2903	0.3299	0.3165	0.2340	0.4379	0.3856	0.1206	0.3437	0.2965	0.4764	0.4260	0.4334	0.4583	0.7191	0.3625	0.3891	0.5430	0.2481	0.3440	0.3970
Poland	0.6080	1.0000	0.6942	0.8108	0.5400	0.6636	0.5402	0.1940	0.5000	0.6289	0.8481	0.9149	0.5858	0.6560	0.1780	0.3567	0.3494	0.5177	0.4909	0.4679	0.6102	0.5897	0.2810	0.2675	0.4137	0.1795	0.1763	0.3753
Portugal	0.3807	0.6890	0.6033	0.4541	0.1933	0.5455	0.2414	0.0948	0.3871	0.4845	0.4684	0.5319	0.2012	0.4058	0.1629	0.3327	0.3787	0.3496	0.2528	0.2149	0.2847	0.3012	0.1806	0.2325	0.3727	0.1751	0.2648	0.2695
Romania	1.0000	0.5976	0.1901	0.8108	0.6000	0.6364	0.6092	0.1595	0.5806	1.0000	0.9241	0.8723	0.5148	0.6535	1.0000	0.8136	0.8980	1.0000	0.9428	0.8172	0.9173	0.8890	0.4815	0.4949	0.5793	0.3034	0.2968	0.7257
Slovakia	0.6761	0.5366	1.0000	0.7189	0.5200	0.6273	0.3908	0.2198	0.3065	0.3814	0.5823	0.4681	0.4911	0.5322	0.2730	0.2926	0.4287	0.7080	0.5256	0.5654	0.6590	0.8231	0.4069	0.4366	0.5769	0.2558	0.2844	0.4797
Slovenia	0.5625	0.3720	0.5455	0.5784	0.2533	0.4727	0.4023	0.0905	0.5161	0.5876	0.6076	0.5106	0.4083	0.4544	0.5449	0.6263	0.4268	0.4617	0.4420	0.5103	0.5614	0.4997	0.2569	0.3043	0.4745	0.2102	0.2580	0.4290
Spain	0.3239	0.6037	0.4380	0.4757	0.2400	0.4909	0.2874	0.1681	0.4839	0.3814	0.3291	0.2128	0.0000	0.3411	0.4522	0.5240	0.4939	0.4676	0.4125	0.3735	0.4712	0.4591	0.2802	0.3206	0.4857	0.2209	0.3080	0.4053
Sweeden	0.3011	0.5671	0.8843	0.6703	0.3533	0.6091	0.2759	0.1466	0.1452	0.2165	0.1899	0.1702	0.5266	0.3889	0.2614	0.4619	0.5600	0.6792	0.6594	0.6810	0.8407	0.8231	0.5323	0.6221	0.8209	0.3216	0.4679	0.5947

Annex 3. Normalized data of the $I_{SusEcon}$ sub-index's indicators: the employment rate and economic freedom index, EU-27, 2008–2020

EU-27	Employ_rate														Econ_freed_index												
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.7569	0.7461	0.7667	0.7374	0.7951	0.8067	0.7828	0.7578	0.7440	0.7333	0.7293	0.7464	0.6954	0.7537	0.6092	0.5941	0.5611	0.6304	0.6930	0.7923	0.8146	0.7544	0.7676	0.7178	0.6277	0.6272	0.6381	0.6790
Belgium	0.3993	0.4197	0.4167	0.3889	0.5000	0.5316	0.5243	0.4805	0.4600	0.4458	0.4454	0.4450	0.4518	0.4545	0.6197	0.6273	0.4932	0.5380	0.6326	0.6667	0.6927	0.6491	0.6307	0.5311	0.4416	0.4211	0.4286	0.5671
Bulgaria	0.2012	0.4974	0.2444	0.1566	0.3197	0.3866	0.4307	0.4688	0.4480	0.5542	0.5502	0.6459	0.6091	0.4241	0.3380	0.3506	0.1403	0.2500	0.4326	0.4638	0.4878	0.5614	0.5270	0.5353	0.4762	0.4956	0.4905	0.4268
Cyprus	0.6499	0.8446	0.8278	0.6970	0.6230	0.5316	0.5356	0.5078	0.5000	0.5417	0.6288	0.6938	0.7005	0.6371	0.6056	0.5793	0.5294	0.7065	0.7628	0.6570	0.5805	0.6096	0.6432	0.5353	0.4545	0.4561	0.4857	0.5851
Croatia	0.0280	0.2694	0.1111	0.0101	0.1270	0.1599	0.2210	0.2227	0.2080	0.2417	0.2489	0.2632	0.2944	0.1850	0.0000	0.0000	0.0000	0.0435	0.2558	0.2850	0.2293	0.3289	0.2448	0.1826	0.1602	0.1623	0.1095	0.1540
Czechia	0.5372	0.6166	0.5722	0.5707	0.6762	0.7286	0.7566	0.7773	0.8200	0.8625	0.8908	0.9139	0.9442	0.7436	0.4930	0.5277	0.4796	0.5489	0.6744	0.7488	0.8049	0.8114	0.8299	0.7593	0.7316	0.7018	0.7095	0.6785
Denmark	0.7910	0.8860	0.8222	0.7677	0.7910	0.7955	0.8015	0.8008	0.7920	0.7833	0.7860	0.8182	0.8477	0.8064	0.8838	0.9041	0.8462	0.9946	0.9674	1.0000	0.9951	0.9781	0.9170	0.8340	0.8355	0.8333	0.8762	0.9127
Estonia	0.5025	0.5699	0.3722	0.5556	0.7049	0.7584	0.7865	0.8438	0.8160	0.8708	0.8734	0.9091	0.8985	0.7278	0.8380	0.7860	0.7014	0.8098	0.8279	0.9614	0.9854	1.0000	0.9959	1.0000	0.9307	0.8289	0.8476	0.8856
Finland	0.7049	0.7513	0.7167	0.7172	0.7787	0.7584	0.7416	0.7031	0.6880	0.6833	0.7336	0.7656	0.7817	0.7326	0.7218	0.7159	0.6606	0.7446	0.7860	0.8986	0.8634	0.8509	0.8050	0.7884	0.7273	0.7544	0.7524	0.7746
France	0.6163	0.5596	0.5278	0.5000	0.6025	0.6245	0.6255	0.6016	0.5800	0.5625	0.5459	0.5311	0.5584	0.5720	0.3732	0.3026	0.2262	0.2337	0.3628	0.4203	0.3805	0.3728	0.3776	0.3444	0.2857	0.2675	0.2905	0.3260
Germany	0.8226	0.7876	0.8278	0.8535	0.8975	0.9071	0.9139	0.9023	0.8960	0.8917	0.8908	0.9282	0.9594	0.8830	0.5810	0.5683	0.5385	0.6250	0.7256	0.8406	0.8634	0.8684	0.8797	0.7801	0.7316	0.6930	0.6476	0.7187
Greece	0.0352	0.3420	0.2056	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0448	0.2289	0.2103	0.1584	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0460
Hungary	0.0889	0.1813	0.1167	0.1616	0.3607	0.4572	0.5768	0.6250	0.7000	0.7333	0.7511	0.7847	0.8325	0.4900	0.4754	0.4317	0.3122	0.3424	0.5442	0.5749	0.5512	0.5614	0.5311	0.4481	0.4069	0.3202	0.3095	0.4469
Ireland	0.2864	0.4663	0.3000	0.2525	0.3893	0.5056	0.5543	0.5859	0.6080	0.6333	0.6376	0.6651	0.6244	0.5007	1.0000	1.0000	1.0000	1.0000	1.0000	0.9807	1.0000	0.9912	1.0000	0.9004	1.0000	1.0000	1.0000	0.9902
Italy	0.0841	0.1347	0.0500	0.0707	0.2418	0.2528	0.2472	0.2188	0.2160	0.1875	0.1528	0.1100	0.0761	0.1571	0.2993	0.2325	0.1584	0.0000	0.1581	0.2512	0.2537	0.3377	0.3320	0.3112	0.2251	0.1974	0.1857	0.2263
Latvia	0.2895	0.3782	0.2111	0.3283	0.5287	0.6171	0.6479	0.6875	0.6720	0.7000	0.7555	0.7703	0.8020	0.5683	0.5000	0.4244	0.3167	0.2989	0.4558	0.5362	0.6341	0.6886	0.7137	0.8216	0.7056	0.5570	0.5714	0.5557
Lithuania	0.3301	0.4145	0.2333	0.3687	0.5533	0.6320	0.6929	0.7188	0.7600	0.7583	0.7991	0.8134	0.7919	0.6051	0.5915	0.5498	0.5023	0.5978	0.7488	0.8068	0.8439	0.9079	0.9129	0.8631	0.7792	0.7237	0.8000	0.7406
Luxembourg	0.5846	0.5907	0.5889	0.5303	0.6721	0.6766	0.7041	0.6250	0.5800	0.5708	0.5502	0.5550	0.5584	0.5990	0.7254	0.7417	0.7330	0.8641	0.8884	0.9082	0.9024	0.8421	0.8589	0.8672	0.8268	0.7982	0.7571	0.8241
Malta	0.0000	0.0000	0.0000	0.1010	0.3648	0.4944	0.5468	0.5508	0.5960	0.6333	0.6987	0.7464	0.8223	0.4273	0.4190	0.4059	0.3620	0.2935	0.5395	0.5845	0.5220	0.5482	0.5602	0.5270	0.4848	0.4781	0.4571	0.4755
Netherlands	0.8489	0.9223	0.8944	0.8485	0.8852	0.8550	0.8277	0.8398	0.8360	0.8417	0.8603	0.9043	0.9594	0.8710	0.8204	0.8081	0.7149	0.7826	0.8326	0.8744	0.9024	0.8640	0.8880	0.8631	0.8182	0.8377	0.8143	0.8324
Poland	0.2105	0.3057	0.2333	0.2475	0.3975	0.4461	0.4944	0.5039	0.5240	0.5458	0.5546	0.5646	0.6345	0.4356	0.2183	0.1919	0.1810	0.2065	0.4093	0.5121	0.5512	0.6404	0.6680	0.5519	0.4848	0.4430	0.4381	0.4228
Portugal	0.2676	0.4456	0.3778	0.3586	0.3689	0.3903	0.4794	0.5078	0.5320	0.6125	0.6638	0.6842	0.6650	0.4887	0.3451	0.3616	0.2353	0.2011	0.3535	0.3720	0.3805	0.4956	0.4938	0.3154	0.2641	0.3333	0.3381	0.3453
Romania	0.2090	0.2332	0.2611	0.2121	0.4016	0.4387	0.4644	0.4336	0.4040	0.4583	0.4541	0.4641	0.4924	0.3790	0.2676	0.2989	0.2262	0.2391	0.4186	0.4686	0.4780	0.5526	0.5145	0.6100	0.5238	0.4781	0.4667	0.4264
Slovakia	0.2485	0.3834	0.2500	0.2727	0.4139	0.4498	0.4719	0.5000	0.5440	0.5542	0.5633	0.5837	0.5787	0.4473	0.5599	0.5277	0.4751	0.5000	0.5395	0.6425	0.5220	0.5789	0.5560	0.4440	0.3463	0.3202	0.3286	0.4877
Slovenia	0.4585	0.6684	0.5667	0.4444	0.5451	0.5316	0.5393	0.5547	0.5560	0.6500	0.6943	0.7273	0.7360	0.5902	0.2148	0.2878	0.2489	0.2337	0.3488	0.3043	0.3415	0.2763	0.3071	0.1743	0.3247	0.3421	0.3762	0.2908
Spain	0.0894	0.2591	0.1500	0.1212	0.1885	0.2119	0.2472	0.2773	0.3080	0.3208	0.3275	0.3254	0.2335	0.2354	0.5282	0.5535	0.4706	0.5380	0.6372	0.6087	0.5610	0.5965	0.6349	0.3568	0.3377	0.3509	0.3333	0.5006
Sweeden	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.5880	0.5683	0.5973	0.6304	0.7581	0.8454	0.8488	0.8202	0.7801	0.8257	0.8225	0.7675	0.7143	0.7359

Annex 4. Normalized data of the $I_{SusEcon}$ sub-index's indicators: new business density rate, EU-27, 2008–2020

EU-27	New_business													
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.0083	0.0048	0.0000	0.0074	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016
Belgium	0.0951	0.1211	0.1159	0.1263	0.1020	0.1338	0.1297	0.1315	0.1367	0.1232	0.1388	0.1533	0.1748	0.1294
Bulgaria	0.0587	0.0588	0.0360	0.0555	0.0574	0.0750	0.0652	0.0759	0.0799	0.0683	0.0628	0.0515	0.0370	0.0602
Cyprus	1.0000	1.0000	1.0000	1.0000	1.0000	0.8156	0.7776	0.7596	0.8533	0.7589	0.7400	0.6133	0.5382	0.8351
Croatia	0.1023	0.1128	0.0826	0.0899	0.1056	0.2848	0.2404	0.2280	0.2320	0.2356	0.2321	0.2086	0.1652	0.1785
Czechia	0.0886	0.1244	0.1063	0.1065	0.1136	0.1638	0.1710	0.1814	0.1833	0.1870	0.1683	0.1511	0.1379	0.1449
Denmark	0.2198	0.2182	0.1954	0.1961	0.1941	0.2637	0.3888	0.4451	0.4581	0.4408	0.4122	0.3876	0.4178	0.3260
Estonia	0.3258	0.4248	0.4074	0.5972	0.6784	1.0000	0.9143	0.9723	1.0000	1.0000	1.0000	1.0000	1.0000	0.7939
Finland	0.1170	0.1493	0.1245	0.1355	0.1396	0.1922	0.1712	0.1780	0.1806	0.1652	0.1639	0.1973	0.2260	0.1646
France	0.1135	0.1581	0.1414	0.1506	0.1511	0.2076	0.2024	0.2055	0.2123	0.1996	0.1875	0.1955	0.1996	0.1788
Germany	0.0304	0.0474	0.0364	0.0428	0.0379	0.0504	0.0445	0.0442	0.0422	0.0384	0.0366	0.0357	0.0350	0.0402
Greece	0.0000	0.0000	0.0028	0.0000	0.0002	0.0122	0.0123	0.0090	0.0165	0.0282	0.0403	0.0507	0.0517	0.0172
Hungary	0.1897	0.2784	0.2464	0.3005	0.1937	0.2306	0.1829	0.1497	0.1506	0.1392	0.1399	0.1414	0.1472	0.1916
Ireland	0.1404	0.1883	0.1640	0.1778	0.1817	0.2740	0.3067	0.3275	0.3271	0.3087	0.2837	0.2704	0.2641	0.2473
Italy	0.0634	0.0851	0.0730	0.0724	0.0672	0.1038	0.1071	0.1164	0.1116	0.1102	0.1063	0.0968	0.1018	0.0935
Latvia	0.1807	0.2217	0.3282	0.4879	0.5053	0.6925	0.5949	0.5249	0.4004	0.3264	0.3249	0.3050	0.2686	0.3970
Lithuania	0.0709	0.1035	0.1083	0.1439	0.2257	0.2238	0.2232	0.1525	0.1491	0.1417	0.1216	0.1136	0.1031	0.1447
Luxembourg	0.3126	0.4957	0.5080	0.2096	0.6163	0.9644	1.0000	0.9272	0.7814	0.7266	0.7232	0.7912	0.8473	0.6849
Malta	0.2934	0.4216	0.4151	0.4646	0.6005	0.9418	0.9728	1.0000	0.8686	0.7820	0.7343	0.5047	0.4025	0.6463
Netherlands	0.0810	0.1220	0.1023	0.1115	0.1183	0.1666	0.1578	0.1565	0.1231	0.1112	0.1066	0.1015	0.1087	0.1206
Poland	0.0071	0.0062	0.0070	0.0167	0.0201	0.0392	0.0366	0.0574	0.0608	0.0464	0.0404	0.0444	0.0469	0.0330
Portugal	0.1316	0.1781	0.1485	0.1755	0.1608	0.2632	0.2449	0.2591	0.2380	0.2409	0.2594	0.2705	0.2081	0.2137
Romania	0.2149	0.1787	0.1349	0.1844	0.1831	0.2483	0.2151	0.2454	0.2680	0.3307	0.2953	0.2863	0.2409	0.2328
Slovakia	0.1343	0.1794	0.1667	0.1888	0.2122	0.4042	0.1662	0.1557	0.2234	0.2223	0.2057	0.2064	0.1943	0.2046
Slovenia	0.1273	0.1817	0.1389	0.1549	0.1776	0.2427	0.2320	0.1956	0.1354	0.1313	0.1097	0.0982	0.0800	0.1543
Spain	0.0913	0.0952	0.0788	0.0928	0.1002	0.1510	0.1432	0.1401	0.1422	0.1172	0.1094	0.1012	0.0830	0.1112
Sweeden	0.1354	0.1764	0.2155	0.2824	0.2691	0.3700	0.3709	0.3914	0.3950	0.3394	0.2897	0.2779	0.3570	0.2977

Annex 5. Normalized data of the $I_{SusInnov}$ sub-index's indicators: GDE on R&D and human resource in science and technology, EU-27, 2008–2020

EU-27	GDE_on_R&D														Human_in_tech													
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.6921	0.6565	0.7003	0.7003	0.8345	0.8889	0.9747	0.9380	0.9537	0.8951	0.9184	0.9107	0.9016	0.8434	0.5485	0.4813	0.4706	0.4702	0.4850	0.4972	0.5835	0.6792	0.6719	0.7249	0.6757	0.6451	0.6503	0.5833
Belgium	0.4921	0.4742	0.4954	0.5426	0.6216	0.6736	0.7184	0.7117	0.7402	0.7587	0.8369	0.9244	1.0000	0.6915	0.8955	0.7719	0.7864	0.7586	0.7425	0.6806	0.6555	0.7390	0.7344	0.8608	0.7958	0.7437	0.7705	0.7642
Bulgaria	0.0190	0.0152	0.0398	0.0252	0.0541	0.0868	0.1480	0.1715	0.1174	0.0839	0.0922	0.1237	0.1279	0.0850	0.3134	0.2594	0.2539	0.2288	0.2186	0.2472	0.2519	0.2925	0.2875	0.2848	0.2673	0.2366	0.2623	0.2619
Cyprus	0.0000	0.0000	0.0000	0.0000	0.0000	0.0347	0.0469	0.0000	0.0285	0.0175	0.0426	0.0893	0.1246	0.0295	0.7724	0.6094	0.6223	0.6803	0.6886	0.6333	0.5964	0.7013	0.7188	0.7508	0.7237	0.6845	0.6721	0.6811
Croatia	0.1587	0.1216	0.0917	0.0946	0.1047	0.1458	0.1444	0.1314	0.1495	0.1259	0.1667	0.2165	0.2623	0.1472	0.2239	0.2125	0.2384	0.1379	0.1796	0.2611	0.2442	0.2893	0.3063	0.3398	0.3634	0.3352	0.3169	0.2653
Czechia	0.2667	0.2584	0.2722	0.3438	0.4493	0.5174	0.5704	0.5255	0.4377	0.4441	0.4965	0.4983	0.4984	0.4291	0.5261	0.4500	0.4303	0.3292	0.3323	0.3361	0.3213	0.3491	0.3469	0.3851	0.3604	0.3268	0.3333	0.3713
Denmark	0.7556	0.7964	0.7584	0.7855	0.8581	0.8958	0.9134	0.9416	0.9431	0.8497	0.8759	0.8419	0.8393	0.8504	0.9813	0.8188	0.8452	0.8370	0.8323	0.7972	0.7326	0.8679	0.8688	0.9450	0.8949	0.8507	0.8443	0.8551
Estonia	0.2730	0.2918	0.3486	0.5868	0.5676	0.4618	0.3791	0.3613	0.2847	0.2727	0.3262	0.3952	0.4328	0.3832	0.7985	0.7000	0.6594	0.6865	0.7096	0.6611	0.5990	0.6572	0.6344	0.6926	0.6697	0.6676	0.6667	0.6771
Finland	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8723	0.8114	0.7797	0.8014	0.7973	0.8098	0.9132	1.0000	0.8406	0.8514	0.8527	0.8413	0.8194	0.7712	0.9277	0.9156	0.9709	0.9159	0.8930	0.9071	0.8851
France	0.5302	0.5380	0.5321	0.5489	0.6047	0.6424	0.6679	0.6387	0.6335	0.5944	0.6028	0.5876	0.6164	0.5952	0.7313	0.6250	0.6161	0.6897	0.6766	0.6611	0.6041	0.7233	0.7188	0.7508	0.7297	0.7127	0.7322	0.6901
Germany	0.7079	0.6991	0.7003	0.7445	0.8243	0.8507	0.9025	0.8942	0.8897	0.8916	0.9255	0.9244	0.8754	0.8331	0.7836	0.6688	0.6749	0.6082	0.6257	0.6028	0.5501	0.6509	0.6500	0.6796	0.6426	0.6225	0.6093	0.6438
Greece	0.0857	0.0578	0.0489	0.0726	0.0912	0.1493	0.1661	0.1788	0.2028	0.2273	0.2518	0.2715	0.3344	0.1645	0.3321	0.2656	0.2663	0.2602	0.2635	0.2778	0.2519	0.2862	0.3063	0.3495	0.3393	0.3127	0.3361	0.2959
Hungary	0.1873	0.2097	0.2110	0.2303	0.2770	0.3472	0.3502	0.3139	0.2633	0.2867	0.3582	0.3436	0.3770	0.2889	0.3843	0.3063	0.2817	0.2884	0.3024	0.3028	0.2751	0.3050	0.2719	0.2848	0.2823	0.2817	0.3142	0.2985
Ireland	0.3175	0.3556	0.3547	0.3470	0.3784	0.4097	0.4116	0.2555	0.2633	0.2657	0.2376	0.2577	0.2492	0.3157	0.8022	0.7094	0.7307	0.7806	0.7904	0.7694	0.7069	0.8553	0.8531	0.9353	0.8799	0.8394	0.8852	0.8106
Italy	0.2444	0.2371	0.2385	0.2366	0.2770	0.3160	0.3466	0.3139	0.3310	0.3042	0.3262	0.3402	0.3508	0.2971	0.4627	0.3406	0.3127	0.2884	0.2754	0.2694	0.2416	0.2673	0.2531	0.2783	0.2733	0.2563	0.2623	0.2909
Latvia	0.0603	0.0030	0.0520	0.0757	0.0743	0.0764	0.1119	0.0511	0.0000	0.0035	0.0496	0.0550	0.0754	0.0529	0.6119	0.4750	0.4365	0.4013	0.4371	0.4472	0.3882	0.4843	0.4906	0.5405	0.4955	0.5239	0.5273	0.4815
Lithuania	0.1270	0.1185	0.1040	0.1420	0.1520	0.1944	0.2347	0.2044	0.1423	0.1399	0.1560	0.1787	0.2295	0.1633	0.7201	0.5688	0.5820	0.5705	0.5509	0.5694	0.5373	0.6667	0.6719	0.7023	0.6787	0.6676	0.6557	0.6263
Luxembourg	0.3905	0.3769	0.3242	0.3186	0.2804	0.3160	0.3213	0.2993	0.3060	0.2692	0.2376	0.2337	0.2164	0.2992	0.8396	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9676	1.0000	1.0000	1.0000	0.9852
Malta	0.0444	0.0213	0.0459	0.0694	0.1216	0.1215	0.1119	0.0876	0.0427	0.0175	0.0248	0.0309	0.0623	0.0617	0.3433	0.2875	0.2693	0.3103	0.3623	0.3861	0.3573	0.4151	0.3969	0.4887	0.5465	0.5408	0.5246	0.4022
Netherlands	0.3905	0.3739	0.3853	0.4511	0.5000	0.6146	0.6462	0.6095	0.6085	0.5874	0.5816	0.5842	0.5967	0.5330	0.9701	0.8156	0.8359	0.8276	0.7964	0.7667	0.6992	0.8365	0.8438	0.8932	0.8709	0.8592	0.8852	0.8385
Poland	0.0667	0.0669	0.0856	0.0946	0.1486	0.1701	0.2022	0.1898	0.1851	0.1853	0.2518	0.2887	0.3016	0.1721	0.3881	0.3563	0.3715	0.3511	0.3653	0.3861	0.3805	0.4591	0.4750	0.5275	0.5195	0.5014	0.4973	0.4291
Portugal	0.3333	0.3465	0.3364	0.3186	0.3176	0.3229	0.3285	0.2774	0.2989	0.2867	0.3014	0.3162	0.3639	0.3191	0.0000	0.0000	0.0000	0.0470	0.0958	0.1361	0.1902	0.2453	0.2688	0.2816	0.2883	0.2845	0.3415	0.1676
Romania	0.0508	0.0000	0.0061	0.0158	0.0169	0.0000	0.0000	0.0036	0.0142	0.0000	0.0000	0.0000	0.0000	0.0083	0.0299	0.0188	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0040
Slovakia	0.0222	0.0091	0.0520	0.0662	0.1216	0.1493	0.1805	0.2482	0.1246	0.1364	0.1206	0.1203	0.1475	0.1153	0.3358	0.2656	0.2972	0.2665	0.2096	0.2056	0.1877	0.2044	0.2063	0.2427	0.2703	0.2789	0.3087	0.2522
Slovenia	0.3937	0.4164	0.4924	0.6183	0.7162	0.7535	0.7184	0.6277	0.5587	0.4790	0.5142	0.5395	0.5508	0.5676	0.6381	0.5344	0.5232	0.5329	0.5180	0.5111	0.4653	0.5692	0.5906	0.6505	0.5856	0.5634	0.6066	0.5607
Spain	0.2984	0.2796	0.2813	0.2776	0.2905	0.3090	0.3105	0.2701	0.2669	0.2483	0.2624	0.2646	0.3082	0.2821	0.5933	0.4781	0.4861	0.4608	0.4461	0.4472	0.4267	0.4937	0.4938	0.5372	0.5165	0.5155	0.5301	0.4942
Sweeden	0.9778	0.8997	0.8349	0.8644	0.9426	0.9965	0.9819	1.0000	1.0000	1.0000	1.0000	1.0000	0.9967	0.9611	0.9813	0.8188	0.8173	0.8245	0.8114	0.7972	0.7584	0.9182	0.9469	1.0000	0.9610	0.9155	0.9016	0.8809

Annex 6. Normalized data of the $I_{SusInnov}$ sub-index's indicators: R&D personnel and number of patent application to EPO, EU-27, 2008–2020

EU-27	R&D personnel														Patent												
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.5895	0.5856	0.6136	0.6053	0.7024	0.7025	0.7432	0.7315	0.7308	0.7779	0.8419	0.8535	0.8321	0.7161	0.0561	0.0591	0.0635	0.0657	0.0683	0.0748	0.0763	0.0798	0.0808	0.0861	0.0851	0.0870	0.0880	0.0747
Belgium	0.4916	0.5236	0.5029	0.5219	0.6129	0.6089	0.6544	0.6894	0.6734	0.7543	0.8267	0.8470	0.9576	0.6665	0.0710	0.0644	0.0745	0.0764	0.0688	0.0706	0.0749	0.0819	0.0883	0.0839	0.0876	0.0899	0.0917	0.0788
Bulgaria	0.0962	0.1265	0.1049	0.1074	0.1208	0.1309	0.1569	0.2084	0.2402	0.1978	0.2538	0.2521	0.2507	0.1728	0.0003	0.0002	0.0001	0.0001	0.0000	0.0005	0.0010	0.0010	0.0004	0.0009	0.0007	0.0006	0.0012	0.0005
Cyprus	0.0000	0.0125	0.0139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0376	0.0716	0.0699	0.0158	0.0018	0.0012	0.0015	0.0016	0.0016	0.0012	0.0014	0.0012	0.0010	0.0015	0.0014	0.0011	0.0016	0.0014
Croatia	0.1329	0.1563	0.1534	0.1402	0.1551	0.1581	0.1305	0.1457	0.1633	0.1639	0.2151	0.2600	0.2862	0.1739	0.0006	0.0003	0.0003	0.0002	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0002
Czechia	0.3594	0.3728	0.3805	0.4049	0.4911	0.4993	0.5201	0.5281	0.4937	0.5550	0.6220	0.6499	0.6705	0.5036	0.0039	0.0049	0.0058	0.0057	0.0047	0.0053	0.0062	0.0082	0.0071	0.0077	0.0088	0.0069	0.0071	0.0063
Denmark	0.9282	0.9148	0.9124	0.9111	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9743	0.0592	0.0583	0.0662	0.0675	0.0585	0.0729	0.0771	0.0771	0.0740	0.0814	0.0890	0.0896	0.0919	0.0740
Estonia	0.2392	0.2833	0.2694	0.2889	0.3360	0.3351	0.3287	0.3032	0.2846	0.3127	0.3312	0.3405	0.3399	0.3071	0.0000	0.0008	0.0007	0.0005	0.0010	0.0012	0.0012	0.0009	0.0013	0.0017	0.0013	0.0011	0.0013	0.0010
Finland	0.9682	1.0000	0.9739	0.9211	0.9880	0.9629	0.9391	0.8776	0.7894	0.8616	0.8882	0.8896	0.9348	0.9227	0.0673	0.0558	0.0589	0.0586	0.0675	0.0711	0.0848	0.0800	0.0716	0.0700	0.0644	0.0630	0.0722	0.0681
France	0.5521	0.5761	0.5735	0.5647	0.6283	0.6307	0.6216	0.6214	0.6057	0.6549	0.6862	0.6842	0.7060	0.6235	0.3408	0.3569	0.3502	0.3667	0.3629	0.3708	0.4139	0.4335	0.4202	0.4156	0.3923	0.3819	0.4061	0.3855
Germany	0.5151	0.5516	0.5713	0.5830	0.6557	0.6406	0.6527	0.6799	0.6590	0.7293	0.7734	0.7787	0.7793	0.6592	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Greece	0.2337	0.2749	0.2976	0.2359	0.2707	0.3281	0.3392	0.4040	0.2935	0.3721	0.4327	0.4553	0.5048	0.3417	0.0031	0.0035	0.0027	0.0024	0.0024	0.0022	0.0034	0.0033	0.0026	0.0036	0.0040	0.0046	0.0044	0.0032
Hungary	0.1870	0.2313	0.2462	0.2625	0.3067	0.3313	0.3022	0.2816	0.2424	0.2990	0.4865	0.4980	0.5297	0.3234	0.0038	0.0041	0.0036	0.0031	0.0034	0.0035	0.0041	0.0035	0.0039	0.0033	0.0039	0.0029	0.0033	0.0036
Ireland	0.2962	0.3144	0.3203	0.3563	0.5930	0.6471	0.6785	0.6182	0.6335	0.6431	0.5821	0.5690	0.5801	0.5255	0.0179	0.0243	0.0230	0.0244	0.0219	0.0210	0.0240	0.0244	0.0287	0.0255	0.0305	0.0323	0.0366	0.0257
Italy	0.3186	0.3490	0.3406	0.3302	0.3795	0.3909	0.3858	0.3979	0.4352	0.5115	0.5874	0.5944	0.6000	0.4324	0.1632	0.1540	0.1489	0.1511	0.1370	0.1395	0.1421	0.1604	0.1662	0.1704	0.1648	0.1664	0.1765	0.1570
Latvia	0.1519	0.1173	0.1308	0.1205	0.1483	0.1416	0.1623	0.1492	0.1080	0.1157	0.1468	0.1560	0.1848	0.1410	0.0013	0.0014	0.0008	0.0005	0.0004	0.0026	0.0000	0.0008	0.0000	0.0002	0.0000	0.0001	0.0002	0.0007
Lithuania	0.2838	0.2725	0.2832	0.2408	0.2421	0.2667	0.2856	0.2371	0.2292	0.2623	0.2829	0.3157	0.3620	0.2741	0.0002	0.0000	0.0000	0.0000	0.0002	0.0005	0.0006	0.0012	0.0006	0.0005	0.0009	0.0004	0.0011	0.0005
Luxembourg	1.0000	0.9752	1.0000	1.0000	0.9198	0.9415	0.9504	0.8758	0.8624	0.9074	0.8745	0.8756	0.8300	0.9241	0.0100	0.0140	0.0150	0.0145	0.0160	0.0158	0.0174	0.0168	0.0219	0.0205	0.0157	0.0148	0.0143	0.0159
Malta	0.1329	0.1298	0.1853	0.2436	0.2778	0.2343	0.2374	0.2103	0.1958	0.1814	0.1557	0.1427	0.1813	0.1930	0.0008	0.0019	0.0008	0.0006	0.0004	0.0012	0.0021	0.0034	0.0025	0.0023	0.0014	0.0015	0.0017	0.0016
Netherlands	0.4172	0.3968	0.4683	0.5548	0.6270	0.7010	0.7043	0.7020	0.7025	0.7742	0.8231	0.8071	0.8079	0.6528	0.2758	0.2661	0.2180	0.2143	0.1856	0.2205	0.2679	0.2878	0.2748	0.2755	0.2675	0.2589	0.2450	0.2506
Poland	0.0714	0.0727	0.1026	0.1010	0.1342	0.1421	0.1703	0.1823	0.1742	0.2794	0.3526	0.3538	0.3808	0.1936	0.0061	0.0064	0.0072	0.0089	0.0136	0.0137	0.0185	0.0225	0.0153	0.0171	0.0190	0.0166	0.0178	0.0140
Portugal	0.3253	0.3367	0.3350	0.3436	0.3613	0.3563	0.3557	0.3617	0.3667	0.4263	0.4724	0.4941	0.5461	0.3909	0.0029	0.0040	0.0026	0.0026	0.0023	0.0032	0.0041	0.0053	0.0059	0.0055	0.0078	0.0095	0.0088	0.0050
Romania	0.0054	0.0000	0.0000	0.0151	0.0335	0.0417	0.0286	0.0282	0.0205	0.0009	0.0000	0.0000	0.0000	0.0134	0.0004	0.0001	0.0002	0.0002	0.0008	0.0009	0.0008	0.0008	0.0008	0.0016	0.0014	0.0008	0.0012	0.0008
Slovakia	0.1443	0.1624	0.2035	0.1936	0.2138	0.1906	0.1933	0.1869	0.1687	0.1902	0.2247	0.2402	0.2627	0.1981	0.0008	0.0005	0.0006	0.0011	0.0008	0.0007	0.0007	0.0015	0.0013	0.0012	0.0014	0.0009	0.0013	0.0010
Slovenia	0.4403	0.5063	0.5217	0.6394	0.6810	0.6941	0.6658	0.6129	0.6045	0.6281	0.6936	0.7443	0.6737	0.6235	0.0045	0.0041	0.0045	0.0044	0.0035	0.0047	0.0046	0.0044	0.0041	0.0034	0.0033	0.0039	0.0055	0.0042
Spain	0.3366	0.3603	0.3536	0.3219	0.3400	0.3284	0.3199	0.3143	0.3072	0.3398	0.3723	0.3707	0.3732	0.3414	0.0495	0.0495	0.0520	0.0531	0.0562	0.0564	0.0571	0.0609	0.0627	0.0651	0.0663	0.0698	0.0682	0.0590
Sweeden	0.7194	0.7208	0.6981	0.6788	0.7665	0.7459	0.7589	0.7333	0.7705	0.7772	0.8152	0.7798	0.8193	0.7526	0.1173	0.1248	0.1311	0.1384	0.1287	0.1383	0.1508	0.1544	0.1419	0.1478	0.1517	0.1636	0.1697	0.1430

Annex 7. Normalized data of the $I_{SusInnov}$ sub-index's indicators: enterprises with Internet and households with Internet, EU-27, 2008–2020

EU-27	Enter_with_Int														Households_with_Int												
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.8757	0.8934	0.9113	0.9295	0.9048	0.8824	0.8667	0.8187	0.9444	1.0000	1.0000	1.0000	1.0000	0.9251	0.6721	0.6182	0.6833	0.7455	0.7297	0.6741	0.6053	0.6111	0.6471	0.6774	0.6538	0.6087	0.5556	0.6525
Belgium	0.8000	0.8251	0.8505	0.8761	0.8571	0.7647	0.8000	0.7602	0.9444	1.0000	0.9333	0.9444	1.0000	0.8735	0.7705	0.7091	0.7833	0.7818	0.6757	0.6481	0.6579	0.5556	0.5588	0.5484	0.5000	0.5652	0.6667	0.6478
Bulgaria	0.3026	0.3601	0.4181	0.4768	0.3810	0.3529	0.4000	0.3509	0.5000	0.6667	0.6667	0.6667	0.7895	0.4871	0.1311	0.0364	0.0500	0.1636	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0314
Cyprus	0.6654	0.6850	0.7048	0.7249	0.7619	0.5882	0.7333	0.5848	0.7778	0.7333	0.7333	0.7778	0.8947	0.7204	0.3279	0.4182	0.4667	0.4545	0.3243	0.2593	0.3421	0.3333	0.3235	0.3871	0.5769	0.6087	0.7222	0.4265
Croatia	0.6962	0.6986	0.7010	0.7035	0.7619	0.8824	0.7333	0.2924	0.5000	0.7333	0.8000	0.8889	0.6842	0.6981	0.2295	0.2727	0.4333	0.4545	0.2703	0.2593	0.3158	0.4722	0.4118	0.2903	0.3846	0.2609	0.3333	0.3376
Czechia	0.8320	0.8380	0.8440	0.8501	0.8571	0.7647	0.8667	0.7602	0.8889	0.8667	0.8667	0.8333	0.8947	0.8433	0.3770	0.4545	0.5167	0.5818	0.5135	0.3889	0.5263	0.4722	0.5000	0.5161	0.5769	0.5217	0.5000	0.4958
Denmark	0.8487	0.8683	0.8880	0.9080	0.8571	0.8824	0.8667	0.8187	0.9444	0.8667	1.0000	1.0000	1.0000	0.9038	1.0000	0.9455	0.9500	0.9636	0.9459	0.8556	0.7632	0.6944	0.8529	0.8065	0.7308	0.7826	0.7778	0.8514
Estonia	0.7539	0.7710	0.7884	0.8059	0.8095	0.8235	0.7333	0.7018	0.7778	0.6667	0.9333	0.8889	0.9474	0.8001	0.6721	0.6727	0.6833	0.6182	0.6216	0.6222	0.6579	0.7778	0.6471	0.6452	0.6923	0.6522	0.5556	0.6552
Finland	0.9821	0.9849	0.9877	0.9906	1.0000	0.9412	1.0000	0.8772	1.0000	1.0000	1.0000	1.0000	1.0000	0.9818	0.8689	0.9091	0.8833	0.9091	0.9459	0.8815	0.8684	0.8611	0.8235	0.8387	0.8462	0.7826	0.8889	0.8698
France	0.9218	0.9282	0.9346	0.9412	0.9524	0.9412	0.9333	0.8187	0.8889	0.9333	0.9333	1.0000	1.0000	0.9328	0.7213	0.7091	0.7167	0.7091	0.7297	0.6222	0.5526	0.4722	0.4706	0.3871	0.3846	0.3478	0.4453	0.5591
Germany	0.8449	0.8557	0.8667	0.8777	0.8571	0.8824	0.8667	0.7602	0.8889	0.8000	0.9333	0.9444	0.9474	0.8712	0.6885	0.7455	0.8667	0.8545	0.8649	0.8037	0.8158	0.8056	0.7941	0.8065	0.7308	0.8261	0.8889	0.8070
Greece	0.2872	0.2905	0.2939	0.2973	0.5714	0.2353	0.2667	0.1170	0.2222	0.0667	0.0667	0.1667	0.7895	0.2824	0.1475	0.1636	0.3000	0.2545	0.0270	0.0259	0.2368	0.2222	0.1471	0.1290	0.1923	0.1304	0.0556	0.1563
Hungary	0.2821	0.3221	0.3625	0.4033	0.4762	0.2941	0.2000	0.2339	0.4444	0.5333	0.4000	0.6111	0.6842	0.4036	0.4590	0.4727	0.4667	0.5091	0.4324	0.3889	0.4474	0.4444	0.4412	0.4839	0.4615	0.4783	0.4444	0.4561
Ireland	0.7577	0.7643	0.7709	0.7776	0.7143	0.7059	0.8667	0.7018	0.8889	0.7333	0.8000	0.7778	0.7895	0.7730	0.4918	0.5455	0.5833	0.6182	0.4054	0.3370	0.6316	0.6667	0.6765	0.6774	0.6538	0.6522	0.7222	0.5894
Italy	0.8333	0.8374	0.8414	0.8455	0.8095	0.8235	0.8667	0.7602	0.8889	0.8667	0.8000	0.8889	0.8421	0.8388	0.2951	0.2727	0.4333	0.3818	0.1351	0.3630	0.3947	0.4167	0.4118	0.3871	0.4615	0.3913	0.4444	0.3684
Latvia	0.6433	0.6927	0.7426	0.7930	0.5714	0.6471	0.7333	1.0000	0.8333	0.8667	0.9333	0.9444	1.0000	0.8001	0.4426	0.4727	0.5000	0.5091	0.4595	0.4148	0.4474	0.4167	0.3529	0.2903	0.3077	0.3478	0.5000	0.4201
Lithuania	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8772	1.0000	1.0000	1.0000	1.0000	1.0000	0.9906	0.4918	0.4727	0.5167	0.4545	0.2703	0.2593	0.2368	0.2222	0.2353	0.2581	0.2692	0.2609	0.1667	0.3165
Luxembourg	0.7680	0.7929	0.8181	0.8436	0.7619	0.7647	0.8667	0.7602	0.8889	0.8667	0.9333	0.9444	0.9474	0.8428	0.7869	0.8545	0.7833	0.6727	0.4865	0.4148	0.9737	1.0000	1.0000	0.9677	0.8462	0.8696	0.8333	0.8069
Malta	0.7398	0.7491	0.7586	0.7682	0.7619	0.7059	0.8000	0.7018	0.7778	0.7333	0.7333	0.8333	0.8421	0.7619	0.6885	0.7091	0.7667	0.8000	0.7297	0.6222	0.6316	0.6111	0.5294	0.5806	0.5000	0.4783	0.6111	0.6353
Netherlands	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8772	1.0000	1.0000	1.0000	1.0000	1.0000	0.9906	1.0000	0.9636	0.9500	0.9455	0.9189	0.8556	1.0000	0.9722	0.9412	1.0000	1.0000	1.0000	1.0000	0.9652
Poland	0.5526	0.5871	0.6220	0.6572	0.6667	0.6471	0.5333	0.4678	0.6667	0.6667	0.7333	0.7778	0.9474	0.6558	0.4098	0.4909	0.5667	0.5455	0.4595	0.3889	0.3947	0.3333	0.3824	0.3548	0.3077	0.3478	0.6111	0.4302
Portugal	0.7782	0.7926	0.8071	0.8218	0.7619	0.7647	0.8000	0.7602	0.8889	0.8667	0.8667	0.8889	0.8421	0.8184	0.4262	0.4000	0.4500	0.4727	0.2703	0.2074	0.1842	0.2778	0.2941	0.2903	0.2308	0.1304	0.1667	0.2924
Romania	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0519	0.0526	0.1667	0.2059	0.2258	0.3077	0.3043	0.2778	0.1225
Slovakia	0.8987	0.8818	0.8647	0.8475	0.9048	0.8824	0.8667	0.7018	0.8333	0.8667	0.7333	0.7778	0.7895	0.8345	0.3607	0.3273	0.4333	0.4364	0.5946	0.4148	0.5263	0.5278	0.4412	0.3871	0.3077	0.2174	0.3333	0.4083
Slovenia	0.8705	0.8815	0.8926	0.9038	0.9048	0.8235	0.8667	0.8187	0.9444	0.9333	0.9333	0.9444	0.9474	0.8973	0.6066	0.5818	0.6500	0.6545	0.6216	0.5185	0.5000	0.5278	0.4412	0.4839	0.6154	0.6087	0.6111	0.5709
Spain	0.8231	0.8329	0.8427	0.8527	0.8095	0.8235	0.8667	0.7602	0.8889	0.8667	0.8667	0.8889	0.8947	0.8475	0.5082	0.4727	0.5500	0.5455	0.4054	0.3889	0.4474	0.5278	0.5294	0.5161	0.5769	0.6957	0.8889	0.5425
Sweeden	0.8129	0.8235	0.8343	0.8452	0.8571	0.8235	0.8000	0.7602	0.8889	0.7333	0.8000	0.9444	0.9474	0.8362	0.9508	1.0000	1.0000	1.0000	1.0000	1.0000	0.8158	0.6667	0.7647	0.8387	0.7692	0.8696	0.6667	0.8725

Annex 8. Normalized data of the I_{SusSoc} sub-index's indicators: purchasing power adjusted by GDP per capita and income distribution, EU-27, 2008–2020

EU-27	Purchase_power														Income_dist													
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.3557	0.3709	0.3619	0.3652	0.3750	0.3736	0.3578	0.3525	0.3519	0.3505	0.3616	0.3625	0.3339	0.3595	0.7877	0.7813	0.7640	0.7829	0.7618	0.7930	0.8316	0.8877	0.8592	0.8157	0.7819	0.8256	0.7831	0.8043
Belgium	0.3104	0.3273	0.3339	0.3208	0.3226	0.3223	0.3131	0.3106	0.3070	0.3100	0.3145	0.3211	0.3066	0.3169	0.8210	0.8389	0.8706	0.8684	0.8401	0.8805	0.9171	0.9335	0.9165	0.9089	0.8359	0.9433	0.8755	0.8808
Bulgaria	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2020	0.3582	0.3782	0.0132	0.1599	0.0700	0.1150	0.2516	0.0000	0.0000	0.0000	0.0000	0.0000	0.1191
Cyprus	0.2701	0.2745	0.2483	0.2235	0.1926	0.1636	0.1438	0.1506	0.1690	0.1807	0.1871	0.1924	0.1605	0.1967	0.7596	0.7284	0.7132	0.7105	0.6144	0.5598	0.5000	0.6486	0.6706	0.7598	0.7279	0.7395	0.7430	0.6827
Croatia	0.0889	0.0855	0.0699	0.0683	0.0625	0.0645	0.0543	0.0543	0.0558	0.0607	0.0629	0.0652	0.0449	0.0644	0.4323	0.4589	0.4594	0.3026	0.3981	0.4344	0.5668	0.6570	0.6420	0.6625	0.5745	0.7017	0.6827	0.5364
Czechia	0.1795	0.1891	0.1731	0.1689	0.1605	0.1686	0.1709	0.1739	0.1736	0.1869	0.1934	0.1987	0.1830	0.1785	0.9821	0.9447	0.9848	0.9737	0.9843	1.0000	1.0000	1.0000	1.0000	1.0000	0.9374	1.0000	0.9378	0.9804
Denmark	0.3540	0.3636	0.3741	0.3652	0.3547	0.3587	0.3466	0.3432	0.3442	0.3629	0.3679	0.3688	0.3836	0.3606	0.9309	0.6707	0.7462	0.8289	0.8433	0.8222	0.8342	0.8815	0.8663	0.8592	0.7667	0.8424	0.8052	0.8229
Estonia	0.1141	0.0891	0.0909	0.1126	0.1199	0.1289	0.1294	0.1211	0.1209	0.1340	0.1415	0.1447	0.1413	0.1222	0.5831	0.5745	0.5939	0.3783	0.3824	0.3761	0.2032	0.4387	0.5084	0.5818	0.5594	0.6345	0.5984	0.4933
Finland	0.3389	0.3309	0.3217	0.3208	0.3057	0.2959	0.2764	0.2686	0.2682	0.2804	0.2830	0.2798	0.2793	0.2961	0.8977	0.8870	0.9492	0.9243	0.9216	0.9446	0.9679	0.9896	0.9809	0.9710	0.8661	0.9265	0.8614	0.9298
France	0.2735	0.2855	0.2815	0.2765	0.2652	0.2727	0.2588	0.2516	0.2465	0.2461	0.2500	0.2623	0.2376	0.2621	0.7340	0.7163	0.7411	0.6217	0.6552	0.6851	0.7941	0.8378	0.8043	0.8116	0.7408	0.8046	0.7088	0.7427
Germany	0.3171	0.3236	0.3304	0.3413	0.3361	0.3388	0.3371	0.3261	0.3287	0.3380	0.3443	0.3370	0.3242	0.3325	0.6419	0.7019	0.7259	0.6711	0.7304	0.6501	0.5668	0.7318	0.7327	0.7743	0.5594	0.6744	0.3092	0.6515
Greece	0.2181	0.2255	0.1748	0.1263	0.1064	0.1107	0.1038	0.0932	0.0806	0.0763	0.0708	0.0636	0.0353	0.1143	0.3529	0.3942	0.4416	0.1776	0.0000	0.0671	0.2086	0.3763	0.2721	0.4389	0.4644	0.6282	0.5743	0.3382
Hungary	0.0872	0.0945	0.0944	0.0939	0.0861	0.0942	0.0927	0.0947	0.0853	0.0872	0.0943	0.0970	0.0915	0.0918	0.9386	0.9351	1.0000	0.8421	0.8245	0.7405	0.7781	0.8358	0.8186	0.8199	0.7149	0.8130	0.7731	0.8334
Ireland	0.3909	0.3782	0.3776	0.3737	0.3750	0.3719	0.3850	0.5668	0.5550	0.6028	0.6572	0.6804	0.7384	0.4964	0.7263	0.7596	0.6726	0.6151	0.5674	0.6122	0.6257	0.7942	0.7733	0.7453	0.7408	0.8550	0.7791	0.7128
Italy	0.2768	0.2800	0.2675	0.2611	0.2466	0.2347	0.2157	0.2096	0.2186	0.2196	0.2186	0.2146	0.1862	0.2346	0.5269	0.5024	0.5000	0.2533	0.3103	0.2857	0.3904	0.5156	0.3389	0.4783	0.3391	0.4391	0.3492	0.4022
Latvia	0.0721	0.0436	0.0402	0.0461	0.0608	0.0711	0.0719	0.0745	0.0729	0.0779	0.0849	0.0795	0.0738	0.0669	0.0000	0.0000	0.1294	0.0000	0.0502	0.1487	0.2032	0.3763	0.3556	0.3996	0.1901	0.3277	0.3494	0.1946
Lithuania	0.0872	0.0582	0.0717	0.0922	0.1030	0.1207	0.1214	0.1165	0.1178	0.1324	0.1431	0.1510	0.1541	0.1130	0.2967	0.2428	0.0000	0.2171	0.4107	0.2274	0.3048	0.1788	0.1504	0.1967	0.1231	0.3487	0.3755	0.2364
Luxembourg	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8082	0.7428	0.8249	0.8322	0.7837	0.6531	0.7540	0.8441	0.7327	0.7598	0.5356	0.5798	0.6064	0.7275
Malta	0.1628	0.1745	0.1853	0.1689	0.1723	0.1868	0.1917	0.2127	0.2093	0.2368	0.2406	0.2464	0.2006	0.1991	0.7698	0.8197	0.7665	0.8191	0.8433	0.7843	0.8529	0.8669	0.8282	0.8323	0.7300	0.8235	0.6667	0.8002
Netherlands	0.4211	0.4200	0.4021	0.3925	0.3851	0.3884	0.3626	0.3571	0.3473	0.3598	0.3711	0.3720	0.3724	0.3809	0.8338	0.8245	0.9391	0.9046	0.9467	0.9475	0.9118	0.9356	0.8974	0.8778	0.7797	0.8739	0.7751	0.8806
Poland	0.0554	0.0709	0.0822	0.0870	0.0878	0.0909	0.0863	0.0916	0.0853	0.0888	0.0912	0.0954	0.0995	0.0856	0.5499	0.5841	0.6015	0.5099	0.5361	0.5685	0.6230	0.7069	0.6993	0.7598	0.7365	0.7836	0.7912	0.6500
Portugal	0.1644	0.1727	0.1661	0.1416	0.1250	0.1355	0.1278	0.1258	0.1240	0.1246	0.1274	0.1256	0.1027	0.1356	0.2967	0.3341	0.4543	0.2697	0.2539	0.2391	0.2701	0.4802	0.4320	0.5135	0.5270	0.6176	0.6064	0.4073
Romania	0.0352	0.0382	0.0297	0.0273	0.0304	0.0380	0.0351	0.0357	0.0450	0.0607	0.0676	0.0795	0.0803	0.0464	0.0691	0.2091	0.3147	0.0855	0.0094	0.0000	0.0000	0.0000	0.1169	0.3685	0.0972	0.2143	0.2791	0.1357
Slovakia	0.1242	0.1236	0.1381	0.1331	0.1318	0.1339	0.1294	0.1289	0.1039	0.0919	0.0881	0.0811	0.0722	0.1139	1.0000	0.9231	0.9010	0.8849	0.9091	0.9475	0.8850	0.9938	0.9690	0.9814	1.0000	1.0000	1.0000	0.9534
Slovenia	0.2030	0.1873	0.1748	0.1689	0.1588	0.1587	0.1518	0.1475	0.1504	0.1620	0.1698	0.1749	0.1621	0.1669	1.0000	1.0000	0.9975	1.0000	1.0000	0.9417	0.9465	0.9813	0.9857	0.9959	0.9244	0.9895	0.9418	0.9772
Spain	0.2500	0.2491	0.2255	0.2065	0.1909	0.1884	0.1821	0.1848	0.1860	0.1947	0.1887	0.1860	0.1413	0.1980	0.4297	0.3678	0.3020	0.0724	0.0502	0.1574	0.1150	0.3015	0.2601	0.3395	0.3521	0.4538	0.4498	0.2809
Sweeden	0.3658	0.3618	0.3654	0.3686	0.3632	0.3537	0.3387	0.3432	0.3271	0.3271	0.3255	0.3243	0.3274	0.3455	0.9130	0.8269	0.8883	0.8388	0.8307	0.8338	0.8262	0.8857	0.8210	0.8199	0.7624	0.7920	0.7811	0.8323

Annex 9. Normalized data of the I_{SusSoc} sub-index's indicators: people at risk of poverty or social exclusion and young people not in employment or education, EU-27, 2008–2020

EU-27	People_at_risk														Y-people_n_empl												
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.8094	0.8416	0.8707	0.8846	0.8980	0.8743	0.8275	0.8425	0.8266	0.7790	0.7427	0.7833	0.7228	0.8233	0.7273	0.7467	0.8276	0.8617	0.9163	0.9343	0.8614	0.8947	0.8556	0.8626	0.8475	0.8424	0.7841	0.8432
Belgium	0.8027	0.8075	0.8161	0.8314	0.8076	0.8144	0.7490	0.7399	0.7196	0.6854	0.6214	0.6552	0.6535	0.7464	0.5105	0.5333	0.6034	0.5798	0.6108	0.6385	0.6238	0.5947	0.6278	0.6319	0.6441	0.6303	0.6420	0.6055
Bulgaria	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0078	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	0.0559	0.0000	0.0000	0.0000	0.1034	0.1315	0.1337	0.1842	0.1056	0.2857	0.2994	0.3333	0.2955	0.1483
Cyprus	0.7191	0.7050	0.7069	0.7249	0.6472	0.6048	0.5059	0.4542	0.4686	0.5131	0.4320	0.5172	0.5347	0.5795	0.5874	0.6200	0.6092	0.5266	0.4680	0.3803	0.3564	0.3789	0.3500	0.3571	0.4802	0.4909	0.4545	0.4661
Croatia	0.3902	0.4365	0.5201	0.4882	0.4869	0.5419	0.4314	0.4469	0.4613	0.4682	0.3883	0.4680	0.4406	0.4591	0.4406	0.3933	0.3391	0.2979	0.3498	0.2911	0.2426	0.3053	0.2667	0.3407	0.4407	0.4848	0.4943	0.3605
Czechia	0.9866	1.0000	1.0000	1.0000	0.9883	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9981	0.6014	0.5400	0.6092	0.6702	0.6847	0.7371	0.7228	0.7316	0.7333	0.7747	0.7853	0.7515	0.6989	0.6954
Denmark	0.9532	0.8882	0.8879	0.9320	0.9271	0.8892	0.8784	0.8645	0.8708	0.8127	0.7670	0.8128	0.8020	0.8681	0.9441	0.8933	0.8793	0.8670	0.8768	0.9531	0.9257	0.9053	0.8833	0.7857	0.7797	0.7636	0.7443	0.8616
Estonia	0.7692	0.7081	0.7902	0.7692	0.7551	0.7335	0.5608	0.6264	0.5904	0.5805	0.4078	0.4187	0.4356	0.6266	0.5524	0.1667	0.3103	0.5319	0.5764	0.6667	0.6386	0.6947	0.5833	0.7198	0.6610	0.7515	0.6875	0.5801
Finland	0.9164	0.9099	0.9282	0.9231	0.9359	0.9581	0.9020	0.8974	0.8782	0.8689	0.7913	0.8473	0.7970	0.8887	0.7273	0.6333	0.7471	0.7819	0.8079	0.8263	0.7376	0.7000	0.7000	0.7253	0.7514	0.7697	0.7386	0.7420
France	0.8796	0.8602	0.8621	0.8817	0.8805	0.8952	0.8549	0.8645	0.8192	0.8202	0.7476	0.7340	0.6881	0.8298	0.4685	0.4067	0.5000	0.5319	0.5764	0.6901	0.6238	0.5789	0.5556	0.5659	0.5537	0.5576	0.5284	0.5490
Germany	0.8261	0.8137	0.8477	0.8639	0.8659	0.8293	0.7725	0.7802	0.7638	0.7453	0.6845	0.7586	0.4010	0.7656	0.5804	0.6267	0.7299	0.7979	0.8621	0.9296	0.8911	0.9053	0.8556	0.8571	0.8757	0.8848	0.8352	0.8178
Greece	0.5585	0.5776	0.6178	0.5355	0.4286	0.3683	0.1686	0.2051	0.1771	0.1536	0.0485	0.1379	0.1584	0.3181	0.3147	0.3267	0.2816	0.0904	0.0000	0.0000	0.0000	0.0842	0.1167	0.1538	0.2203	0.2727	0.2614	0.1633
Hungary	0.5552	0.5155	0.5546	0.5207	0.4606	0.3952	0.3333	0.4799	0.5203	0.4981	0.6408	0.6847	0.7079	0.5282	0.2378	0.1933	0.3333	0.3777	0.3990	0.4742	0.5099	0.5579	0.5667	0.5934	0.5932	0.5455	0.4886	0.4516
Ireland	0.7057	0.6366	0.6293	0.5385	0.5598	0.5419	0.4706	0.5531	0.5904	0.6067	0.5680	0.6010	0.5545	0.5812	0.2587	0.0400	0.1034	0.1223	0.2562	0.4554	0.4406	0.4842	0.5444	0.6209	0.6667	0.6545	0.5170	0.3973
Italy	0.6455	0.6615	0.6954	0.6213	0.5656	0.5838	0.4706	0.4615	0.3838	0.3745	0.2670	0.3547	0.1622	0.4806	0.0000	0.0200	0.0862	0.1170	0.1478	0.1174	0.0248	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0395
Latvia	0.3545	0.2578	0.3161	0.2663	0.3819	0.3862	0.2980	0.3810	0.4391	0.4007	0.2136	0.2709	0.3020	0.3283	0.3986	0.0000	0.1609	0.2979	0.4729	0.6056	0.5693	0.6263	0.6111	0.6484	0.6667	0.7212	0.6477	0.4944
Lithuania	0.5518	0.5155	0.4368	0.4734	0.4898	0.5150	0.5098	0.4396	0.3801	0.3483	0.2184	0.3202	0.3614	0.4277	0.5175	0.3867	0.3736	0.5319	0.6355	0.6948	0.6832	0.7316	0.7556	0.7637	0.7966	0.6848	0.5852	0.6262
Luxembourg	0.9799	0.8820	0.9224	0.9556	0.9009	0.8683	0.8353	0.8352	0.7860	0.7303	0.5874	0.6010	0.5545	0.8030	0.7063	0.8867	1.0000	0.9628	0.9458	1.0000	1.0000	0.9526	0.9722	0.9615	0.8983	0.9515	0.8864	0.9326
Malta	0.8261	0.8043	0.8046	0.7988	0.7638	0.7006	0.6431	0.6703	0.7417	0.7341	0.6699	0.6256	0.6485	0.7255	0.5524	0.5467	0.6494	0.6702	0.7291	0.8263	0.7475	0.7316	0.8278	0.8407	0.9096	0.8667	0.7841	0.7448
Netherlands	1.0000	0.9658	0.9799	0.9882	1.0000	0.9611	0.9333	0.9121	0.8745	0.8202	0.7816	0.8030	0.7921	0.9086	1.0000	1.0000	1.0000	1.0000	1.0000	0.9859	0.9455	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9947
Poland	0.4783	0.5714	0.6149	0.6479	0.6589	0.6647	0.6118	0.6557	0.6827	0.7266	0.6748	0.7192	0.7327	0.6492	0.4615	0.4533	0.5000	0.5053	0.5468	0.5775	0.5545	0.5842	0.5833	0.6154	0.6384	0.6182	0.5909	0.5561
Portugal	0.6288	0.6615	0.6868	0.7308	0.6997	0.6138	0.5020	0.5385	0.5646	0.5843	0.5437	0.5517	0.6089	0.6088	0.5175	0.5533	0.5690	0.5745	0.5517	0.5681	0.5990	0.6579	0.6389	0.7418	0.7797	0.7879	0.6989	0.6337
Romania	0.0201	0.0994	0.2213	0.2426	0.1778	0.1826	0.0000	0.1429	0.0590	0.1199	0.0146	0.0788	0.0842	0.1110	0.4266	0.3400	0.2644	0.2766	0.3695	0.4178	0.3366	0.2526	0.2278	0.3462	0.3616	0.3273	0.3807	0.3329
Slovakia	0.8094	0.8261	0.8218	0.8432	0.8397	0.8443	0.8588	0.8388	0.8229	0.8464	0.8010	0.8079	0.8564	0.8321	0.2797	0.2333	0.2586	0.3191	0.3941	0.4460	0.4208	0.4474	0.4667	0.4451	0.4972	0.4667	0.4602	0.3950
Slovenia	0.8796	0.9037	0.8879	0.8817	0.8659	0.8263	0.7804	0.8095	0.8118	0.8165	0.8058	0.9064	0.8465	0.8479	0.8252	0.7667	0.8103	0.8138	0.7389	0.7324	0.6832	0.7053	0.7444	0.8132	0.8249	0.8121	0.8011	0.7747
Spain	0.7023	0.6677	0.6638	0.6627	0.6443	0.6198	0.4353	0.4652	0.4613	0.4607	0.3252	0.3695	0.2822	0.5200	0.2797	0.0600	0.2011	0.2181	0.2266	0.2817	0.2970	0.3316	0.3444	0.4231	0.4576	0.4424	0.3409	0.3003
Sweeden	0.9398	0.8820	0.9052	0.9053	0.9213	0.8892	0.8667	0.8315	0.8155	0.7940	0.7184	0.6897	0.7030	0.8355	0.7902	0.7267	0.8736	0.8936	0.9064	0.9671	0.9356	0.9632	0.9556	0.9505	0.9322	0.9636	0.9148	0.9056

Annex 10. Normalized data of the I_{SusEnv} sub-index's indicators: resource productivity and CO2 emission per GDP, EU-27, 2008–2020

EU-27	Resource_prod														CO2_per_GDP													
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.4464	0.4637	0.4450	0.4208	0.4320	0.4455	0.4556	0.5245	0.4567	0.4231	0.4333	0.4038	0.3841	0.4411	0.9368	0.9424	0.9300	0.9247	0.9202	0.9167	0.9282	0.9288	0.9252	0.9129	0.9148	0.8880	0.8692	0.9183
Belgium	0.5123	0.5711	0.5630	0.5215	0.5714	0.5854	0.6112	0.6969	0.6394	0.5626	0.5949	0.6792	0.5947	0.5926	0.8620	0.8633	0.8574	0.8681	0.8536	0.8443	0.8603	0.8578	0.8477	0.8478	0.8255	0.8063	0.7848	0.8445
Bulgaria	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0066	0.0005	0.0000	0.0000	0.0319	0.0000	0.0000	0.0611	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0072
Cyprus	0.0892	0.1184	0.1314	0.1380	0.2034	0.2892	0.2917	0.3372	0.2825	0.2139	0.2328	0.2044	0.2112	0.2110	0.7494	0.7041	0.7465	0.7587	0.7424	0.7317	0.6947	0.7130	0.6699	0.6700	0.6449	0.6385	0.5617	0.6943
Croatia	0.1195	0.1437	0.1734	0.1750	0.1900	0.1758	0.2053	0.2215	0.1946	0.1883	0.1879	0.1709	0.1506	0.1767	0.7446	0.7023	0.7286	0.7165	0.6965	0.6840	0.6881	0.6956	0.6658	0.6595	0.6541	0.6231	0.5238	0.6756
Czechia	0.1439	0.1432	0.1536	0.1461	0.1684	0.1715	0.1752	0.2018	0.1840	0.1749	0.1796	0.1683	0.1873	0.1691	0.5909	0.5036	0.5389	0.5682	0.5188	0.4933	0.4870	0.5336	0.4816	0.5254	0.4865	0.4966	0.4437	0.5129
Denmark	0.3942	0.4562	0.4824	0.4209	0.4156	0.4535	0.4666	0.5076	0.4591	0.4055	0.4172	0.3771	0.3740	0.4331	0.8221	0.7984	0.8232	0.8130	0.8127	0.8047	0.8303	0.8358	0.8110	0.8117	0.7730	0.7597	0.7679	0.8049
Estonia	0.0763	0.0498	0.0485	0.0534	0.0539	0.0450	0.0581	0.0805	0.0666	0.0471	0.0455	0.0610	0.0698	0.0581	0.2871	0.1878	0.0000	0.1266	0.1241	0.0000	0.0995	0.2860	0.1584	0.1505	0.1356	0.4099	0.4986	0.1896
Finland	0.2088	0.2343	0.2097	0.2124	0.2165	0.1778	0.2364	0.2721	0.2366	0.2059	0.1974	0.2086	0.2092	0.2174	0.8772	0.8486	0.8196	0.8495	0.8509	0.8364	0.8551	0.8750	0.8451	0.8604	0.8347	0.8328	0.8415	0.8482
France	0.5512	0.6111	0.6110	0.5897	0.6067	0.6152	0.6377	0.7538	0.7109	0.5965	0.6285	0.5849	0.6100	0.6236	0.9628	0.9636	0.9598	0.9521	0.9366	0.9283	0.9421	0.9423	0.9341	0.9302	0.9310	0.9236	0.9119	0.9399
Germany	0.5124	0.5113	0.5130	0.4839	0.5015	0.5068	0.5165	0.6221	0.5728	0.5065	0.5492	0.5309	0.5292	0.5274	0.8463	0.8306	0.8311	0.8344	0.8052	0.7883	0.8127	0.8167	0.8017	0.8071	0.7905	0.7910	0.7811	0.8105
Greece	0.1976	0.2246	0.2312	0.2289	0.2298	0.2432	0.2450	0.2898	0.2754	0.2629	0.2726	0.2873	0.3139	0.2540	0.7459	0.7145	0.7230	0.6777	0.6073	0.6144	0.6124	0.6222	0.5785	0.5326	0.4635	0.4384	0.3698	0.5923
Hungary	0.1406	0.1651	0.1829	0.1868	0.2174	0.1828	0.1373	0.1708	0.1608	0.1274	0.1113	0.1032	0.1223	0.1545	0.6859	0.6024	0.6389	0.6427	0.6281	0.6332	0.6358	0.6338	0.5978	0.6019	0.5660	0.5554	0.4765	0.6076
Ireland	0.2538	0.3331	0.3918	0.4665	0.4607	0.4300	0.5006	0.6870	0.5883	0.5372	0.5492	0.5196	0.6104	0.4868	0.9260	0.9240	0.8783	0.8784	0.8555	0.8486	0.8644	0.9176	0.8916	0.8983	0.8962	0.9021	0.9434	0.8942
Italy	0.5191	0.5593	0.5673	0.5499	0.6316	0.7533	0.7654	0.8825	0.8142	0.7447	0.7474	0.6946	0.7010	0.6870	0.8897	0.8951	0.8918	0.8820	0.8655	0.8708	0.8807	0.8753	0.8648	0.8617	0.8454	0.8271	0.7988	0.8653
Latvia	0.1512	0.2449	0.1799	0.1597	0.1652	0.1507	0.1712	0.1863	0.1948	0.1536	0.1440	0.1477	0.1554	0.1696	0.8114	0.7219	0.6447	0.7080	0.7281	0.7269	0.7323	0.7365	0.7169	0.7174	0.6667	0.6429	0.6494	0.7079
Lithuania	0.1087	0.1466	0.1212	0.1188	0.1412	0.1069	0.1335	0.1579	0.1306	0.1026	0.1139	0.0998	0.1078	0.1223	0.7086	0.6458	0.6464	0.6685	0.6492	0.6706	0.6760	0.6695	0.6338	0.6272	0.5585	0.5180	0.3901	0.6202
Luxembourg	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9425	0.8068	0.8872	0.8113	0.9043	0.9502	0.9467	0.9360	0.9447	0.9462	0.9389	0.9418	0.9442	0.9312	0.9287	0.9269	0.9185	0.8951	0.8910	0.9300
Malta	0.5292	0.4899	0.5921	0.4207	0.3716	0.4975	0.3728	0.3747	0.3442	0.4071	0.3599	0.3850	0.3440	0.4222	0.7603	0.7490	0.7758	0.7616	0.7260	0.7724	0.7962	0.9059	0.9393	0.9338	0.9294	0.9159	0.8976	0.8356
Netherlands	0.8092	0.8491	0.8276	0.8363	0.8634	0.9227	0.9166	0.9554	1.0000	1.0000	1.0000	1.0000	1.0000	0.9215	0.8917	0.8726	0.8623	0.8634	0.8402	0.8267	0.8333	0.8304	0.8135	0.8197	0.8088	0.7996	0.7878	0.8346
Poland	0.0691	0.0661	0.0608	0.0427	0.0592	0.0670	0.0793	0.1045	0.0810	0.0707	0.0739	0.0891	0.0911	0.0734	0.4258	0.2159	0.3114	0.3403	0.2859	0.2516	0.3009	0.3384	0.1994	0.2124	0.1377	0.1336	0.0260	0.2446
Portugal	0.1348	0.1400	0.1536	0.1691	0.1768	0.2201	0.2008	0.2313	0.2208	0.1810	0.1907	0.1749	0.1665	0.1816	0.8557	0.8380	0.8664	0.8465	0.8114	0.8083	0.8075	0.7947	0.7922	0.7683	0.7665	0.7704	0.7435	0.8053
Romania	0.0145	0.0188	0.0414	0.0125	0.0168	0.0179	0.0239	0.0170	0.0053	0.0183	0.0151	0.0020	0.0000	0.0156	0.5647	0.5041	0.5549	0.5317	0.4620	0.5356	0.5575	0.5950	0.5669	0.5841	0.5514	0.5556	0.4809	0.5419
Slovakia	0.1447	0.1559	0.1669	0.1713	0.2063	0.2195	0.2054	0.2480	0.2248	0.1995	0.1952	0.2109	0.2190	0.1975	0.6482	0.6126	0.6516	0.6595	0.6468	0.6276	0.6550	0.6657	0.6194	0.6066	0.5672	0.5698	0.5318	0.6201
Slovenia	0.1816	0.2037	0.2146	0.2486	0.2844	0.2888	0.2786	0.3148	0.3041	0.2801	0.2627	0.2697	0.2624	0.2611	0.7879	0.7614	0.7580	0.7594	0.7316	0.7188	0.7651	0.7636	0.7256	0.7221	0.6914	0.6746	0.6206	0.7292
Spain	0.2905	0.3529	0.3920	0.4418	0.5521	0.5892	0.5988	0.6573	0.6349	0.5710	0.5448	0.5299	0.5309	0.5143	0.8862	0.8894	0.8985	0.8750	0.8453	0.8519	0.8456	0.8393	0.8362	0.8230	0.8066	0.8064	0.7862	0.8454
Sweeden	0.4379	0.4910	0.4326	0.4132	0.4075	0.4018	0.4096	0.4847	0.4358	0.3765	0.3736	0.3271	0.3356	0.4098	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

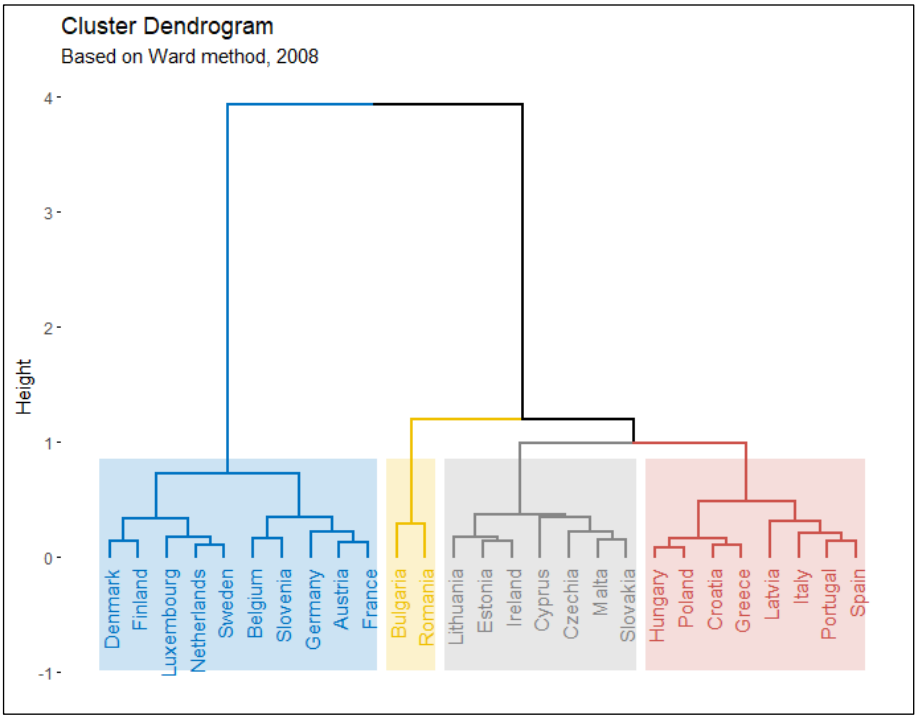
Annex 11. Normalized data of the I_{SusEnv} sub-index's indicators: circular material usage rate and share of renewable energy, EU-27, 2008–2020

EU-27	Circular_mater														Share_of_renev_energy												
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Austria	0.2315	0.2421	0.2241	0.2189	0.2460	0.2756	0.3254	0.3734	0.3545	0.3464	0.3504	0.3554	0.3615	0.3004	0.6539	0.6585	0.6699	0.6488	0.6418	0.6252	0.6229	0.6036	0.5929	0.5709	0.5673	0.5480	0.5228	0.6097
Belgium	0.0338	0.0264	0.0373	0.0043	0.0238	0.0315	0.0516	0.0581	0.1007	0.0643	0.0365	0.0348	0.0439	0.0421	0.0781	0.0967	0.1114	0.0972	0.0908	0.0895	0.0764	0.0651	0.0716	0.0623	0.0447	0.0592	0.0463	0.0761
Bulgaria	0.0338	0.0264	0.0373	0.0043	0.0238	0.0315	0.0516	0.0581	0.1007	0.0643	0.0365	0.0348	0.0439	0.0421	0.2321	0.2518	0.2870	0.2687	0.2788	0.3301	0.2909	0.2810	0.2836	0.2649	0.2835	0.2975	0.2551	0.2773
Cyprus	0.0167	0.0109	0.0332	0.0086	0.0278	0.0276	0.0317	0.0290	0.0261	0.0250	0.0474	0.0557	0.0709	0.0316	0.1129	0.1218	0.1148	0.0960	0.0913	0.1057	0.1001	0.1041	0.0946	0.0908	0.1393	0.1381	0.1248	0.1103
Croatia	0.0491	0.0512	0.0166	0.0300	0.0913	0.0866	0.1349	0.1203	0.1082	0.1250	0.1277	0.1359	0.1284	0.0927	0.4983	0.4994	0.5347	0.5142	0.5134	0.5261	0.5001	0.5077	0.4849	0.4468	0.4439	0.4395	0.4110	0.4862
Czechia	0.1259	0.1449	0.1701	0.1588	0.1984	0.1969	0.2143	0.2158	0.2164	0.2643	0.3285	0.3484	0.4088	0.2301	0.1939	0.2084	0.2113	0.1987	0.2138	0.2236	0.2271	0.2135	0.2024	0.1823	0.1665	0.1886	0.1334	0.1972
Denmark	0.2614	0.2493	0.2822	0.2275	0.2024	0.2362	0.3016	0.2739	0.2351	0.2214	0.2409	0.2195	0.2162	0.2437	0.4196	0.4215	0.4634	0.4705	0.4857	0.5075	0.5321	0.5395	0.5579	0.5974	0.5968	0.6150	0.4237	0.5100
Estonia	0.4653	0.4590	0.3154	0.5365	0.7063	0.5079	0.3770	0.3983	0.3694	0.3821	0.4380	0.4983	0.5405	0.4611	0.4257	0.4869	0.5230	0.5169	0.4883	0.4685	0.4640	0.5081	0.5053	0.4946	0.4853	0.5065	0.3917	0.4819
Finland	0.5183	0.4599	0.5104	0.5279	0.5556	0.3307	0.2341	0.1950	0.1343	0.1393	0.1606	0.1742	0.1655	0.3158	0.7061	0.6586	0.6912	0.6702	0.6738	0.7102	0.7318	0.7249	0.7109	0.7344	0.7263	0.7320	0.6697	0.7031
France	0.6399	0.6396	0.6763	0.6481	0.6190	0.6142	0.6508	0.7054	0.6604	0.6107	0.6642	0.6516	0.7061	0.6528	0.2514	0.2563	0.2591	0.1958	0.2230	0.2226	0.2119	0.2078	0.2136	0.2045	0.1932	0.2078	0.1699	0.2167
Germany	0.4003	0.3934	0.4232	0.3906	0.3929	0.3780	0.3929	0.4274	0.3918	0.3607	0.3978	0.4042	0.4088	0.3971	0.2259	0.2271	0.2369	0.2320	0.2296	0.2200	0.2124	0.2100	0.2017	0.1967	0.1992	0.2097	0.1740	0.2135
Greece	0.0000	0.0000	0.0622	0.0215	0.0238	0.0039	0.0000	0.0083	0.0224	0.0393	0.0657	0.0976	0.1385	0.0372	0.1827	0.1818	0.2016	0.2032	0.2338	0.2536	0.2402	0.2266	0.2123	0.2353	0.2280	0.2583	0.2233	0.2216
Hungary	0.1554	0.1540	0.1701	0.1588	0.1905	0.1772	0.1587	0.1701	0.1791	0.1857	0.2007	0.2091	0.2500	0.1815	0.1914	0.2447	0.2607	0.2648	0.2722	0.2724	0.2174	0.2013	0.1908	0.1560	0.1108	0.1147	0.0635	0.1970
Ireland	0.0198	0.0078	0.0207	0.0172	0.0198	0.0000	0.0238	0.0083	0.0000	0.0000	0.0036	0.0105	0.0169	0.0114	0.0865	0.1073	0.1059	0.1039	0.0895	0.0863	0.0867	0.0867	0.0810	0.0917	0.0763	0.1012	0.1102	0.0933
Italy	0.4469	0.4698	0.4274	0.4249	0.5000	0.5630	0.5833	0.6432	0.6007	0.5964	0.6314	0.6341	0.6858	0.5544	0.2584	0.2682	0.2669	0.2409	0.2703	0.2839	0.2702	0.2655	0.2551	0.2558	0.2236	0.2285	0.1952	0.2525
Latvia	0.0451	0.0471	0.0000	0.0515	0.0000	0.0827	0.1548	0.1494	0.1791	0.1321	0.1168	0.1045	0.0980	0.0893	0.6773	0.7285	0.6515	0.6908	0.7058	0.7189	0.7317	0.6892	0.6727	0.6953	0.7013	0.6952	0.6359	0.6918
Lithuania	0.0923	0.0836	0.1120	0.0815	0.0992	0.0551	0.0913	0.0996	0.1082	0.1000	0.1022	0.0906	0.1047	0.0939	0.4032	0.4183	0.4136	0.3952	0.3991	0.4114	0.4096	0.4395	0.4287	0.4205	0.3719	0.3781	0.3250	0.4011
Luxembourg	0.7835	0.7125	0.9502	0.8155	0.6825	0.5394	0.3929	0.3320	0.2015	0.3179	0.3394	0.3206	0.4155	0.5233	0.0598	0.0579	0.0415	0.0220	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0333	0.0000	0.0199	0.0184
Malta	0.1216	0.1234	0.1701	0.1202	0.1032	0.1811	0.1984	0.1203	0.0933	0.1714	0.2482	0.2230	0.2230	0.1613	0.0000	0.0000	0.0000	0.0000	0.0000	0.0057	0.0058	0.0028	0.0179	0.0217	0.0112	0.0243	0.0000	0.0069
Netherlands	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0778	0.0864	0.0651	0.0584	0.0386	0.0257	0.0202	0.0154	0.0102	0.0066	0.0000	0.0378	0.0665	0.0391
Poland	0.4092	0.3897	0.3983	0.3219	0.3690	0.3976	0.4444	0.4108	0.3172	0.2929	0.3029	0.3136	0.2905	0.3583	0.1713	0.1807	0.1840	0.1854	0.1739	0.1706	0.1528	0.1460	0.1277	0.1031	0.1621	0.1709	0.1090	0.1567
Portugal	0.0223	0.0126	0.0249	0.0000	0.0278	0.0315	0.0397	0.0166	0.0149	0.0107	0.0255	0.0348	0.0304	0.0225	0.5199	0.5167	0.5135	0.4970	0.4665	0.4759	0.5364	0.5404	0.5399	0.5174	0.4903	0.4837	0.4709	0.5053
Romania	0.0670	0.0472	0.0954	0.0343	0.0516	0.0315	0.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0273	0.4576	0.4687	0.4844	0.4345	0.4289	0.4370	0.4365	0.4192	0.4164	0.3869	0.3543	0.3538	0.2786	0.4121
Slovakia	0.1262	0.1201	0.1618	0.1330	0.1111	0.1142	0.1349	0.1411	0.1343	0.1179	0.1241	0.1777	0.1723	0.1361	0.1722	0.1954	0.1800	0.1856	0.1631	0.1423	0.1551	0.1672	0.1411	0.1117	0.0968	0.2021	0.1342	0.1574
Slovenia	0.2348	0.2403	0.1950	0.2532	0.3175	0.2992	0.2817	0.2863	0.2612	0.2893	0.3102	0.3519	0.3716	0.2840	0.4220	0.4389	0.4455	0.4169	0.4016	0.4215	0.3853	0.3788	0.3517	0.3277	0.3006	0.3062	0.2891	0.3758
Spain	0.3283	0.3136	0.3817	0.3476	0.3373	0.2835	0.2500	0.2407	0.2425	0.2536	0.2737	0.2892	0.3345	0.2982	0.2412	0.2721	0.2838	0.2474	0.2445	0.2483	0.2444	0.2378	0.2467	0.2315	0.2070	0.2217	0.2126	0.2415
Sweeden	0.2555	0.2374	0.2490	0.2532	0.2738	0.2165	0.1984	0.2075	0.1903	0.1786	0.1861	0.1812	0.1959	0.2172	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

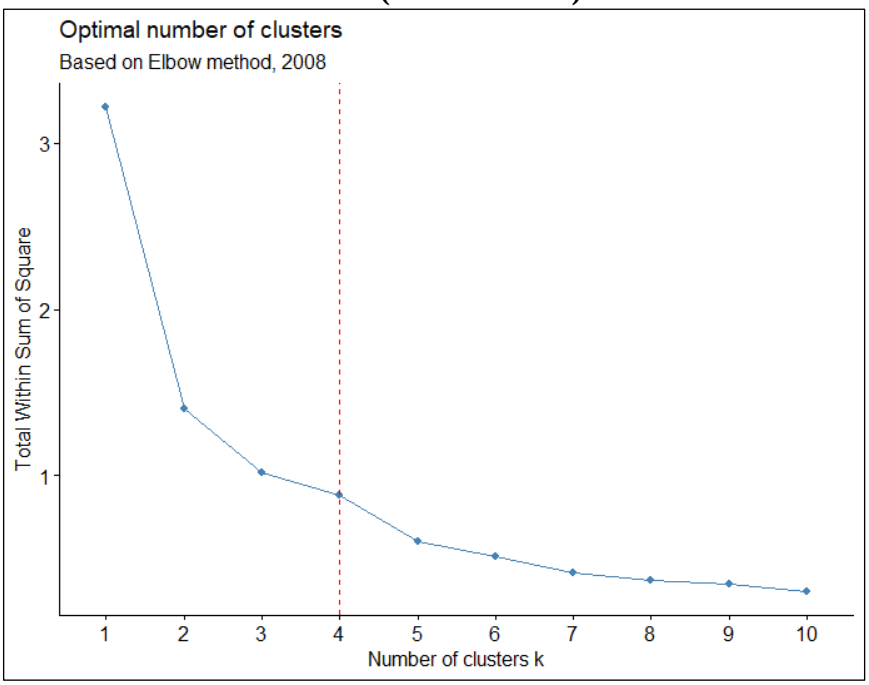
Annex 12. Descriptive statistics of the *ImpCountSus* indices based on EU-27 countries and time period 2008–2020

Country	Ranking based on ICountSusShE index	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
Sweden	1	0.6166	0.0186	0.6167	0.6171	0.0184	0.5816	0.6459	0.0644	-0.3097	-1.0575	0.0051
Netherlands	2	0.6043	0.0096	0.6042	0.6040	0.0055	0.5867	0.6243	0.0375	0.1701	-0.3395	0.0027
Luxembourg	3	0.5996	0.0408	0.6061	0.6009	0.0458	0.5320	0.6533	0.1213	-0.2755	-1.4847	0.0113
Denmark	4	0.5679	0.0167	0.5662	0.5680	0.0217	0.5428	0.5926	0.0498	0.1801	-1.5118	0.0046
Finland	5	0.5602	0.0239	0.5562	0.5602	0.0255	0.5245	0.5954	0.0710	0.2149	-1.5564	0.0066
Germany	6	0.5401	0.0242	0.5504	0.5414	0.0160	0.4955	0.5701	0.0746	-0.7022	-1.0445	0.0067
Austria	7	0.5329	0.0209	0.5376	0.5338	0.0267	0.4917	0.5638	0.0721	-0.3468	-1.0658	0.0058
France	8	0.4981	0.0177	0.4967	0.4972	0.0146	0.4739	0.5328	0.0589	0.2386	-0.8715	0.0049
Belgium	9	0.4567	0.0149	0.4546	0.4583	0.0028	0.4164	0.4800	0.0636	-1.1087	1.7017	0.0041
Ireland	10	0.4546	0.0716	0.4683	0.4558	0.0941	0.3581	0.5382	0.1801	-0.1058	-1.8639	0.0199
Slovenia	11	0.4487	0.0087	0.4511	0.4489	0.0095	0.4336	0.4621	0.0284	-0.2523	-1.2786	0.0024
Czechia	12	0.4461	0.0236	0.4489	0.4480	0.0235	0.3938	0.4770	0.0832	-0.6694	-0.5596	0.0065
Estonia	13	0.4302	0.0442	0.4455	0.4348	0.0299	0.3393	0.4705	0.1312	-0.9567	-0.6555	0.0123
Malta	14	0.3994	0.0442	0.4164	0.4012	0.0433	0.3211	0.4579	0.1368	-0.3900	-1.3646	0.0123
Cyprus	15	0.3593	0.0356	0.3632	0.3602	0.0415	0.2964	0.4124	0.1160	-0.1784	-1.2441	0.0099
Slovakia	16	0.3464	0.0162	0.3467	0.3464	0.0084	0.3156	0.3770	0.0614	0.0312	-0.4153	0.0045
Hungary	17	0.3392	0.0269	0.3465	0.3399	0.0275	0.2888	0.3818	0.0930	-0.1905	-1.0415	0.0075
Lithuania	18	0.3367	0.0381	0.3499	0.3407	0.0150	0.2546	0.3749	0.1203	-1.1497	-0.0504	0.0106
Latvia	19	0.3328	0.0534	0.3568	0.3374	0.0203	0.2288	0.3854	0.1567	-0.9471	-0.7455	0.0148
Spain	20	0.3318	0.0140	0.3336	0.3330	0.0145	0.2991	0.3514	0.0523	-0.7037	-0.2234	0.0039
Portugal	21	0.3308	0.0247	0.3330	0.3311	0.0294	0.2905	0.3682	0.0777	-0.1161	-1.3163	0.0068
Italy	22	0.3244	0.0162	0.3275	0.3252	0.0132	0.2918	0.3479	0.0562	-0.3396	-0.9311	0.0045
Poland	23	0.3052	0.0290	0.3123	0.3070	0.0295	0.2486	0.3424	0.0937	-0.4580	-1.1858	0.0081
Croatia	24	0.2757	0.0228	0.2758	0.2757	0.0281	0.2378	0.3133	0.0755	-0.1017	-1.3479	0.0063
Romania	25	0.2234	0.0172	0.2240	0.2220	0.0178	0.1996	0.2626	0.0630	0.6143	-0.2963	0.0048
Greece	26	0.1790	0.0393	0.1708	0.1760	0.0411	0.1281	0.2631	0.1350	0.6521	-0.7558	0.0109
Bulgaria	27	0.1580	0.0166	0.1578	0.1585	0.0129	0.1230	0.1873	0.0643	-0.1428	-0.3176	0.0046

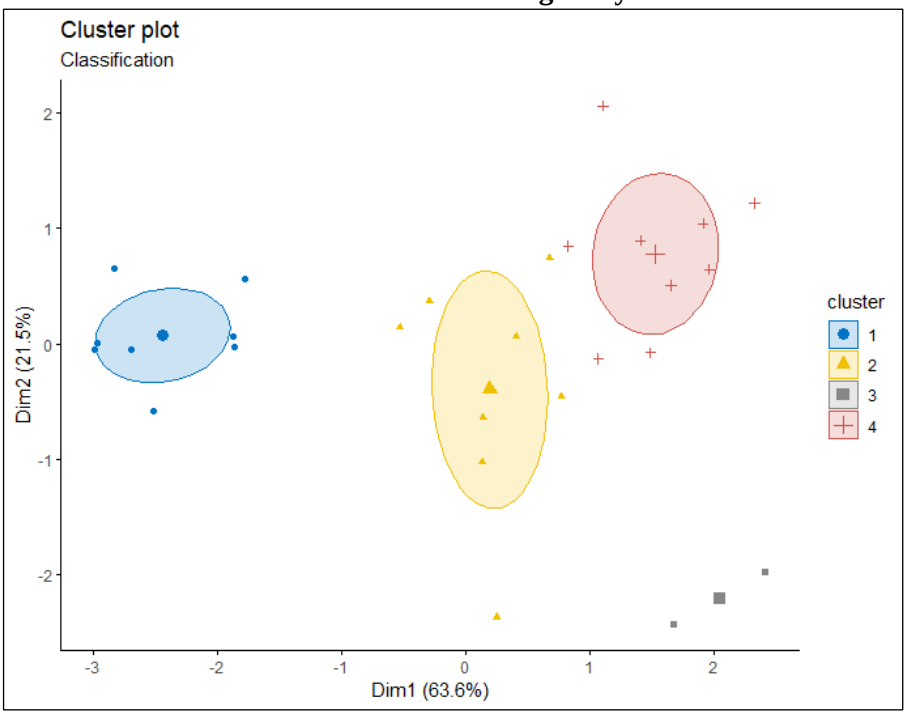
Annex 13. Dendrogram of hierarchical cluster analysis based on the Ward method in 2008



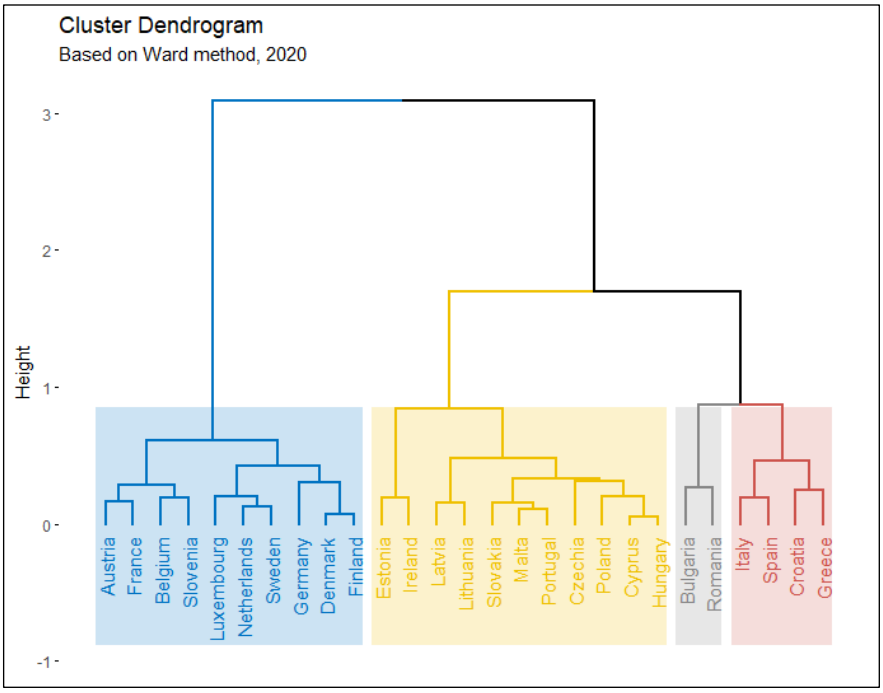
Annex 14. Number of clusters (Elbow method) in 2008



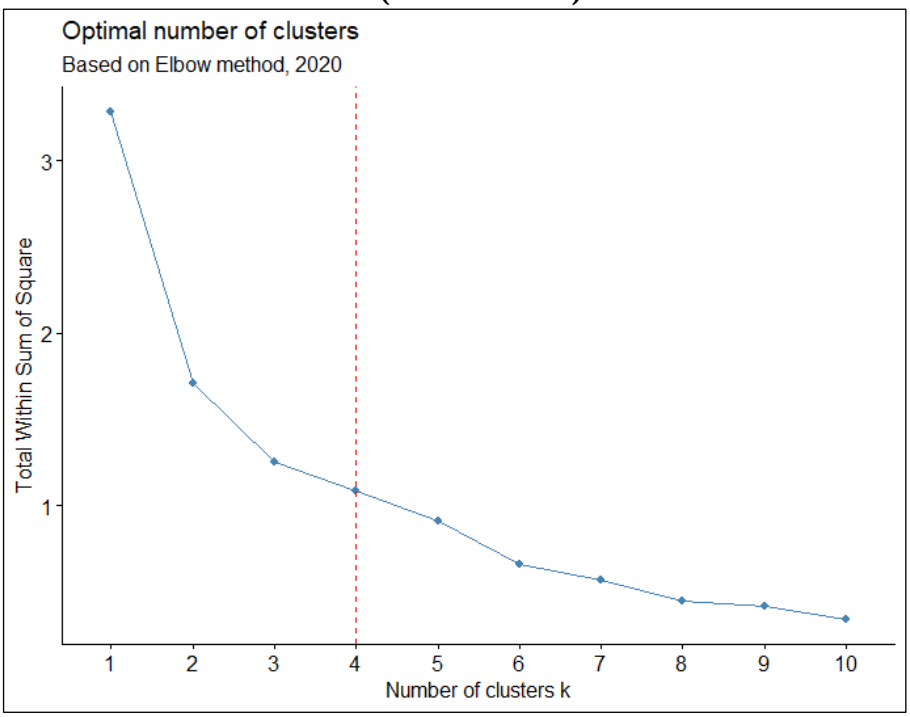
Annex 15. Results of model-based clustering analysis in 2008



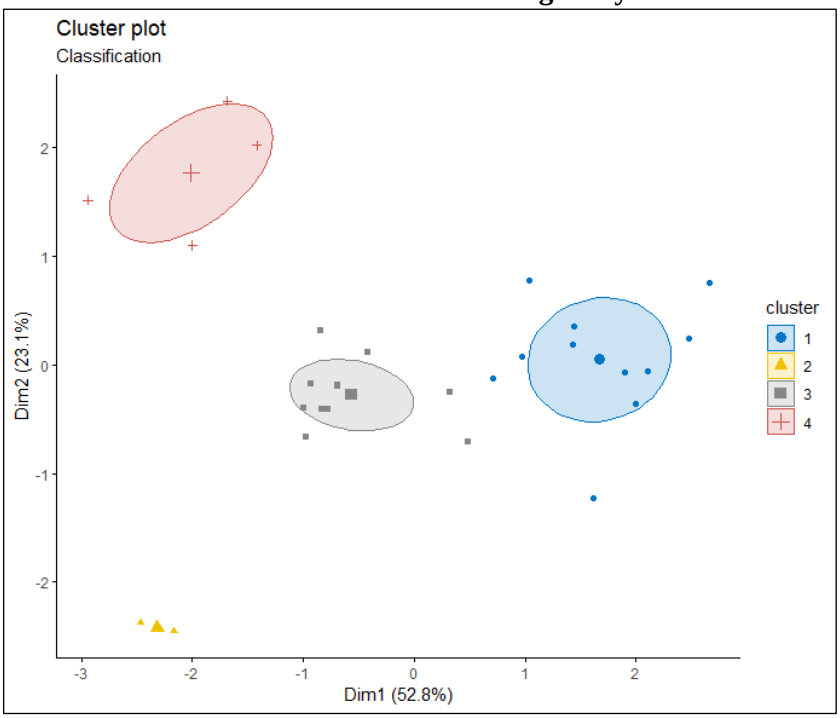
Annex 16. Dendrogram of hierarchical cluster analysis based on the Ward method in 2020



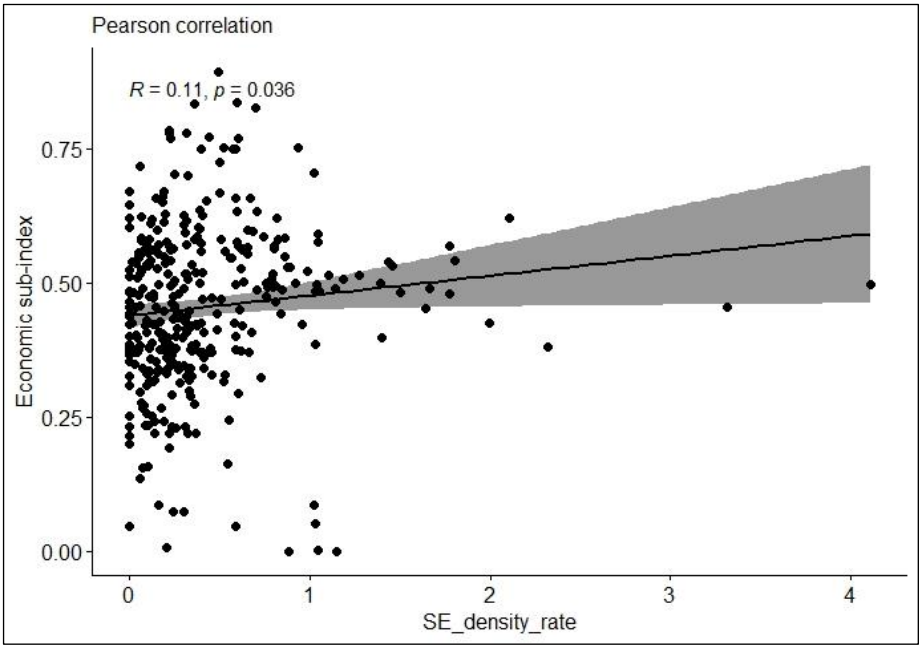
Annex 17. Number of clusters (Elbow method) in 2020



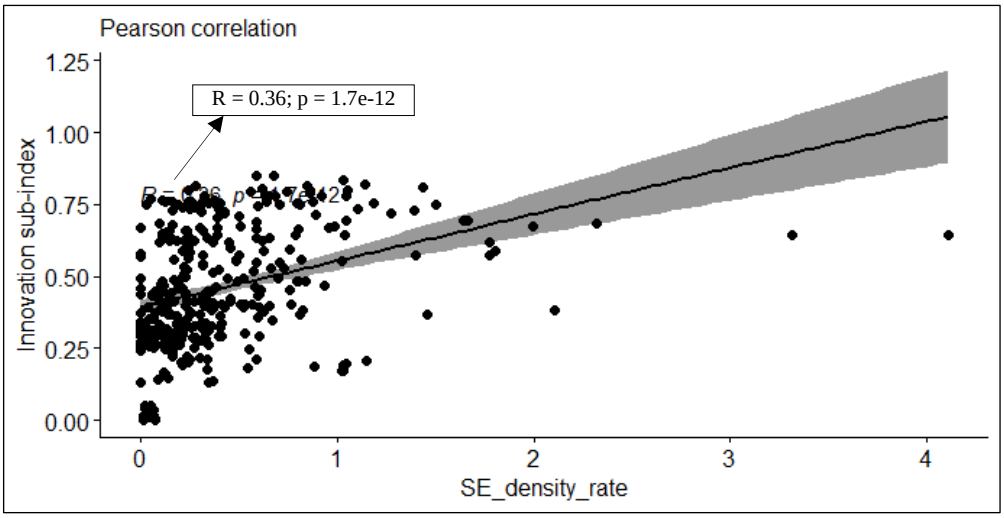
Annex 18. Results of model-based clustering analysis in 2020



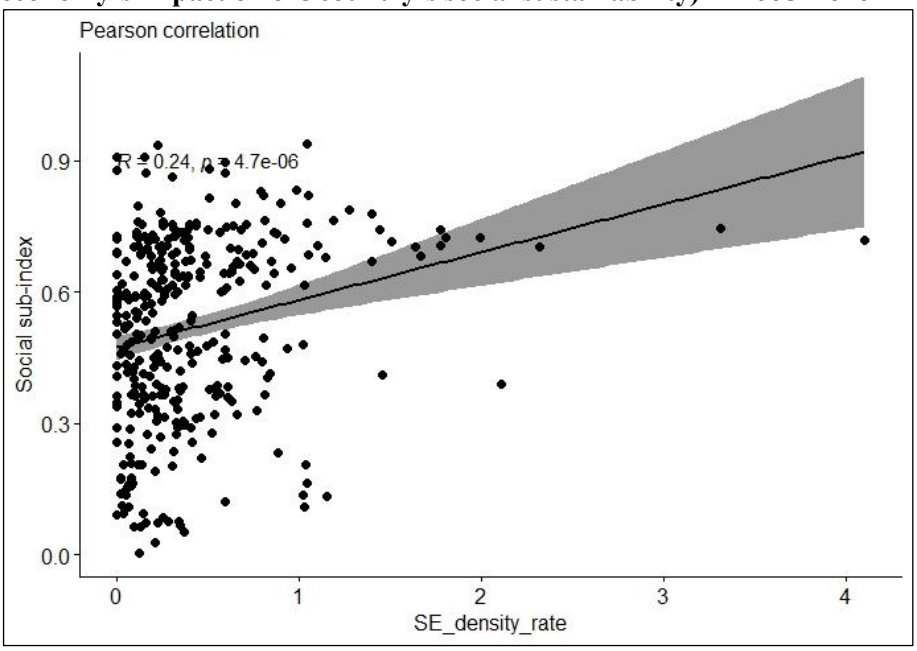
Annex 19. Results of Pearson correlation measuring dependences between the sharing economy's companies' density rate and $I_{SusEcon}$ (sub-index of the sharing economy's impact on the country's economic sustainability) in 2008–2020



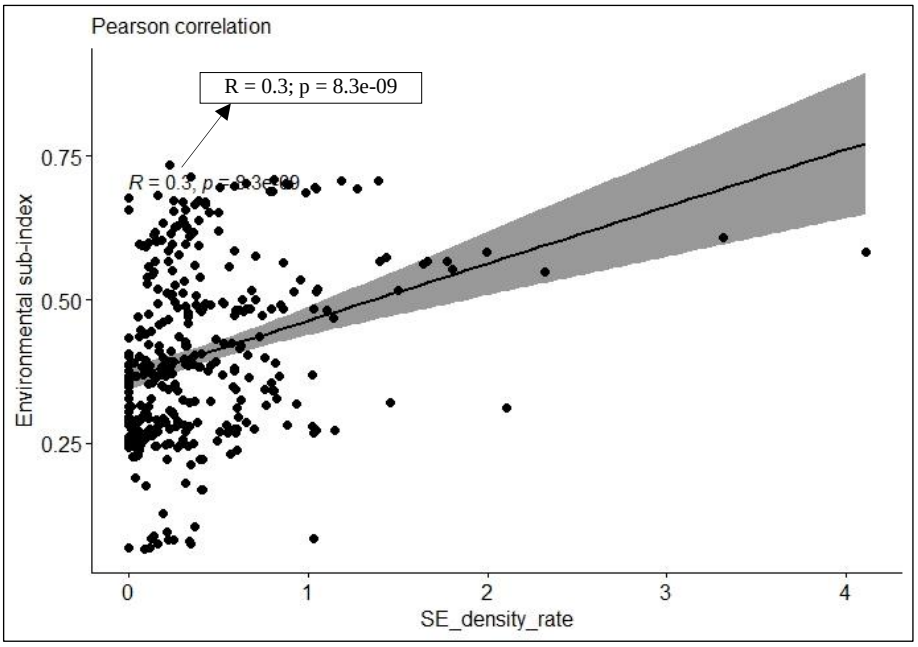
Annex 20. Results of Pearson correlation measuring dependences between the sharing economy's companies' density rate and ISusInnov (sub-index of the sharing economy's impact on country's innovation sustainability) in 2008–2020



Annex 21. Results of Pearson correlation measuring dependences between the sharing economy's companies' density rate and I_{SusSoc} (sub-index of sharing economy's impact on the country's social sustainability) in 2008–2020



Annex 22. Results of Pearson correlation measuring dependences between the sharing economy's companies' density rate and I_{SusEnv} (sub-index of sharing economy's impact on the country's environmental sustainability) in 2008–2020



UDK 330:502.131.1+330.34](043.3)

SL 344. 2024-01-23, 22 leidyb. apsk. l. Tiražas 18 egz. Užsakymas 8.
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