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Altin Kulli,

Małgorzata Grzywińska-Rąpca,

Nelson Duarte, Enkelejda Goci,

Carla Pereira

Consumption behavior towards the circular economy

Altin Kulli iD

Qiriazi University College, Faculty of Economy, Rr. Koder Kamez, 1001 Tirana, Albania
corresponding author: altin.kulli@qiriazi.edu.al

Małgorzata Grzywińska-Rąpca iD

University of Warmia and Mazury in Olsztyn, Faculty of Economic Sciences, Plac Cieszyński
1/429A, 10-720 Olsztyn, Poland

Nelson Duarte iD

INESC TEC, ESTG, Instituto Politécnico do Porto, Casa do Curral, Rua do Curral, Margaride,
4610-156, Felgueiras, Portugal

Enkelejda Goci iD

Aldent University, Faculty of Medical Sciences, Rr. e Dibres, Nr. 235, 1001, Tirana, Albania

Carla Pereira iD

INESC TEC, ESTG, Instituto Politécnico do Porto, Casa do Curral, Rua do Curral, Margaride,
4610-156, Felgueiras, Portugal

Consumption behavior towards the circular economy

Abstract

The article focuses on the consumption of goods used by consumers of different generations from 3 different countries: Albania, Polish and Portugal. The aim of the analysis was to identify respondents' indications concerning: (1) knowledge of the definition of the circular economy, (2) declared by respondents places of purchase of used products and (3) type of purchased products used by respondents. The analysis was conducted among 495 respondents from Albania, Polish and Portugal representing three generations (X, Y, Z). Correspondence analysis was used for statistical data analysis. Statistically significant differences in knowledge of the definition of the circular economy were shown between respondents from Albania, Polish and Portugal. It was also found that respondents' preferences regarding the place of purchase of second-hand goods are differentiated (at a statistically significant level) by nationality and year of birth (generation). The obtained results open the possibility of further research aimed at identifying different behaviors among these groups of consumers. The presented work, both in the cognitive and application part, can be a source of knowledge and popularization of research, as well as a source of inspiration for in-depth reflection and scientific discussion. The analyses presented in the publication may complement the existing research in the field of circular economy. Extending the survey to other EU countries can help define a strategy for policymakers, manufacturers and retailers to make greater use of circular economy solutions, while maintaining the viability of their operations.

1. Introduction

The Circular Economy (CE) is a concept that is gaining increasing attention as a sustainable development strategy. According to the New Circular Economy Action Plan from the European Commission (European Commission, 2020), CE aims to decouple economic growth from resource consumption and waste generation.

A CE approach emphasizes the use of renewable resources, the reduction of waste and pollution, and the promotion of the sharing and reuse of products and materials. Together, smaller but relevant actions are crucial to tackling global challenges such as climate change (EMF, 2023).

In this context, several actors, such as policymakers and producers must be committed to this global effort. Along with the latter stakeholders mentioned above, consumers play a critical role in driving the transition to a circular economy, by making sustainable choices and adopting new consumption patterns. However, little is known about the factors that influence consumers' behaviour in the circular economy context.

To fill this gap, this paper aims to investigate the circular economy behaviour of consumers and attempts to identify factors such as age, gender, geographical location, or household composition that may influence it. Specifically, we examine the following research questions: (1) What is the level of awareness of the circular economy among consumers? (2) Where are consumers buying second-hand products? (3) What kind of second-hand products are consumers buying?

To answer these research questions, a survey was conducted in 3 different countries: Albania, Poland, and Portugal. The data were mainly analysed by performing a correspondence analysis. In terms of structure, this present paper starts with a brief presentation of the literature review, followed by the methodological assumptions, and concludes with the results achieved. In conclusion, the most relevant achievements are presented in an effort to provide some clues for policymakers and producers regarding the circular behaviour of consumers. As this research could be considered a first attempt at identifying consumer behaviour, some limitations are also identified and discussed in the paper's last section.

2. Literature Review

The conventional economy depends solely upon the production and consumption of materials (Ūsas et al., 2021). Such an approach causes the exhaustion of resources and excessive production of waste, leading many countries to face critical economic and environmental difficulties. Awareness of finite energy sources has called for countries to act more cautiously in terms of resource use. To this end, the concept of CE makes important contributions to understanding both the economy and the environment (Gökgöz et al, 2021). There is no unique definition of CE, as we can confirm for instance from Kirchherr et al. (2017), who analysed 114 definitions of CE. The Ellen MacArthur Foundation (2013) defined the CE as *"an industrial system that is restorative or regenerative by intention and design. It replaces the "end-of-life" concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models."*

The European Commission defines the concept of the CE under the new EU Action Plan for the Circular Economy (EC, 2020) as follows: *"In a circular economy the value of products and materials is maintained for as long as possible. Waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value."* This paper will mainly address the last item, as it deals with the EU principles. Today, one of the main problems for both developed and developing countries is balancing economic growth and environmental protection (Gao et al., 2021), and the CE is a remarkable concept for this purpose.

A CE differs from a linear economy because of its focus on repairing, reusing and refurbishing materials, replacing the "end-of-life" concept with reducing, reusing, recycling and recovering materials during production, distribution and consumption (Kirchherr et al., 2017). Kirchherr et al. define it as operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), to further sustainable development. This includes simultaneously improving environmental quality, economic prosperity and social equity for the benefit of current and future generations.

Figure 1a. The Linear Economy (AkzoNobel, 2015)
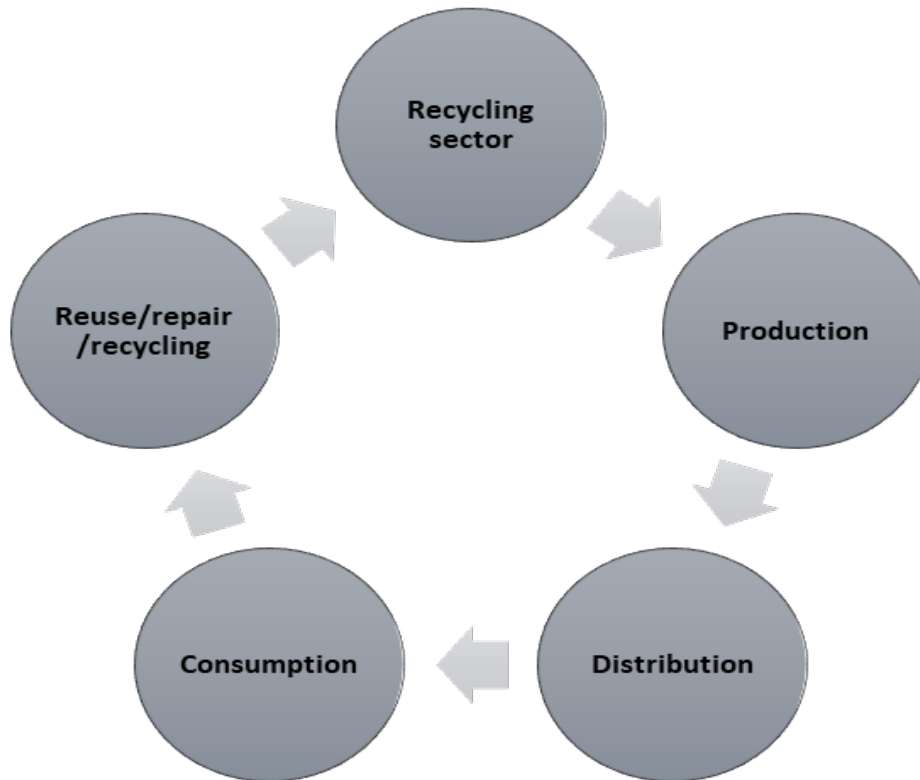
Figure 1b. The Circular Economy (AkzoNobel, 2015)

Authorities at all levels of governance are increasingly encouraging a transition towards a circular economy. The European Commission adopted the EU Action Plan for the Circular Economy in 2015, detailing key measures, specific areas of intervention and targets for waste reduction and recycling. The Action Plan has been enhanced by amendments and directives to form the Circular Economy Package. National, regional and local governments and authorities support the CE through sector policies, as well as by setting up platforms or funding schemes. One example is the European Circular Economy Stakeholder Platform (ECESP), which was established in 2017 by the European Commission and the European Economic and Social Committee to promote the CE across territories, sectors and themes by gathering knowledge and fostering dialogue. More recently, the European Commission released an updated version of this Plan (EC, 2020), where the stakeholders interact and share experiences via this platform.

The term CE appeared for the first time in a study by Pearce and Turner (1989) that addressed the interlinkages between the environment and economic activities (Andersen, 2007). Pearce and Turner identified a closed-loop material flow in which the economic system takes place according to the principle "*everything is an input to everything else*" (Su et. al., 2013).

In recent years, the concept of CE has gained the attention of institutions, scholars and firms (Ghisellini et. al., 2016), (Nikolaou & Tsagarakis, 2021). In 2014, the European Union issued in the Communication "Towards a circular economy: A zero waste program for Europe" and another in 2015, "Closing the loop – An EU action plan for the circular economy", which is part of the CE Package (European Commission, 2015a).

The CE underscores the necessity of re-design the traditional linear path of production and consumption, transitioning from the "take, make, use, dispose" model (Geng & Doberstein, 2008) to a more circular society (restorative and regenerative) model (Schulze, 2016; EMF, 2015a) (Figure 1a, Figure 1b), which aims to boost the economic growth while avoiding natural resource depletion and environmental degradation.

Non-governmental organizations such as the Ellen MacArthur Foundation are also committed to spreading CE principles.

The transition to the CE was estimated by Accenture to be capable of creating global growth of $4.5 trillion by 2030, enhancing the resilience of global economies (García-Sanchez, et al, 2021). Convinced by similar arguments, the European Union plans to recover from the consequences of COVID-19 through *Next Generation EU*, with an allocation of 750,000 million euros establishing different areas of investment, with ecological transition towards a circular model being one of the most prominent (García-Sanchez et al., 2021).

The CE involves a new economic model that requires changes in the habits of organizations and individuals towards sustainable production, distribution maintenance and consumption systems in line with the objectives of the 2030 Agenda of the United Nations (Panchal et al., 2021). In other words, the circular transformation requires the abandonment of the take–make–use–dispose linear economy model (Jabbour et al., 2019) favoring the circular approach to material resources and energy (Geissdoerfer et al., 2017), obtaining economic, social and environmental benefits from regenerating the value of utilized resources (Mavi & Mavi, 2019).

The CE requires the instauration of systems that operate coherently with the energy, water and material cycling principles that, according to Zhu et al. (2010), must comply with eco-systemic self-sustaining properties. For a firm, it may require self-organization capacities, consumption efficiency, the recycling of energy and materials, and the reutilization of one company's waste as a resource. One of the most pressing challenges in accelerating this transition is measuring the progress of economic circularity, as it is extremely difficult to measure the progress of companies in the CE and, even more, to compare their progress at a global level.

According to the EU action plan (2015), the CE is often promoted as enabling "wider economic and social benefits, such as greater well-being, sustainable growth and employment".

3. Consumer Behaviour in CE

The CE usually requires more than replacing one type of product purchase with an equivalent, more "sustainable" or "green" purchase. It often entails behavioural changes as well, such as a shift in focus from acquisition to repair, reuse or resale – as well as a net reduction in original acquisitions – in order to bring about a full transition from linear systems (Camacho-Otero et al., 2020). Consumer researchers have examined how consumption and consumer behaviour change from three main perspectives: individual, social, and social (Halkier, 2017; Jackson, 2005; Grzywińska-Rąpca, 2015). The individualistic approach to consumption refers mainly to economic, psychological and cultural factors, answering the question of change.

Consumer behaviour is crucial in enabling the CE system and mechanism, regarding consumer products and services. Consumer contributions to CE-oriented strategies need to be adequately clarified, understood and measured in an effort to encourage sustainable consumption patterns. Existing studies on various consumption solutions that could be considered circular offer insights into the various elements that affect consumer acceptance and adoption of CE (Camacho-Otero et al. 2018, Camacho-Otero et al. 2019). Potential consumers may provide linkage to the use and end of life products, in order to maximize the performance of CE behaviour, supporting and facilitating a successful transition from a linear economy to a CE (Maitre-Ekern & Dalhammar, 2019). Thus, this may require incentivizing consumers to adopt new consumption patterns compatible with CE principles, such as green consumer behaviour, consumer awareness of product circularity, consumer knowledge and culture (Shevchenko et.al. 2023).

Such factors differ across countries, depending on consumers' active role in making sustainable choices or their stage of involvement in CE policy development, as well as specific features of cultures, such as traditions, social norms and practices. Intergenerational relationships (e.g. between Millennials and Zoomers), due to their preferences/ knowledge and awareness of CE strategies, motivated us to investigate the importance and contribution of such differences to adoption of CE across different countries and age cohorts.
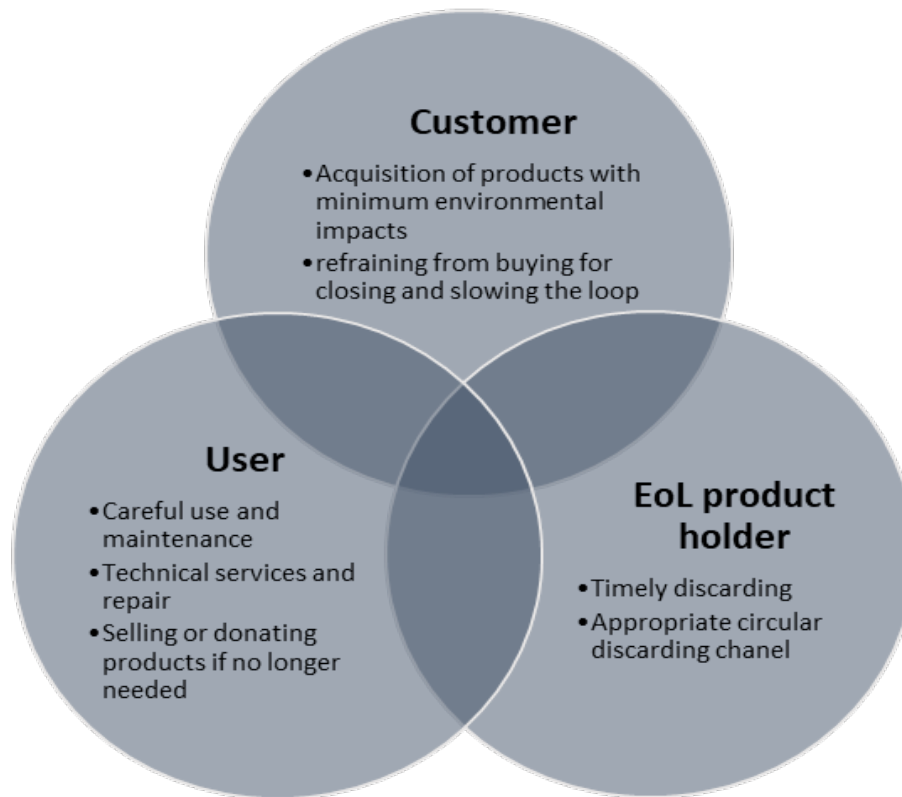
Figure 2. Factors influencing consumer decision-making in the Circular Economy (Shevchenko et al., 2023)

According to a report by Boston Consulting Group-BSG and Vestiaire Collective (2022), consumers' purchase perception and behaviour have recently adapted to CE, mainly at second-hand clothing or other-fashion markets, which generates a level of global revenues of US $100-120B. 50% of the respondents in this survey-report mentioned affordability (which in fact has fallen significantly, since 2020), as their main reason for choosing second-hand goods, especially luxury handbags. In the resale market, they add, "sustainability is an increasingly popular force, driving 40% of pre-loved purchases, while 'the thrill of the hunt' powers 35%." As a result, "25% of an average consumer's wardrobe is now second-hand (and this is projected to grow to 27% by 2023)." This robust resale market, with its potential for future income, is likely to make strong contributions to the CE.

Based on the above-mentioned, our study focused on analysing the impact of such a market on CE consumer behaviour. Figure 2 highlights adjustments to consumer behaviour that are needed in a CE, viewing the consumer in the roles of customer, user and end-of-life holders, as an important actor of CE activities.

We focused on consumer engagement with the CE, investigating the extent to which respondents are aware of CE, and how willing and likely they are to buy more durable products, repair goods, or lease or purchase second-hand products. The European Commission (2018), in Figure 3 below, provides some insights into factors that influence consumer decision-making in the CE, either enhancing or slow/inhibit CE practices.

According to the report, product quality and price are considered to be the most important factors influencing product choice, followed by product durability and repairability (whether repair services exist) and environmental considerations.

Less time and research have been devoted to studying consumer behaviour, and how it can both effect and be affected by the circular economy, with more recent research efforts preferring to focus on circular production and business models. Consumer choices and consumption behaviour, including consumer and user acceptance, influence, either directly or indirectly, the transition to CE. They reflect consumers' perception/awareness, knowledge/information towards circular products and the factors
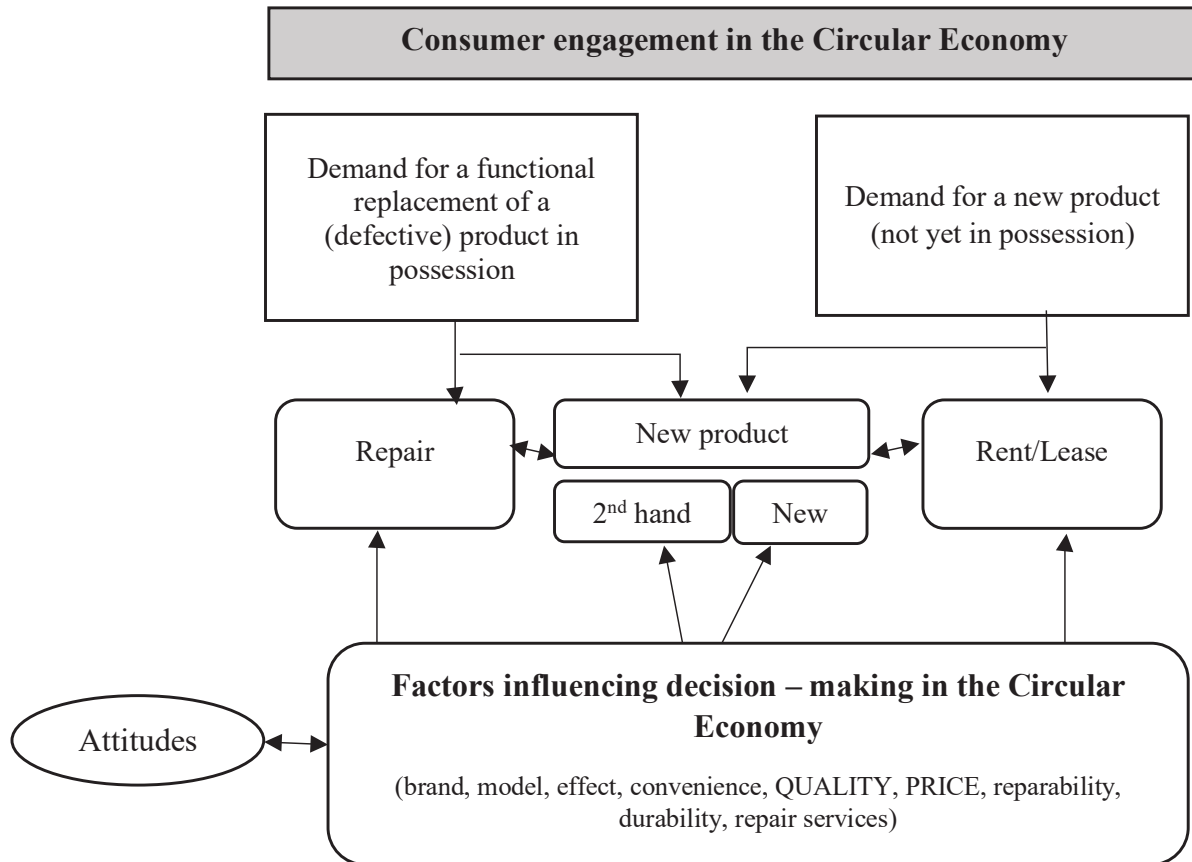
Figure 3. Factors influencing consumers' decisions to replace, repair or lease products (EC, 2018)

that drive or prevent their engagement to the CE process (Van Langen, et.al., 2021).

Comacho-Otero et al. (2018) identified seven main categories of factors affecting consumer perception and willingness to adopt CE principles, starting from a personal perspective (the need for uniqueness, or desire for change) and a psychological perspective (attitudes, values, habits, or ideologies) and moving on to product-related factors (price, quality, durability, design, risk of acceptance). Other authors consider availability of the information with respect to product quality, potential benefits and related costs, as well as knowledge and understanding, to be a key element of consumer decisions on CE (De Kock et al., 2020; Hao et al., 2020; Comacho-Otero et al., 2018; Smol et al., 2018).

Circular economy marketplaces such as Drivy, Vinted, and Backmarket offer a variety of products for sale or purchase, mainly focusing on second-hand, remanufactured, and leftover products, as well as by-products of production.

4. Methodological assumptions

The purpose of the designed and conducted empirical research was: (1) identification of respondents' indications regarding knowledge of the definition of a circular economy, (2) identification of respondents' indications of where they bought used products, and (3) identification of respondents' indications of the type of products they purchased and used.

The first stage of the analysis sought to identify the areas that play a key role in the purchasing behaviour of respondents buying second-hand goods. The study was conducted using a CAPI (Computer-Assisted Personal Interview) questionnaire on a sample of 495 respondents living in Poland, Albania and Portugal. The survey questionnaire contained 19 questions concerning (1) knowledge of the circular economy, (2) preferred shopping locations, and (3) factors determining the respondents' purchasing behaviour.

The study of student behaviour was based on surveys conducted on representative samples of students purposefully selected at three universities:

Table 1. Correspondence analysis operation diagram (Trzęsiok, 2016)

1	Creation of a correspondence matrix based on the contingency table, i.e., a relative frequency matrix
2	Transform columns and mailing matrix rows separately to get points (called row and column profiles) that represent the categories of nonmetric variables being studied
3	Finding a space with a smaller dimension and projecting into it (with possible rotation) points (profiles) obtained in point 2. The choice of space, as well as its rotation, is made in such a way that the loss of information contained in the original data is as small as possible
4	Creation of a perception map – a graphical presentation of the relationships between the categories of variables studied
5	Inference of dependencies and interpretation of results

University of Warmia and Mazury in Olsztyn, Technical University in Porto and Qiriazi University College in Albania. These universities were chosen because they are located in medium-sized urban areas (e.g., Olsztyn, Porto), cities where the importance of these universities for the societies and economy is much greater than in larger urban agglomerations.

The choice of these countries was determined by the fact that Albania is a non-member state of the European Union, and Poland and Portugal represent the groups of the so-called New Union (Poland began integration into the EU in 2004) and the Old Union (Portugal was integrated into the EU in 1986). Moreover, the economies of these countries show contrasts in terms of economic and social level. This diversity is reflected in many areas of functioning of economic units – households. In the next stage, the methods of descriptive statistics and correspondence analysis were used to analyse the research results. The starting point for the correspondence analysis was the previously conducted literature study, which was the basis for determining the key areas influencing the development of the circular economy and their interdependencies, taking into account the nationality and age group of respondents (X, Y, Z).

The data was collected through a survey conducted among four generations. In each country, the following age cohorts of respondents were distinguished as separate generations:

- Born from 1995 to 2012 (Generation Z)

- Born from 1980 to 1994 (Millennials)

- Born from 1965 to 1979 (Generation X)

- Born before 1965 (Baby Boomers).

Correspondence analysis was used to determine the relationship between the characteristics of respondents (nationality and generation) and answers to questions included in the CE questionnaire. It is a descriptive and exploratory technique involving analysis of multi-part tables, allowing for a presentation of the structure of qualitative variables with little loss of information (Greenacre & Hastie, 1987; Khattree & Naik, 2000; Torres-Lacomba et.al., 2006). The analysis allowed to reconstruct the distance between points representing rows and/or columns in two-dimensional space (Misztal, 2015; Stanimir, 2005; Walesiak & Gatnar, 2004; Grzywińska-Rąpca, 2021).

Correspondence analysis is a widely used technique in marketing and economic research. It is used to study similarities and associations between attributes and brands for the purposes of market segmentation, brand and promotional positioning, sales and advertising, as well as in the field of extracting consumer profiles. The aim of this analysis was to produce a graphical presentation of the relationship between the categories of variables studied, from which we could draw inferences about the relationships between these categories. The general scheme of operations in correspondence analysis is presented in Table 1.

Inferences about the relationships between the categories of nominal variables studied take place on the basis of the arrangement of points representing these categories, as presented on the perception map. The following hypotheses about the assumed relationship between respondents' indications and demographic characteristics (country and generation) were considered:

H_1: There is a correlation between CE behaviours and respondents' demographic characteristics.

H_2: Demographic characteristics of respondents make respondents' knowledge and awareness about CE differ.

H_3: The place where second-hand goods are purchased depends on the demographic characteristics of the respondents.

H_4: The type of second-hand products purchased is differentiated by the characteristics of the respondents.

A preliminary Chi-square analysis (χ^2) allowed us to carry out analyses determining the relationship between the socio-demographic characteristics of respondents and their answers regarding their knowledge and awareness of CE concepts. The purpose of this analysis was to determine which characteristics of the respondents significantly differentiate the answers to particular survey questions. The obtained values of the determined statistics indicated the legitimacy of conducting the correspondence analysis. The analysis of the survey results was carried out using the Statistica 13.3 software.

5. Results of the analyses

5.1. Knowledge of the definition of "circular economy"

Verification of the above assumptions about the existence of relationships between the two respondent characteristics (nationality and generation) and their knowledge of the concept of the circular economy requires consideration of the following hypotheses:

H_0: Knowledge of the assumptions of the circular economy concept does not depend on nationality and generation, vs.

H_1: Knowledge of the assumptions of the circular economy concept depends on nationality and generation.

A Chi-square independence test (H_1: There is a correlation between CE behaviours and respondents' demographic characteristics) - as part of the correspondence analysis procedure (χ^2 = 46.5664, df=22, p=.0017) – pointed to the rejection of the null hypothesis in favour of the alternative hypothesis. This means that nationality and/or generation may have an influence on respondents' knowledge about CE.

The numerical values that were obtained regarding the coordinates of the columns (Table 2) indicate that

the most important variants of respondents' answers regarding their knowledge of CE were "I don't know exactly what's going on" and "Yes, I know what the circular economy is".

The aggregate statistics for the row and column points show that the highest projection value – quality – was obtained (for all coordinates where a = 1). The graphical presentation of points representing row and column profiles in the space of the main axes (Figure 4) shows that the most unusual group (farthest from the centre of the coordinate system) are Polish respondents born before 1965.

The arrangement of points in Figure 4 shows that two respondent profiles dominate: (1) respondents from Albania representing Generations X and Z who indicated the answer variant "No, I've never heard that phrase before", and (2) respondents from Poland (Millennials), respondents from Albania (Baby Boomers) and respondents from Portugal (Generation X) who indicated the answer variant "Yes, I know what the circular economy is."

To sum up, it can be stated that there are statistically significant differences in knowledge (or rather lack thereof) of the definition of the CE depending on the country of origin and generation of the respondents. A possible explanation for the countries' differences might be that consumers in the European Union are closer to the concept, since there have been efforts taken by the European Union to adopt CE principles. This is underscored by the fact that most of the respondents from Albania (a non-EU member country) are closer to the answer "No, I've never heard that phrase before". It is interesting to note, however, that among older people (born before 1965), only Albanians indicate awareness of what CE means. Both Polish and Portuguese respondents from that age cohort are not familiar with the concept.

However, we can also find differences between Polish and Portuguese groups (European Union Members). Despite their nationality making them closer to the concept, only two European groups from two different generations (Generation X from Portugal and Millennials from Poland) claim to know what CE means.

An important issue in the context of the CE is the respondents' definition of "Which of the following terms do you associate most with the term 'circular economy'?". In order to verify the assumption that the demographic characteristics of respondents delineate levels of CE knowledge and awareness (H_2),

Table 2. Row and column coordinates and contribution to inertia for country, generation and knowledge of the question: "Have you come across the concept of the circular economy?". Source: own elaboration

Row and column coordinates				Aggregate statistics for row and column points	
Rows					
	Row	**Dimension1**	**Dimension2**	**Mass**	**Quality**
Albania 1995 to 2012	1	-0.487	-0.060	0.071	1.000
Albania 1980 to 1994	2	-0.233	-0.319	0.071	1.000
Albania 1965 to 1979	3	-0.513	-0.129	0.036	1.000
Albania Before 1965	4	0.258	-0.347	0.014	1.000
Poland 1995 to 2012	5	0.085	0.063	0.481	1.000
Poland 1980 to 1994	6	0.360	-0.100	0.024	1.000
Poland 1965 to 1979	7	-0.229	0.256	0.020	1.000
Poland Before 1965	8	-0.548	-0.708	0.004	1.000
Portugal 1995 to 2012	9	-0.446	0.288	0.063	1.000
Portugal 1980 to 1994	10	0.345	0.158	0.057	1.000
Portugal 1965 to 1979	11	0.255	-0.153	0.139	1.000
Portugal Before 1965	12	-0.190	0.032	0.020	1.000
Columns					
"Yes, I know what the circular economy is"	1	0.193	-0.174	**0.364**	1.000
"No, I've never heard that phrase before"	2	-0.481	-0.050	0.224	1.000
"I don't know exactly what's going on"	3	0.091	0.181	**0.412**	1.000

a correspondence analysis was carried out between respondents' profiles, their country and their age group. The statistical value of the significance level and critical value (χ^2 =52.375, df = 33, p = .0174) allowed us to reject the null hypothesis.

After rejecting the null hypothesis, the coordinates and contribution to inertia for rows and columns (Table 3) were calculated.

The values presented in Table 3 contain information about the relative amount of information that rows and columns contribute to the data set. The highest values of the quality level of rows were recorded for data concerning Portugal 1980 to 1994 (quality = 1.0) and Poland 1980 to 1994 (quality = 1.0). For column contributions, the highest quality values were recorded for the response variant "Actions that can lead to a reduction in waste" (quality = 0.9852). In this case, that means the original configurations of points have undergone the least distortion in factorial space. The points representing row and column profiles are presented graphically in the form of a two-dimensional factorial space (Figure 5).

The determined eigenvalues indicated the possibility of presenting this relationship in a two-dimensional system (first dimension: 50.48%, second dimension: 36.56%). The presented points of rows and columns in two-dimensional space show that the most typical group (located closest to the centre of the coordinate system) were Polish respondents born from 1965 to 2012 (Generation X, Millennials and Generation Z) who indicated the answer variant "Includes sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products."

6. Shopping places and nature of used products

The next stage of the analysis was to define the most common places of purchase of used goods: "Where do you most often buy used products?" and to identify the products that were most frequently purchased used: "What used products do you buy most often?".

Table 3. Row and column coordinates and contribution to inertia for country, generation and knowledge for the question "Which of the following terms do you associate most with the term 'circular economy'?". Source: own elaboration.

Row and column coordinates				Aggregate statistics for row and column points	
Rows					
	Row	Dimension1	Dimension2	Mass	Quality
Albania 1995 to 2012	1	-0.183	0.139	0.072	0.873
Albania 1980 to 1994	2	-0.277	0.244	0.072	0.988
Albania 1965 to 1979	3	0.039	0.571	0.037	0.991
Albania Before 1965	4	0.316	0.446	0.014	0.862
Poland 1995 to 2012	5	0.124	-0.047	0.488	0.962
Poland 1980 to 1994	6	0.072	-0.241	0.025	1.000
Poland 1965 to 1979	7	0.622	-0.170	0.020	0.689
Poland Before 1965	8	-0.256	-0.427	0.004	0.560
Portugal 1995 to 2012	9	-0.365	0.075	0.055	0.998
Portugal 1980 to 1994	10	-0.369	0.094	0.053	1.000
Portugal 1965 to 1979	11	-0.158	-0.275	0.139	0.879
Portugal Before 1965	12	0.725	0.414	0.020	0.722
Columns					
Providing consumers with more durable products that will provide savings and a better quality of life	1	-0.269	0.294	0.148	0.835
Includes sharing, renting, reusing, repairing, refurbishing and recycling existing materials and product	2	-0.060	-0.085	0.693	0.798
Actions that can lead to a reduction in waste	3	0.511	0.332	0.111	0.985
Activities that may lead to reductions in total annual greenhouse gas emissions	4	0.496	-0.436	0.049	0.759

Getting to know the decision-making process of the surveyed group of respondents who purchased second-hand goods requires identification and analysis of determinants. Following the procedures previously adopted, an attempt was made to diagnose the level of CE knowledge and awareness in respondents.

Verification of the assumption about the existence of relationships between the characteristics of respondents (nationality and generation) and their favoured locations for used-product shopping requires considering the following hypotheses:

H_0: The place of shopping for used products declared by respondents does not depend on nationality and generation, *or*
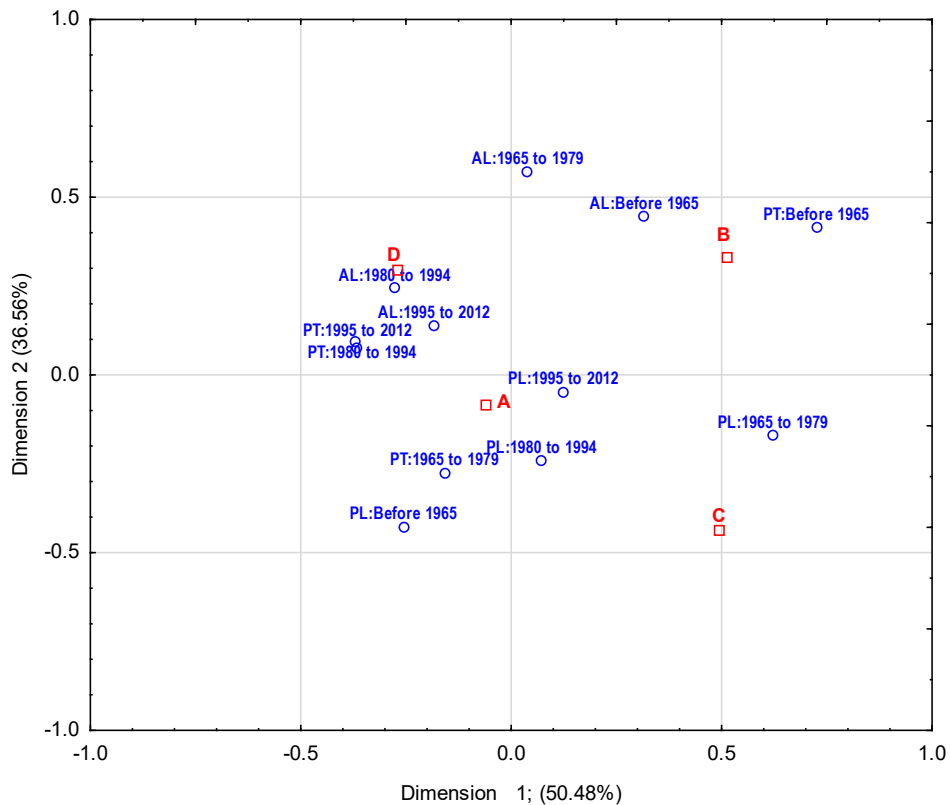
H_1: The place of purchase of used products declared by respondents depends on nationality and generation.

Based on the value of the statistics ($\chi^2 = 272.972$, df = 55, p = 0.000), the level of significance and critical value led us to reject the null hypothesis in favour of the alternative hypothesis, which means that the place of purchase of second-hand goods does depend on the age and nationality of the respondents. As a result of the correspondence analysis, collective row and column coordinates were obtained (Table 4).

With regard to places of purchase for second-hand goods, the highest-quality values were recorded in the case of Other (0.997). With regard to closeness to unity, it can be said that the original configurations of points in the factorial space have not been distorted. The Quality and Weight columns provide values of the quality measures of the mapping of points representing respondents (including country and generation) and the variants of the answer to the question "Where do you most often buy used products?". High-quality
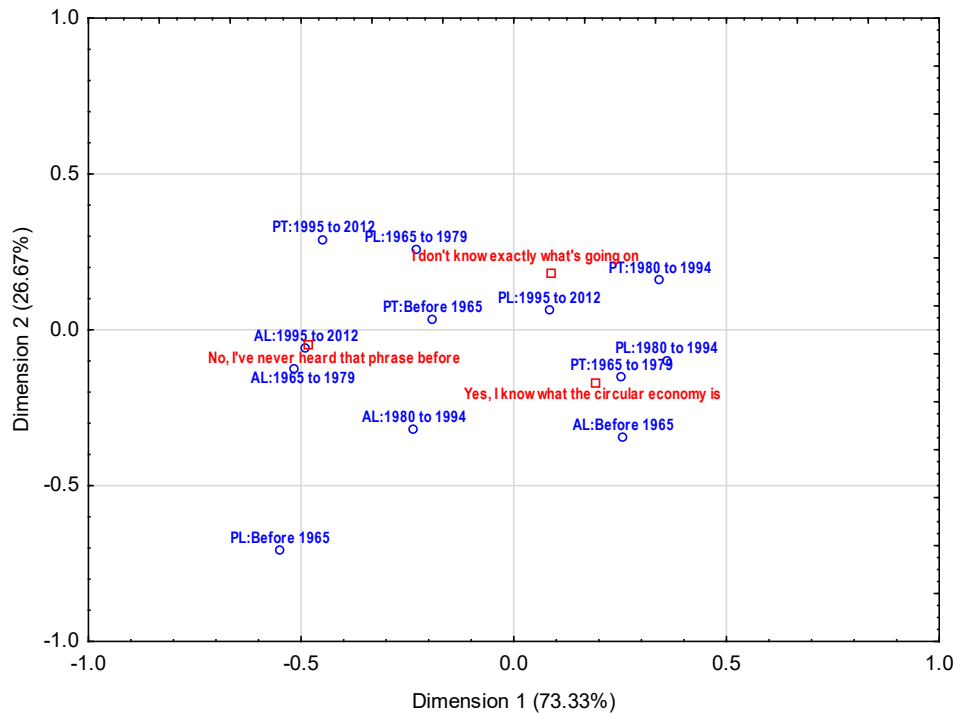
Figure 4. Presentation for the country, generation and knowledge "Have you come across the concept of the circular economy?". Source: Own elaboration using Statistica 13.3

Figure 5. *Presentation for the country, generation and knowledge for the question "Which of the following terms do you associate most with the term circular economy?" A* - Includes sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products; *B* - Actions that can lead to a reduction in waste; *C* -activities that may lead to reductions in total annual greenhouse gas emissions; *D* -providing consumers with more durable products that will provide savings and a better quality of life. Source: Own elaboration using Statistica 13.3

Table 4. Row and column coordinates and contribution to inertia for country, generation and "Where do you most often buy used products?" Source: own elaboration.

Row and column coordinates				Aggregate statistics for row and column points	
Rows					
	Row	Dimension1	Dimension2	Mass	Quality
Albania 1995 to 2012	1.000	-1.314	-0.375	0.071	0.907
Albania 1980 to 1994	2.000	-1.196	-0.006	0.071	0.929
Albania 1965 to 1979	3.000	-0.973	-0.162	0.036	0.873
Albania Before 1965	4.000	-1.365	0.300	0.014	0.948
Poland 1995 to 2012	5.000	0.543	-0.128	0.482	0.997
Poland 1980 to 1994	6.000	0.616	0.261	0.024	0.890
Poland 1965 to 1979	7.000	0.630	0.278	0.020	0.817
Poland Before 1965	8.000	0.617	1.151	0.004	0.840
Portugal 1995 to 2012	9.000	-0.347	0.233	0.061	0.960
Portugal 1980 to 1994	10.000	0.085	0.450	0.057	0.929
Portugal 1965 to 1979	11.000	-0.259	0.191	0.140	0.885
Portugal Before 1965	12.000	-0.337	0.363	0.020	0.998
Columns					
Other	1.000	-1.156	0.036	0.245	0.997
Vinted	2.000	0.322	-0.181	0.370	0.936
OLX	3.000	0.420	0.261	0.330	0.963
Wallapop	4.000	-1.073	-0.939	0.010	0.457
Allegro	5.000	0.808	-0.390	0.040	0.888
Facebook	6.000	0.797	-0.566	0.004	0.888

mapping of column points was obtained for the OLX and Vinted options.

The coordinate values of the rows (Table 4) indicate the highest level of projection quality in two-dimensional space for data for Portugal Before 1965 (0.998). Referring to the data contained in Table 3, the lowest value of the quality measure is recorded in the column containing the point Poland 1965 to 1979 (0.8169). This means that in this case, the original configurations of points in factorial space have undergone the greatest distortion. The points representing row and column profiles are presented graphically in the form of a two-dimensional factorial space below (Figure 6).

The value of the percentage of inertia indicated the possibility of accepting the presentation of dependencies in two dimensions. The cumulative percentage for the two dimensions is 93.38% (dimension 1: 84.10%, dimension 2: 9.28%). Polish respondents and those from Portugal (of all generations) were closest to the centre of the coordinate system. Respondents from Albania were the furthest from the centre. This points to the fact that popular places to purchase second-hand goods are differentiated by nationality to a greater extent than by generation. In general, most of the Albanians reported using apps other than OLX, Vinted or Wallapop.

Another important issue analysed in this study was the identification of the most frequently purchased goods. Preliminary analysis related to the determination of the value and critical value, together with singular values and the percentage of inertia, allowed us to present the relationships in two-dimensional space. Verification of the assumption of the existence of relationships between the characteristics of respondents (nationality and generation) and the type of products used requires consideration of the following hypotheses (H_4):
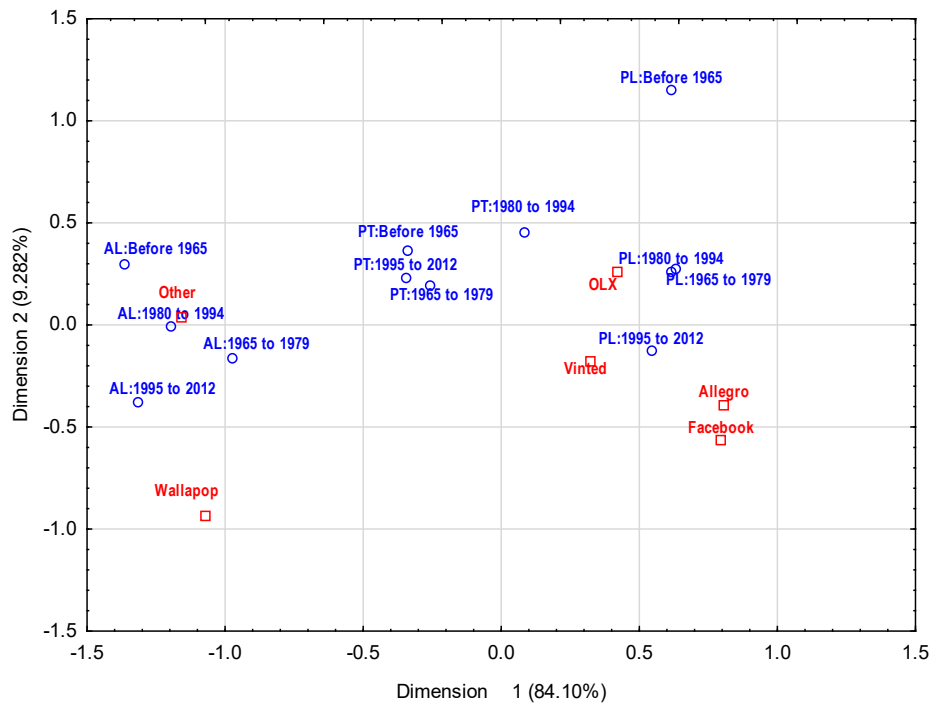
Figure 6. Presentation for country, generation and responses to "Where do you most often buy used products?"
Source: Own elaboration, using Statistica 13.3.

H_0: The type of second-hand products purchased does not depend on nationality and generation, or

H_1: The type of second-hand products purchased depends on nationality and generation.

Based on the value of the statistics (χ^2= 185.526, df = 132, p = 0.0015), the level of significance and critical value led us to reject the null hypothesis in favour of the alternative hypothesis, meaning that the place of purchase of second-hand goods does depend on the age and nationality of the respondents.

The results of the correspondence analysis are presented in Table 5, which contains information about the role of individual objects and variables in creating the system of the first two factorial axes and the mapping quality of the original configuration of points representing objects and variables by these factors.

The points representing row and column profiles are presented graphically below in the form of a two-dimensional factorial space (Figure 7).

Across the respondents, three relationships are clearly visible (Figure 7). Portuguese Generation Z and Polish Generation X consumers mainly purchase used clothing, while both Generation Z and Baby Boomers in Poland tend to buy used computers and laptops.

Baby Boomers from Portugal and Albania tend to buy other types of products.

Statistical analysis of the data, consisting of diagnosis of knowledge and awareness about CE, identification of the place of purchase of second-hand goods, and the type of used products preferred by the respondents, was carried out, taking into account nationality and generation (in relation to the respondent's year of birth).

Verification of the statement about the dependence of respondents' knowledge and shopping habits (second-hand goods) on nationality and generation required the formulation and consideration of the following statistical hypotheses:

H_0: knowledge and awareness of respondents about CE, places of purchase for second-hand goods, and the types of used products preferred by respondents are unaffected by nationality and generation, or

H_1: knowledge and awareness of respondents about CE, places of purchase for second-hand goods, and the types of used products preferred by respondents depend upon their nationality and generation.

On the basis of the values of the statistics determined by χ^2 analysis (in a separate procedure), the level of significance and the critical value in
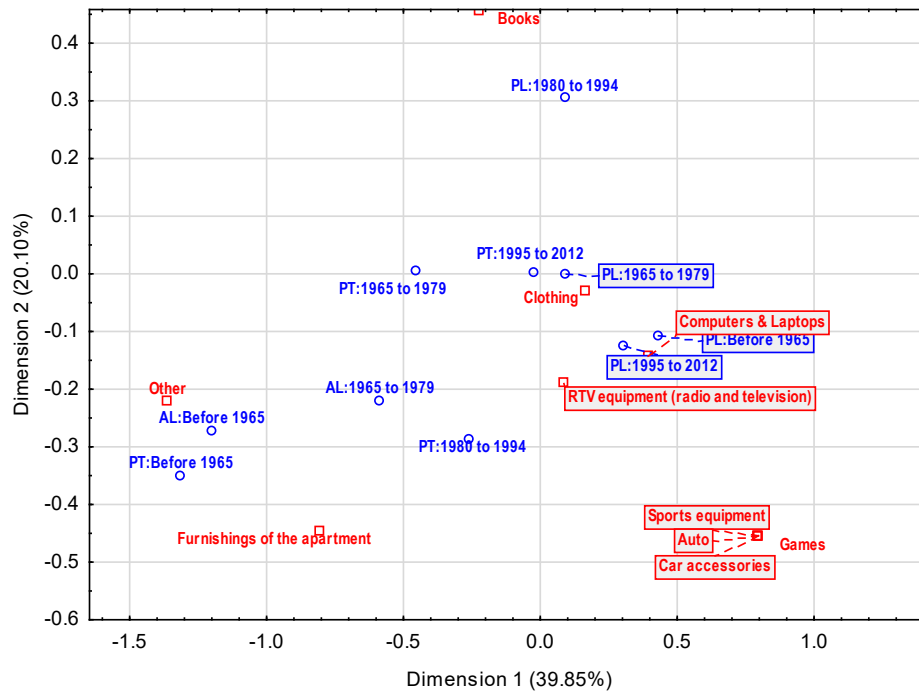
Figure 7. Presentation for country, generation and "What used products do you buy most often?"
Source: Own elaboration using Statistica 13.3

all cases led to the rejection of the null hypothesis. Thus, we determined that respondents' knowledge and consciousness of CE, places where they purchase second-hand goods, and the types of second-hand products they prefer are all influenced by nationality and generation. The percentage value of the inertia indicated the possibility of accepting the presentation of dependencies in two dimensions. The cumulative percentage for the relationship between knowledge of the assumptions of the CE concept and the nationality and generation of the respondents of two dimensions is 100% (dimension 1: 73.33%, dimension 2: 26.67%).

In the analysis of the relationship between the variants of the respondents' answers to the question "Which of the following terms do you most associate with the term circular economy?" and their nationality and generation, the two-dimensional space explained this relationship in 87.04% (Dimension 1: 50.48 %, Dimension 2: 36.56%). Verification of the assumption about the existence of relationships between the respondents' characteristics (nationality and generation) and where they said they purchased used products indicates that the two-dimensional space reflects this relationship in 93.38% (Dimension 1 and Dimension 2 together). Another analysis was to show the relationship between types of second-hand goods and the nationality and generation of respondents.

The cumulative percentage for this relationship in two dimensions was 59.95% (dimension 1: 39.85%, dimension 2: 20.10%). This was the lowest value of cumulative inertia, but within the theoretical limits of acceptability.

7. Conclusion

The results of this study have important implications for policymakers, businesses, and consumers interested in promoting CE. By identifying the key factors that influence consumers' behaviour in this context, our study provides insights into the design of effective communication and education strategies aimed at raising awareness of the CE and promoting sustainable consumption practices.

As presented above in Table 6, some differences were found across countries and generations. This might mean that each country may need to adopt different strategies to reach different generations.

Limitations were also present in this research. The small number of countries included in this research does not allow generalization of the results. The results obtained allow us to get a general perspective on the differences that may exist among nationalities

Table 5. Row and column coordinates and contribution to inertia for country, generation and "What used products do you buy most often?" Source: own elaboration.

Row and column coordinates				Aggregate statistics for row and column points	
Rows					
	Row	**Dimension1**	**Dimension2**	**Mass**	**Quality**
Albania 1995 to 2012	1	-0.191849	0.534824	0.070707	0.472894
Albania 1980 to 1994	2	0.051960	0.706800	0.070707	0.708095
Albania 1965 to 1979	3	-0.584115	-0.220138	0.036364	0.545227
Albania Before 1965	4	-1.198459	-0.272782	0.014141	0.733096
Poland 1995 to 2012	5	0.307759	-0.124694	0.480808	0.974455
Poland 1980 to 1994	6	0.090776	0.303964	0.024242	0.251457
Poland 1965 to 1979	7	0.095099	-0.000663	0.020202	0.014137
Poland Before 1965	8	0.431796	-0.107556	0.004040	0.352646
Portugal 1995 to 2012	9	-0.023527	0.001238	0.062626	0.004099
Portugal 1980 to 1994	10	-0.259301	-0.288581	0.056566	0.359246
Portugal 1965 to 1979	11	-0.452911	0.003187	0.139394	0.461722
Portugal Before 1965	12	-1.311056	-0.351163	0.020202	0.778023
Columns					
Other	1	-1.35968	-0.221362	0.038384	0.823015
Clothing	2	0.16687	-0.029520	0.640404	0.847949
Books	3	-0.22194	0.454150	0.074747	0.365518
Footwear	4	-0.31252	0.955384	0.024242	0.575607
Household goods (e.g., toasters)	5	-0.55651	0.519437	0.026263	0.323437
Furnishings of the apartment	6	-0.80131	-0.446938	0.054545	0.820918
Phones	7	0.14480	1.356521	0.006061	0.783974
Computers & Laptops	8	0.39371	-0.142679	0.026263	0.248796
RTV equipment (Cooperation radio and television)	9	0.08642	-0.190468	0.098990	0.188273
Sports equipment	10	0.79637	-0.454325	0.004040	0.778476
Games	11	0.79637	-0.454325	0.002020	0.778476
Car accessories	12	0.79637	-0.454325	0.002020	0.778476
Auto	13	0.79637	-0.454325	0.002020	0.778476

and generations, or even take a first look at the dichotomy between EU vs non-EU countries. To get more consistent results, however, the questionnaire should be applied to other EU and non-EU countries. This could also help verify whether the efforts of the European Commission to turn Europe into the first climate-neutral continent by 2050 are having a greater impact on the EU member nations.

The results having now been achieved, the observation of significant differences in terms of nationalities and generations opens an opportunity to keep up with further studies aiming at the identification of distinct behaviours among these groups of consumers. The identification of these factors may contribute to the definition of strategies for policymakers, producers and sellers in order to work for a more circular economy while keeping their businesses profitable. The work presented here, both in its conception and application, can be a source of knowledge and popularization of research, and can be a source of inspiration for in-depth reflections and scientific discussion.

Table 6. Summary of research results.

No.	Analysed dependence	Summary
1.	Knowledge of the assumptions of the circular economy concept and the nationality and generation of the respondent	Generations X and Z from Albania indicated the answer variant: "No, I have never heard that sentence before." The answer "Yes, I know what the circular economy is" was clear from Polish Millennials, Albanian Baby Boomers, and Portuguese Generation X.
2.	The variants of the respondents' answers to the question „Which of the following terms do you most associate with the term 'circular economy'", and nationality and generation	„Includes sharing, renting, reusing, repairing, refurbishing and recycling existing materials and products" The most relevant group's answers to this option were Polish respondents from three different generations (X, Millennials and Z).
3.	The place of purchase of used products respondents' and nationality and generation	Consumers from Poland (born: 1965 – 2012) prefer OLX and Vinted as a place to buy second-hand goods. Consumers from Albania (all generations) most often indicated the answer option "Other." The distribution of answers of respondents from Portugal did not clearly indicate preferred shopping place.
4.	Types of second-hand goods and the nationality and generation of respondents	Consumers represented by Portuguese generation Z and Polish generation X mainly purchase clothes. Polish generation Z and baby boomers tend to buy used computers and laptops.

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