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# THE EU E-COMMERCE MARKET IN A PANDEMIC CONTEXT – LINKING DEMOGRAPHIC FACTORS AND TERRITORIAL CONVERGENCE

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**Abstract.** This article presents a comprehensive analysis of the European Union's e-commerce market within the context of the COVID-19 pandemic. It examines the correlation between demographic factors and the territorial convergence of e-commerce activities across EU member states. By leveraging empirical data and employing the General Linear Model – Repeated Measures (GLM-RM) to analyze temporal changes in the phenomena of interest across EU countries, the study provides a nuanced understanding of the market's evolution during and after the pandemic. The research reveals a notable expansion in the EU's e-commerce market value, leading to a reduction in economic disparities among member states. It highlights the role of consumer demographics in shaping online shopping behavior, with age being a pivotal factor that demonstrates significant variations. Additionally, the study delves into the differential performance of various product categories, reflecting a pattern of selective sectoral convergence. A key finding is the pandemic's dual role as a disruptor and an accelerator for digital integration, particularly in enhancing digital inclusivity in less economically developed EU regions. This study contributes to the broader discourse on e-commerce market dynamics in times of global crises, offering valuable insights for policymakers and business strategists.

**Keywords:** e-commerce, demographic factors, online purchases, EU, share of e- commerce in GDP, convergence, pandemic period.

**JEL Classification:** E21, O33, O47.

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## 1. Introduction

The literature, both from Romania and abroad, offers a relatively wide range of studies and research aimed at identifying the link between different demographic and economic indicators and those regarding the dynamics of online trade, respectively studying the influence and underlying mechanisms that have contributed to the sustained growth of sales in online commerce over the last 3 years. It is well known, for example, that the disparities between the EU states, in many areas of socio-economic development, also had a counterpart in the degree of assimilation, operationalization, and use of the Internet, in general, and online commerce, in particular.

Such analyses are typically conducted during "normal" times when most endogenous and exogenous factors are known and predictable. However, they can also be expanded to include extraordinary variables, such as the impact of a global crisis like the COVID-19 pandemic, which has had a transformative effect on our lives. Of particular interest to us is the "new normal" imposed by the global spread of SARS-CoV-2, which accelerated digital adoption.

The impact of the SARS-CoV2 pandemic, as an accelerating factor of the use of the Internet and, implicitly, of sales in the online environment, has been the subject of numerous

studies, the issue being analyzed in various areas of interest (impact on the macroeconomic level, on sectors of activity or at governmental level; impact on companies; impact at the individual level etc.). In other words, a new line of research associated with COVID has emerged. But, there is a notable gap in the literature specifically focused on understanding the dynamics of consumer behavior from a demographic standpoint in EU countries during the pandemic (Tyrväinen & Karjaluoto, 2022). This gap is particularly significant as it overlooks the potential differences in how various demographic groups – distinguished by age, income, education, and geographic location – adapted to and engaged with e-commerce during the pandemic. Such differences could provide valuable insights into consumer resilience, adaptability, and preferences under crisis conditions. Understanding these dynamics is crucial for tailoring e-commerce strategies and policies that are responsive to the needs and behaviors of different demographic segments. Additionally, the pandemic's role as a catalyst for digital transformation across the EU presents a unique opportunity to study these demographic influences. The shift towards online platforms for shopping, necessitated by lockdowns and social distancing measures, could reveal important trends about digital inclusivity, accessibility, and the digital divide among various demographic groups within the EU. Moreover, this gap in research underscores the need for a more granular analysis of consumer behavior during unprecedented global events. Such an analysis can provide a comprehensive understanding of consumer resilience and adaptation strategies, which are vital for predicting future market trends, shaping e-commerce platforms, and informing policy decisions that promote equitable digital access and economic resilience in the face of global challenges.

To accomplish the article's objectives, we have structured it into several key sections: Literature Review, Materials and Methods, Results, Conclusions, as well as Limitations and Future Research.

## 2. Literature review

Despite the digital world and the Internet being integral to global economic life for over two decades, the pandemic years further emphasized humanity's need to adapt to global changes. This situation reaffirmed the European Union's 2020 viewpoint on the urgent necessity of developing and implementing a digital strategy. Consequently, the pandemic caught Europe unprepared in terms of digital readiness. Paradoxically, beyond its negative effects, the pandemic generated by COVID-19 represented an opportunity in the national and European space, both at the macroeconomic level, accelerating the digital transformation (Kannan, 2020), and at the microeconomic level, forcing companies to adopt models of businesses that correspond to the new context (Jasek et al., 2019; Ceocea et al., 2020; Kannan, 2020; Seetharaman, 2020). The existing disparities in European states from the perspective of online trade, very visible before the pandemic, have their origin in the characteristics of the population, expressed with the help of different demographic and economic indicators, among which the most often used are Internet access rate and the level of use of the network for personal purposes (Timiras & Nichifor, 2015).

The impact of demographic factors on online shopping trends has been extensively examined in scholarly work prior to COVID-19 period. Elements like geographic location, age group, educational background, occupational status, and gender were identified as significant drivers of online commerce behavior.

The age category was mentioned as a demographic factor with a strong influence on the dynamics of online commerce, together with a wider group of indicators that contribute,

in an aggregated manner, to the explanation and quantification of unobservable variables such as online activity, purchasing behavior in the online environment and the availability/willingness to spend online (Trocchia & Janda, 2000; Dewalska-Opitek et al., 2022). Devi et al. (2019) highlighted the fact that selling in the online environment is the preferred alternative of the young segment who, beyond having the skills to use new information and communication technologies, also show a high willingness to adopt new elements, the risk associated with the use of different platforms for sale being extremely reduced in this segment (Davidavičienė et al., 2020). Other articles that present reasoned results regarding the relationship of the age indicator with the dynamic variable of online commerce were offered by: Sebastianelli et al. (2008); Handa and Gupta (2014); Lissitsa and Kol (2016); Herrando et al. (2019); Assaker (2020); Liébana-Cabanillas et al. (2021). It must be specified, however, that some of the previously mentioned authors identified a positive link between the two indicators, while others obtained results that either reveal a negative relationship or the lack of a link.

Various studies have underscored gender disparities in online shopping, examining both the frequency of purchases and the nature of the shopping behavior itself. The differences in purchase intention and the actual manifestation of purchase behavior in the online environment on the two genders must also be correlated with a series of variables, among which: the use of the Internet network (Palan et al., 2011); the satisfaction obtained in the online purchase process (Palan et al., 2011; Davidavičienė & Davidavičius, 2022); the risk associated with online payments and purchasing in the online environment, in general (Palan et al., 2011; Al Fagih, 2016; Dewi et al., 2019); digital and or technical skills (Park & Lee, 2017; Raudeliūnienė et al., 2018; Al-Tit, 2020); the availability and time allocated to the search for information in the online environment (Jain et al., 2021; Oghazi et al., 2021).

Results of the studies regarding the link between the education indicator and the purchase intention variables, respectively the manifestation of purchase behavior in the online environment, were also disseminated in the literature (Sánchez-Torres et al., 2017; Mbah et al., 2019; Davidavičienė et al., 2021; Higueras-Castillo et al., 2023). While most studies suggest a correlation between educational level as an independent variable and various dependent variables (such as attitudes towards online shopping, intent to purchase online, and actual purchasing behavior), most indicate a directly proportional relationship.

In relation to the relationship between the independent variable of residence environment and the dependent variable of online purchasing, existing literature points to a discernible gap between urban and rural settings. Specifically, a higher volume of online purchases is typically associated with urban populations (Yuan et al., 2018; Gao et al., 2018; Kshetri, 2018), as well as a certain trend of uniformity, favored by the increase in rural access to the Internet network, on the one hand, and the improvement of the quality of related services, as a result of the operationalization of broadband Internet (Clarke et al., 2015). Moreover, there are studies (Cárdenas et al., 2017) that reveal, at least in the developed states, a wider use, in rural areas, of online sales platforms.

Professional status has also been invoked as a potential discriminator in the manifestation of purchase intention and/or purchase behavior in the online environment (Lissitsa & Kol, 2016; Devi et al., 2019; Ünver & Alkan, 2021). However, there are also studies (Malik & Guptha, 2013; Wu et al., 2016) that invalidated the hypothesis that there is a link between this indicator and the different parameters that define the buying process of individuals in the online environment.

Income, as a vector or barrier in purchasing behavior in the online environment, has been, over time, a topic of great interest. Numerous studies have shown a strong link, directly proportional, between the income and the various variables that shape purchasing behavior, revealing that the population with a high income shows a greater willingness to make online purchases (Cristobal-Fransi et al., 2015; Lissitsa & Kol, 2016; Devi et al., 2019; Alkan et al., 2021), the frequency of purchase and the value of purchases also being high (Doolin et al., 2005).

The pandemic era led to a trend of uniform behavior across market segments, influenced by demographic factors. This led to a narrowing of disparities between European countries in terms of online purchasing habits (Jasińska-Biliczak, 2022). Simon specified, as early as 2009, that demographic indicators such as age, education, average household size, etc. are factors that cause strong changes in purchasing and consumption behavior in a turbulent environment, such as that specific to crisis situations (Simon, 2009). A limited number of studies have focused on how distinct demographic groups across EU countries interacted with online shopping platforms during this unprecedented period.

For example, a study by Gomes and Lopes (2022) analyzing Portuguese consumers found that women were less inclined to purchase groceries online during the pandemic. In contrast, the same study observed a propensity for online grocery shopping among younger demographics. This suggests a nuanced variation in online shopping habits based on gender and age within Portugal. Similarly, Jílková and Králová's (2021) research in the Czech Republic revealed an increase in the use of digital payment methods like Apple Pay and Google Pay, particularly among Generation Z. This demographic group showed a 13% adoption rate, significantly higher than the 1% observed in Generations X and Y. The study also noted a surge in online shopping interest among older generations, particularly Baby Boomers and the Silent Generation, largely driven by the necessity posed by retail closures and health risks.

Complementing these findings, Svatosova (2022) in the Czech Republic reported a pronounced increase in online shopping frequency among younger generations, specifically the "online generation" and Millennials. This aligns with a global trend of younger consumers being more digitally engaged.

An Italian study by Alaimo et al. (2020) found that individuals with higher educational attainment were more likely to buy groceries online, mirroring pre-pandemic behaviors. This indicates a potential correlation between education level and online shopping preferences.

A broader study examining demographics in the context of the COVID era identified distinct online shopping profiles across European countries, represented by various clusters (Ghita et al., 2022). Each cluster demonstrated unique behaviors among specific demographic groups. For instance, Cluster 1 (comprising Bulgaria, Romania, North Macedonia) showed an increase in online purchases primarily among older age groups, the labor force, highly educated individuals, and city residents. In contrast, Cluster 2 (including Greece, Cyprus, Portugal, Italy) exhibited increased online shopping among individuals up to 45 years old, those employed with higher education, and urban dwellers.

These results highlight the diverse influence of demographic factors on online shopping behavior across the EU. They underscore the necessity for more detailed studies to understand these variations better. Starting from here, we aimed to examine how demographic variables impact online commerce, while also considering the significant new variable of the pandemic.

## 3. Materials and methods

The hypothesis behind this study was that the pandemic generated, at least for EU e-commerce market, a positive impact in terms of reducing the disparities between the EU member countries.

The present study was based on information provided by the specialized literature as well as official statistical data. Eurostat, European E-commerce Report, but also information representing estimates of some indicators provided by Statista were used. Thus, the following indicators were predominantly used:

- Last online purchase in the 12 months, by population category according to criteria of age, education, gender, urbanization, employment, income, offered by Eurostat;
- Internet purchases – goods or services, provided by Eurostat;
- E-GDP (share of e-commerce in GDP), made available in the European E-commerce Report 2021.

To analyze the data, appropriate statistical methods aligned with the study's objectives were employed. These methods included tracking temporal changes in various indicators and assessing the statistical significance of these changes. The study also examined disparities and looked for evidence of either convergence among EU countries or similarities between them. Data analysis was conducted using SPSS software, version 21. The study employed the General Linear Model – Repeated Measures (GLM-RM) to analyze temporal changes in the phenomena of interest across EU countries. The aims of using a repeated-measures analysis were threefold: 1) to identify how the units under study evolved over time, 2) to compare these temporal changes across different study groups, as indicated by Nemec (1995), and 3) to evaluate the statistical significance of any observed differences.

Thus, to determine what was the impact of the COVID pandemic on the evolution of the e-commerce market, the analyzed period was divided into sub-periods at the level of which it was tested whether there were significant changes (in the period before, the peak and after the pandemic) in the e-commerce market, respectively:

- For consumer analysis:
  - Period 2016–2019 – Factor name "before";
  - The 2019–2021 period – Factor name "maximum-COVID";
  - The period 2021–2022 – Factor name "after".
- For the E-GDP analysis:
  - Period 2018–2019 – Factor name "before";
  - Period 2019–2021 – Factor name "maximum-COVID".

Testing the existence of a process of convergence of the e-commerce market in a territorial profile presupposed the use of some analytical tools to highlight the reduction of gaps between states over time. The first indicator used to measure convergence is the determination of the standard deviation, an indicator also known as σ-convergence (Barro & Sala-i-Martin, 1992). Thus, if it is found that the value of the indicator, standard deviation, calculated for the data series related to each moment of the analyzed period decreases over time, then it follows that there is a process of convergence in the studied phenomenon, and if an increase is recorded, then the phenomenon knows a divergence process (Iancu, 2006).

Another tool used in the analysis of convergence processes starts from the premises of the neoclassical theory (National Bank of Romania, 2018), which means that disparities between states are reduced over time. This analysis tool is known as β-convergence, and testing the convergence with its help involves building a regression model in which the dynamic of

the indicator during the analyzed period represents the dependent variable, and the initial value of the indicator represents the independent variable. The negative value of the coefficient β of the regression equation precisely indicates the convergence of the phenomenon, namely the fact that the analyzed phenomenon registers a more pronounced dynamic in the states where the initial value of the indicator was lower.

The tested model is the following:

$$\frac{y_{(i,t0+T)}}{y_{(i,t0)}} = \alpha + \beta y_{(i,t0)} + €, \quad (1)$$

where $y_{(i,\ t0+T)}$ – the value of the indicator in the last year taken into analysis; $y_{(i,\ t0\ )}$ – the value of the indicator in the first year taken into analysis.

Thus, to test whether the COVID pandemic determined the emergence or acceleration of a process of convergence of the e-commerce market in a territorial profile, the analyzed period was divided into sub-periods at the level of which it was tested whether there was a process of convergence, respectively:

- For consumer analysis:
  - The period 2016–2019 "before COVID" – to test the existence of a convergence process in the period before the pandemic;
  - The 2019–2022 "COVID" period – to test whether the COVID pandemic determined the emergence or accelerated the convergence process in the member states;
- For category of purchased products analysis:
  - 2020–2022 period – to test the existence of a convergence process in the market;
- For the E-GDP analysis:
  - 2018–2019 period – to test the existence of a convergence process in the period before the pandemic;
  - The 2019–2021 period – to test whether the COVID pandemic determined or accelerated the convergence process in the member states.

## 4. Results

### 4.1. The e-commerce market from the perspective of consumers

The indicator "last online purchase: in the 12 months / Percentage of individuals in the EU countries", as shown in Figure 1, registered an increase in the vast majority of EU member states, in the period 2016–2022, simultaneously with the manifestation of a phenomenon of diminishing the gap between countries compared to the EU average, as can also be seen from Figure 2, where box plots are represented – distributions of the states in each analyzed year.

As can be seen from Figure 3, the evolution, by category of the population, of the distribution of the EU member states, depending on the share of the population that makes online purchases, is similar to that of the population as a whole. Thus, there are increases in the analyzed indicator over time in all the categories considered, and in some of them (especially, the population from the smaller age categories, the population with the "high" level of education, the population with higher incomes, from the "cities", employed and students) it was noticed the decrease of the disparities in the Member States.

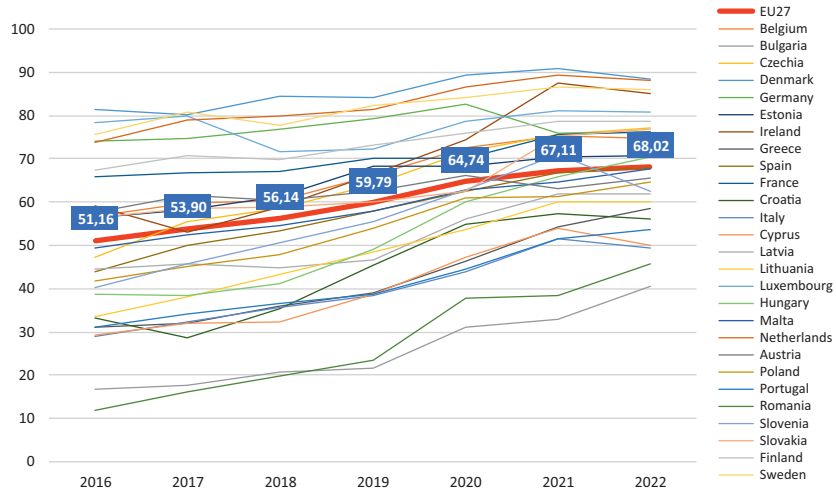



**Figure 1.** Evolution of the share of the population that made online purchases in the total population, in the EU member states (%), during the period 2016–2022 (source: own processing according to Eurostat, 2023)

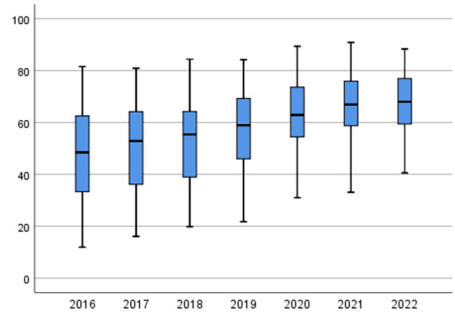
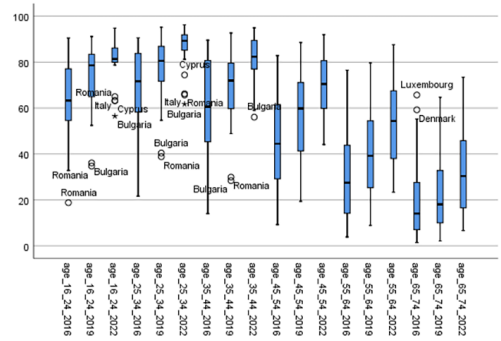



**Figure 2.** Boxplots of the distribution of EU countries according to the share of the population that made online purchases in the total population, in the period 2016–2022 (source: own processing according to Eurostat, 2023)

a) Age




b) Education

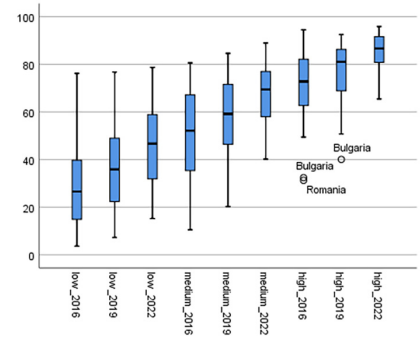



**Figure 3.** To be continued

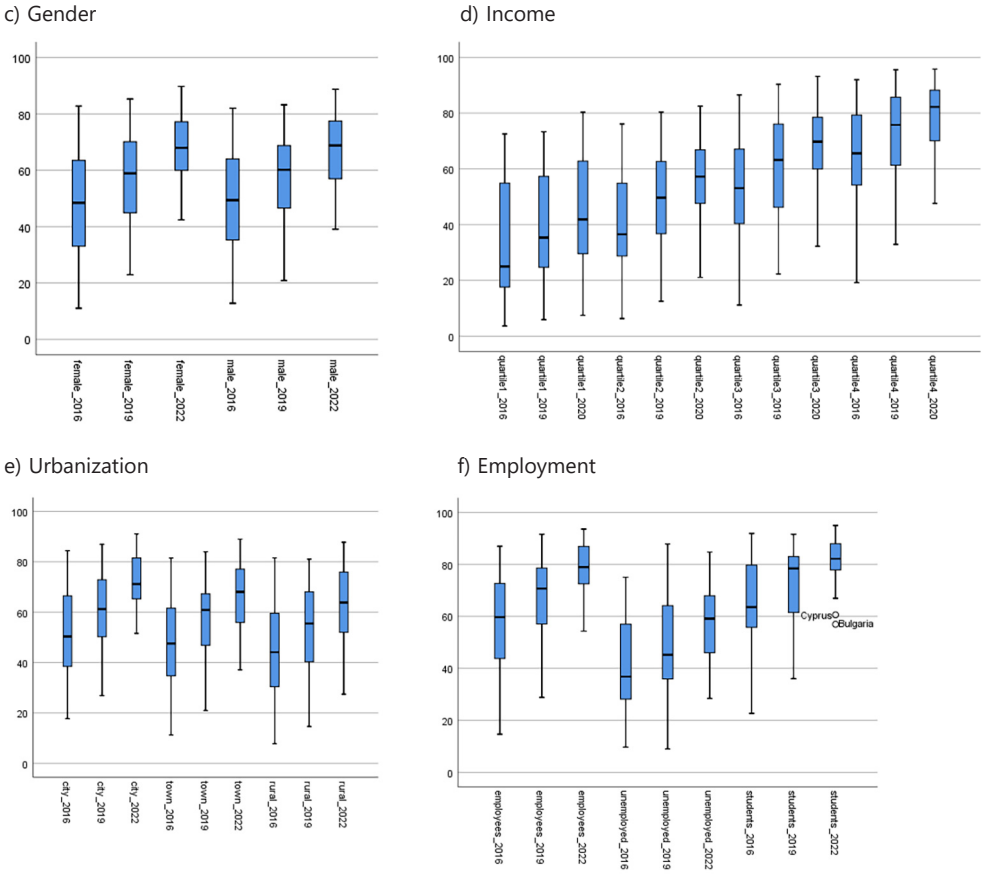



**Figure 3.** Box plots of the distribution of EU member states according to the share of the population that made online purchases in the total population by age, gender, residence, education, occupation, income, in the years 2016, 2019, 2022 (source: own processing according to Eurostat, 2023)

### *4.1.1. Analysis of changes over time in the share of the population that made online purchases in the EU countries (analysis using GLM-RM)*

In order to determine whether, over time, the COVID pandemic had a significant impact on the evolution of the e-commerce market (from the perspective of the same indicator – the share of the population that makes online purchases in total individuals), we use the GLM – RM analysis to test if there were changes, in the EU countries, of the share of the population that made online purchases in the total population during the analyzed period.

According to the information presented in Table 1 and Figure 4, in which the results of the analysis are presented, we note that:

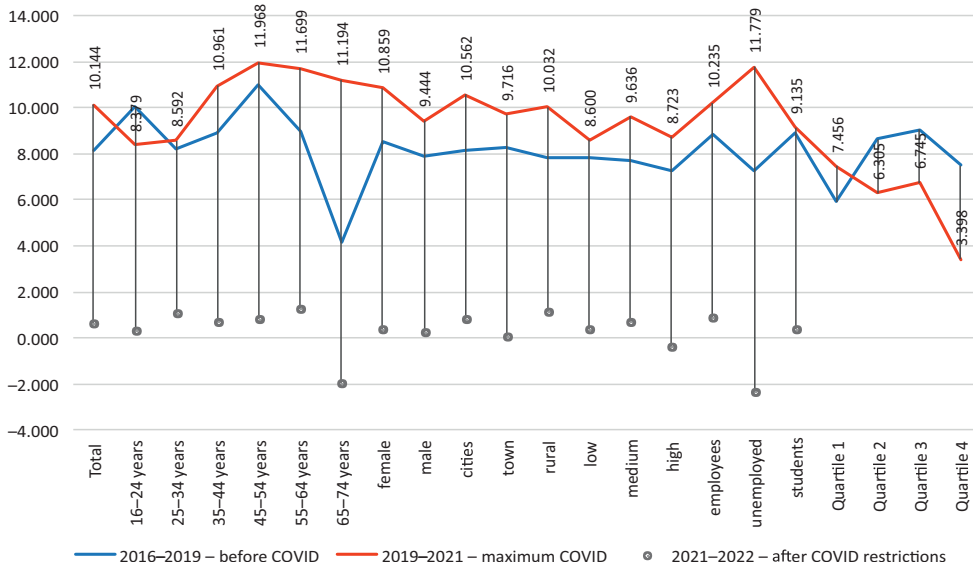
- in 2019, compared to 2016, the period before the pandemic, there were significant differences in terms of the indicator analyzed in the 27 EU countries, both on the total population and categories. On the total population the mean difference was 8.171 ($p = 0.000$).

**Table 1.** Testing the changes over time, in EU countries, of the share of the population that made online purchases in the total population, by total and population categories (General Linear Model – Repeated Measures) (source: own processing according to Eurostat, 2023)

| Population categories | | 2016–2019 – before COVID | | | | 2019–2021 – maximum COVID | | | | | | 2021–2022 – after COVID restrictions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tests of Within-Subjects Effects | | Pairwise Comparisons | | Tests of Within-Subjects Effects | | Pairwise Comparisons | | | | Tests of Within-Subjects Effects | | Pairwise Comparisons | |
| | | | | 2019–2016 | | | | 2020–2019 | | 2021–2019 | | | | 2022–2021 | |
| | | Sig. | Partially Eta Squared | Mean Difference | Sig. | Sig. | Partially Eta Squared | Mean Difference | Sig. | Mean Difference | Sig. | Sig. | Partially Eta Squared | Mean Differences | Sig . |
| Total | | 0.000 | 0.752 | 8.171 | 0.000 | 0.000 | 0.742 | 6.237 | 0.000 | 10.144 | 0.000 | 0.312 | 0.038 | 0.631 | 0.312 |
| Age | 16–24 years | 0.000 | 0.694 | 10.032 | 0.000 | 0.000 | 0.496 | 5.274 | 0.000 | 8.379 | 0.000 | 0.705 | 0.005 | 0.353 | 0.705 |
| | 25–34 years | 0.000 | 0.605 | 8.228 | 0.000 | 0.000 | 0.519 | 5.698 | 0.000 | 8.592 | 0.000 | 0.076 | 0.112 | 1,099 | 0.076 |
| | 35–44 years | 0.000 | 0.640 | 8.886 | 0.000 | 0.000 | 0.696 | 7.821 | 0.000 | 10.961 | 0.000 | 0.387 | 0.028 | 0.715 | 0.387 |
| | 45–54 years | 0.000 | 0.775 | 10.986 | 0.000 | 0.000 | 0.720 | 6.986 | 0.000 | 11.968 | 0.000 | 0.317 | 0.037 | 0.852 | 0.317 |
| | 55–64 years | 0.000 | 0.684 | 8.961 | 0.000 | 0.000 | 0.691 | 7.277 | 0.000 | 11.699 | 0.000 | 0.160 | 0.075 | 1,260 | 0.160 |
| | 65–74 years | 0.000 | 0.339 | 4.146 | 0.000 | 0.000 | 0.500 | 6.006 | 0.000 | 11.194 | 0.000 | 0.080 | 0.113 | –1,947 | 0.080 |
| Gender | female | 0.000 | 0.765 | 8.529 | 0.000 | 0.000 | 0.761 | 6.597 | 0.003 | 10.859 | 0.000 | 0.578 | 0.012 | 0.356 | 0.578 |
| | male | 0.000 | 0.716 | 7.888 | 0.000 | 0.000 | 0.721 | 5.923 | 0.000 | 9.444 | 0.000 | 0.693 | 0.006 | 0.262 | 0.693 |
| Urbanization | cities | 0.000 | 0.708 | 8.141 | 0.000 | 0.000 | 0.675 | 6.586 | 0.000 | 10.562 | 0.000 | 0.227 | 0.054 | 0.809 | 0.227 |
| | town | 0.000 | 0.774 | 8.265 | 0.000 | 0.000 | 0.662 | 5.859 | 0.000 | 9.716 | 0.000 | 0.954 | 0,000 | 0.041 | 0.954 |
| | rural | 0.000 | 0.685 | 7.858 | 0.000 | 0.000 | 0.642 | 5.424 | 0.000 | 10.032 | 0.000 | 0.239 | 0.051 | 1,175 | 0.239 |
| Education | low | 0.001 | 0.596 | 7.857 | 0.001 | 0.000 | 0.566 | 5.966 | 0.000 | 8.600 | 0.000 | 0.747 | 0.004 | 0.383 | 0.747 |
| | medium | 0.000 | 0.777 | 7.676 | 0.000 | 0.000 | 0.620 | 5.748 | 0.000 | 9.636 | 0.000 | 0.388 | 0.028 | 0.673 | 0.388 |
| | high | 0.000 | 0.611 | 7.271 | 0.000 | 0.000 | 0.589 | 5.362 | 0.000 | 8.723 | 0.000 | 0.550 | 0.013 | –0.365 | 0.550 |
| Employment | employees | 0.000 | 0.772 | 8.834 | 0.000 | 0.000 | 0.676 | 6.347 | 0.000 | 10.235 | 0.000 | 0.169 | 0.069 | 0.864 | 0.169 |
| | unemployed | 0.029 | 0.367 | 7.244 | 0.029 | 0.000 | 0.460 | 9.799 | 0.000 | 11.779 | 0.000 | 0.144 | 0.078 | –2.346 | 0.144 |
| | students | 0.006 | 0.518 | 8.898 | 0.006 | 0.000 | 0.500 | 5.352 | 0.000 | 9.135 | 0.000 | 0.748 | 0.004 | 0.356 | 0.748 |
| Income | Quartile 1 | 0.001 | 0.543 | 5.922 | 0.001 | 0.000 | 0.470 | 7.456 | 0.000 | | | | | | |
| | Quartile 2 | 0.000 | 0.721 | 8.625 | 0.000 | 0.000 | 0.483 | 6.305 | 0.000 | | | | | | |
| | Quartile 3 | 0.000 | 0.704 | 9.047 | 0.000 | 0.000 | 0.581 | 6.745 | 0.000 | | | | | | |
| | Quartile 4 | 0.000 | 0.650 | 7.489 | 0.000 | 0.051 | 0.133 | 3.398 | 0.051 | | | | | | |

- in the period 2019–2021, a period marked by the restrictions imposed by the COVID pandemic, the evolution of the analyzed indicator also experienced significant changes, both for the total population and for the considered categories. During the COVID crisis, the mean differences between 2021 and 2019 are relatively large, in the total population the mean difference being 10.144 (p = 0.000) (in the context of a value the Partial eta squared, the effect size 0.742, which attests a strong influence of the COVID restrictions on the e-commerce market). The mean differences during the COVID crisis were greater compared to the period before COVID, confirming the more accelerated growth of the indicator during this period.
- period 2021–2022, the period after the peak of the pandemic, we observe the absence of significant differences in terms of the evolution of the e-commerce market from the perspective of the weight of those who make online purchases (p > 0.05), both for the total population and categories.

The growth of the e-commerce market in EU accelerated during the period 2019–2021 (Chang et al., 2023). Practically, we can say that the pandemic led to the elimination of some psychological and physical barriers manifested at the individual level, through an indirect phenomenon of coercion, with some individuals becoming e-consumers in the absence of diminishing alternatives for making purchases. As shown in Figure 5, the barriers to online purchasing were only partially overcome. According to 2021 data, which corresponds to the latter half of the pandemic's peak, the EU population identified several factors that hindered their decision to buy online.




*Note*: for 2019–2020 revenue in maximum COVID.

**Figure 4.** Test result of the changes over time (Mean Difference between the last and the first year – applying GLM – RM), in EU countries, of the share of the population that made online purchases in the total population, by total and population categories (source: own processing according to Eurostat, 2023)

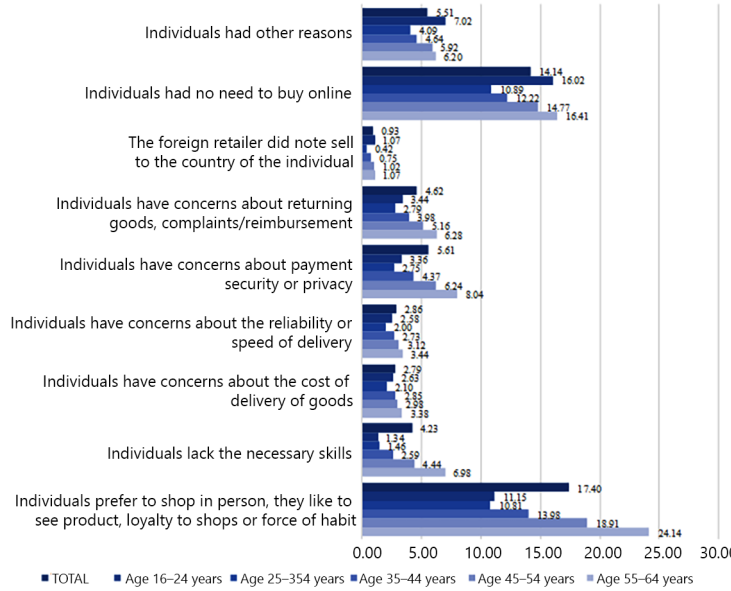



**Figure 5.** Internet purchases – perceived barriers (Percentage of individuals), in EU, in 2021 (source: own processing according to Eurostat, 2023)

The lack of notable shifts in the proportion of online shoppers within the total population from 2021 to 2022 suggests that the pandemic served as a catalyst for e-commerce market development. This acceleration appears to have brought the actual number of e-consumers close to its current potential as of the year 2022.

### *4.1.2. Testing the convergence of the e-commerce market from the perspective of the share of the population that made online purchases in EU countries*

To continue the previous analysis, the existence of the e-commerce market convergence from the perspective of the percentage of people who made online purchases within the total population in the "before-COVID" and "COVID" periods was tested (see Table 2 and Figure 6).

On the total population, between the share of those who made online purchases in the total population and the dynamics of this indicator recorded in the period 2019–2022, there is a stronger connection compared to the period before the pandemic, 2016–2019 and significant ($p = 0.000$), the higher negative value of the β coefficient in the "COVID" period compared to the "before-COVID" period (β 2019–2022 = –1.159 compared to β 2016–2019 = –0.822), confirming the inverse link between the two correlated variables and, implicitly, the acceleration of the convergence phenomenon during the COVID period.

Studying the convergence by population categories according to a series of socio-demographic and economic criteria, we find that, from one segment to another, depending on the criteria envisaged, there are differences in the level of convergence manifested in the e-commerce market from the perspective of the share of those who make online purchases in the total population, in accordance with the recorded values of the indicators in Table 2. Also, it can be established that for all the characteristics studied, the negative values of the

**Table 2.** The registered level of the e-commerce market in EU-27, from the perspective of the share of the population that made online purchases in 2016 and 2022 and the convergence recorded in the considered period, in total and population categories (σ convergence and β convergence) (source: own processing according to Eurostat, 2023)

| Population categories | | Online purchase / Percentage of Individually – EU27 | | σ – convergence | | β – convergence 2016–2019 – before COVID | | | β – convergence 2019–2022 – COVID | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2022 | σ 2019–σ 2016 | σ 2022–σ 2019 | R Square | β | Sig . | R Square | β | Sig . |
| Total | | 51.16 | 68.02 | –1.916 | –3.808 | 0.615 | –0.822 | 0.000 | 0.729 | –1.159 | 0.000 |
| Age | 16–24 years | 63.15 | 79.94 | –1.742 | –5.864 | 0.552 | –0.792 | 0.000 | 0.826 | –1.162 | 0.000 |
| | 25–34 years | 68.91 | 85.26 | –3.599 | –5.821 | 0.755 | –0.818 | 0.000 | 0.871 | –1.076 | 0.000 |
| | 35–44 years | 61.65 | 80.75 | –3.469 | –6.117 | 0.633 | –0.880 | 0.000 | 0.799 | –1.317 | 0.000 |
| | 45–54 years | 51.04 | 70.22 | –2.080 | –5.557 | 0.643 | –1.039 | 0.000 | 0.760 | –1.377 | 0.000 |
| | 55–64 years | 36.07 | 56.66 | –0.994 | –1.466 | 0.507 | –1.420 | 0.000 | 0.615 | –1.502 | 0.000 |
| | 65–74 years | 22.76 | 35.73 | –1.169 | 1.800** | 0.251 | –2.097 | 0.007 | 0.325 | –2.067 | 0.002 |
| Gender | female | 50.00 | 67.80 | –1.901 | –4.307 | 0.592 | –0.887 | 0.000 | 0.773 | –1.190 | 0.000 |
| | male | 52.80 | 68.55 | –1.996 | –3.402 | 0.614 | –0.782 | 0.000 | 0.692 | –1.095 | 0.000 |
| Urbanization | cities | 54.77 | 71.59 | –2.053 | –4.423 | 0.594 | –0.686 | 0.000 | 0.685 | –1.231 | 0.000 |
| | town | 51.44 | 66.72 | –1.707 | –3.049 | 0.550 | –0.844 | 0.000 | 0.712 | –1.052 | 0.000 |
| | rural | 46.13 | 64.11 | –1.360 | –3.054 | 0.550 | –1.073 | 0.000 | 0.773 | –1.158 | 0.000 |
| Education | low | 28.57 | 44.82 | 0.393** | –1.571 | 0.342 | –1.187 | 0.001 | 0.610 | –1.540 | 0.000 |
| | medium | 52.81 | 68.26 | –1.718 | –4.313 | 0.573 | –0.834 | 0.000 | 0.716 | –1.207 | 0.000 |
| | high | 74.29 | 86.63 | –3.170 | –5.002 | 0.649 | –0.685 | 0.000 | 0.758 | –1.050 | 0.000 |
| Employment | employees | 62.08 | 78.72 | –2.169 | –5.557 | 0.609 | –0.800 | 0.000 | 0.787 | –1.177 | 0.000 |
| | unemployed | 37.60 | 57.04 | –0.411 | –4.403 | 0.279 | –0.846 | 0.004 | 0.541 | –1.707 | 0.000 |
| | students | 63.45 | 80.08 | –2.892 | –4.537 | 0.574 | –0.810 | 0.000 | 0.683 | –1.162 | 0.000 |
| Income | Quartile 1 | 37.83 | 49.93* | –2.145 | 0.754** | 0.340 | –1.214 | 0.002 | 0.232 | –0.800 | 0.015 |
| | Quartile 2 | 45.27 | 61.16* | 0.788 | –2.338 | 0.249 | –0.724 | 0.011 | 0.499 | –1.179 | 0.000 |
| | Quartile 3 | 56.83 | 71.41* | –0.074 | –3.601 | 0.357 | –0.715 | 0.002 | 0.620 | –0.896 | 0.000 |
| | Quartile 4 | 70.56 | 81.53* | –1.019 | –4.189 | 0.473 | –0.577 | 0.000 | 0.779 | –0.716 | 0.000 |

*Note*: * data related to 2020; ** σ 2019 > σ 2016 or σ 2022 > σ 2019.

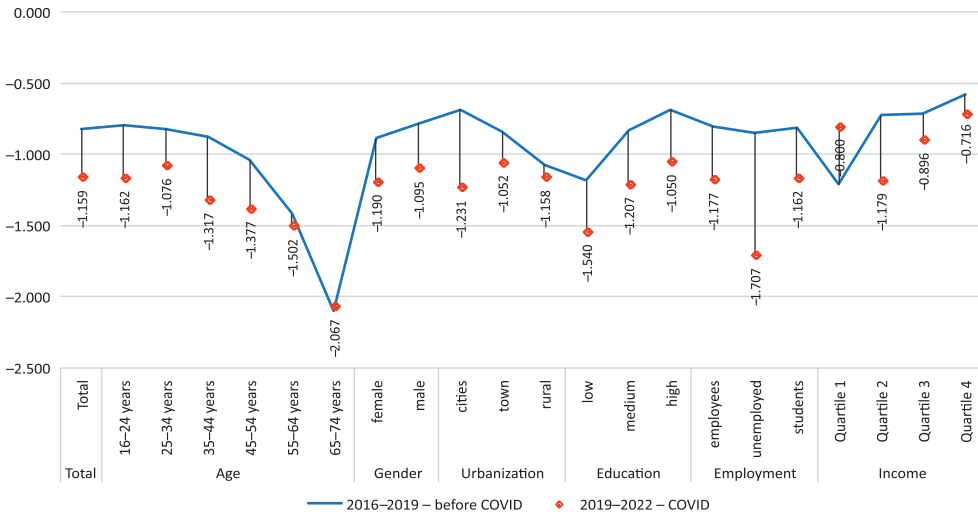



**Figure 6.** The result of β convergence (the value of the β coefficient from the regression equation) testing for EU-27 e-commerce market, from the perspective of the share of the population that made online purchases in 2016 and 2022, in total and population categories (source: own processing according to Eurostat, 2023)

β coefficients are, in absolute terms, higher in the period marked by COVID compared to the "before COVID" period, which attests to the fact that the COVID factor has accelerated the process of convergence in the member states of the studied indicator.

Therefore, in the period 2019–2022 (period during which the level of convergence manifested itself with greater intensity), the largest gaps between segments are registered according to the age criterion, the segments in which there was a decrease in disparities bigger being people under 45 years old. The segments that before the pandemic registered a certain degree of "reluctance" towards online purchases (elderly, unemployed, with low education or with low incomes), recorded the most accelerated average dynamics of the analyzed indicator.

### *4.1.3. The evolution of the EU e-commerce market by product category, from the perspective of the share of the population that made online purchases*

The dynamics and convergence observed in the EU e-commerce market were not uniform across all product categories. (Figure 7, Table 3 and Figure 8).

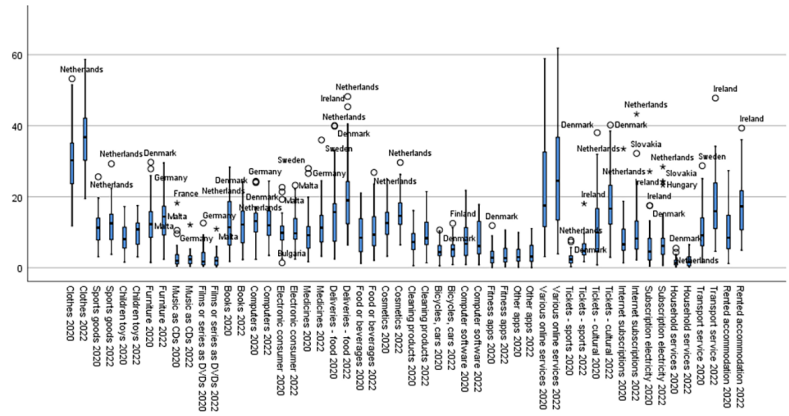
Studying the convergence in the e-commerce market, by product category, from the perspective of the share of the population that made online purchases in the total population, from the perspective of σ – convergence and β – convergence (Table 3 and Figure 8), we find that this was manifested in the EU countries, in the considered period, for the following categories of products/services: clothes (including sports clothing), shoes or accessories, computers, tablets, mobile phones or accessories, various online services (music, films, books, newspapers, magazines, games), printed books, magazines or newspapers, music as CDs, vinyl, etc., these being presented in the reverse order of the intensity of the correlation between the share of purchases in 2020 and the dynamics recorded by it in the interval 2020–2022.

**Table 3.** The e-commerce market, by product category, in EU-27, from the perspective of the share of the population that made online purchases in 2020 and 2022 and the convergence recorded in the considered period (σ convergence and β convergence)
(source: own processing – Eurostat, 2023)

| EU e-commerce markets by product category/ Internet purchases – goods or services (% of individuals in all individuals) | EU27 | | β – convergence | | | σ – convergence | |
|---|---|---|---|---|---|---|---|
| | 2020 | 2022 | R Square | β | Sig. | 2020 | 2022 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Physical products | | | | | | | |
| Market increases, in descending order of market growth rates | | | | | | | |
| Children toys or childcare items | 9.13 | 10.70 | 0.137 | –0.029 | 0.058 | 4.096 | 4.415 |
| Clothes (including sports clothing), shoes or accessories | 33.47 | 38.22 | 0.529 | –0.010 | 0.000 | 11.322 | 10.592 |
| Deliveries from restaurants, fast-food chains, catering services | 14.89 | 16.99 | 0.248 | –0.021 | 0.008 | 9.846 | 11.402 |
| Sports goods (excluding sports clothing) | 11.26 | 12.77 | 0.092 | –0.017 | 0.123 | 5.372 | 5.985 |
| Cosmetics, beauty, or wellness products | 13.90 | 14.95 | 0.227 | –0.023 | 0.012 | 5.466 | 5.918 |
| Cleaning products or personal hygiene products | 8.35 | 8.53 | 0.178 | –0.039 | 0.028 | 3.744 | 4.532 |
| Market declines, in descending order of market growth rates | | | | | | | |
| Food or beverages from stores or from meal kits providers | 9.99 | 9.74 | 0.131 | –0.027 | 0.063 | 5.728 | 6.425 |
| Furniture, home accessories or gardening products | 15.20 | 14.75 | 0.081 | –0.011 | 0.151 | 7.355 | 7.403 |
| Consumer electronics or household appliances | 9.69 | 9.28 | 0.206 | –0.027 | 0.018 | 5.365 | 5.641 |
| Bicycles, mopeds, cars or other vehicles or theirs spare shares | 5.14 | 4.87 | 0.266 | –0.062 | 0.006 | 2.984 | 3.035 |
| Medicine or dietary supplements such as vitamins (online renewal of prescriptions is not incl.) | 11.99 | 11.30 | 0.286 | –0.031 | 0.004 | 6.650 | 7.127 |
| Computer or other software as downloads including upgrades | 9.04 | 8.20 | 0.268 | –0.028 | 0.006 | 5.704 | 5.434 |
| Printed books, magazines or newspapers | 14.21 | 12.79 | 0.207 | –0.017 | 0.017 | 7.330 | 6.602 |
| Computers, tablets, mobile phones or accessories | 13.83 | 12.09 | 0.268 | –0.028 | 0.006 | 5.727 | 5.230 |
| Music as CDs, vinyl, etc. | 3.87 | 3.22 | 0.165 | –0.079 | 0.036 | 2.612 | 2.377 |
| Films or series as DVDs, Blu-ray, etc. | 4.25 | 2.94 | 0.112 | –0.051 | 0.088 | 3.013 | 2.347 |

*End of Table 3*

| 1 | | | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Services | | | | | | | | | |
| | Market increases, in descending order of market growth rates | | | | | | | | |
| | | Tickets to sport events | 3.00 | 4.83 | 0.363 | –0.439 | 0.001 | 2.025 | 3.262 |
| | | Transport service | 10.11 | 15.45 | 0.323 | –0.066 | 0.002 | 7.684 | 10.303 |
| | | Rented accommodation | 11.16 | 16.59 | 0.425 | –0.081 | 0.000 | 7.165 | 8.884 |
| | | Tickets to cultural or other events | 12.36 | 16.42 | 0.398 | –0.082 | 0.000 | 9.400 | 9.938 |
| | | Household services (e.g. cleaning, babysitting, repair work, gardening) | 1.59 | 1.95 | 0.022 | –0.068 | 0.479 | 1.397 | 1.840 |
| | | Subscriptions to the internet or mobile phone connections | 7.82 | 8.92 | 0.025 | –0.026 | 0.426 | 6.810 | 9.617 |
| | | Subscription to electricity, water or heating supply, waste disposal or similar services | 5.68 | 6.15 | 0.088 | –0.100 | 0.150 | 6.498 | 7.855 |
| | Market declines, in descending order of market growth rates | | | | | | | | |
| | | Various online services (music, films, books, newspapers, magazines, games) | 24.80 | 24.76 | 0.225 | –0.011 | 0.012 | 15.738 | 15.361 |
| | | Computer or other software as downloads including upgrades | 9.04 | 8.20 | 0.129 | –0.023 | 0.065 | 5.704 | 5.434 |
| | | Apps related to health or fitness (excluding free apps) | 3.63 | 3.26 | 0.120 | –0.153 | 0.077 | 2.757 | 2.811 |
| | | Other apps (e.g. related to learning languages, traveling, weather) (excluding free apps) | 4.44 | 3.83 | 0.078 | –0.106 | 0.159 | 2.849 | 3.212 |




*Note*: the meaning of the different product categories as presented in an abbreviated version on the chart is shown in Table 3; ** Online purchases (3 months).

**Figure 7.** Boxplot of the distribution of EU member states according to the share of those who made online purchases in the total population, by product category, in the years 2020* and 2022 (source: own processing according to Eurostat, 2023)

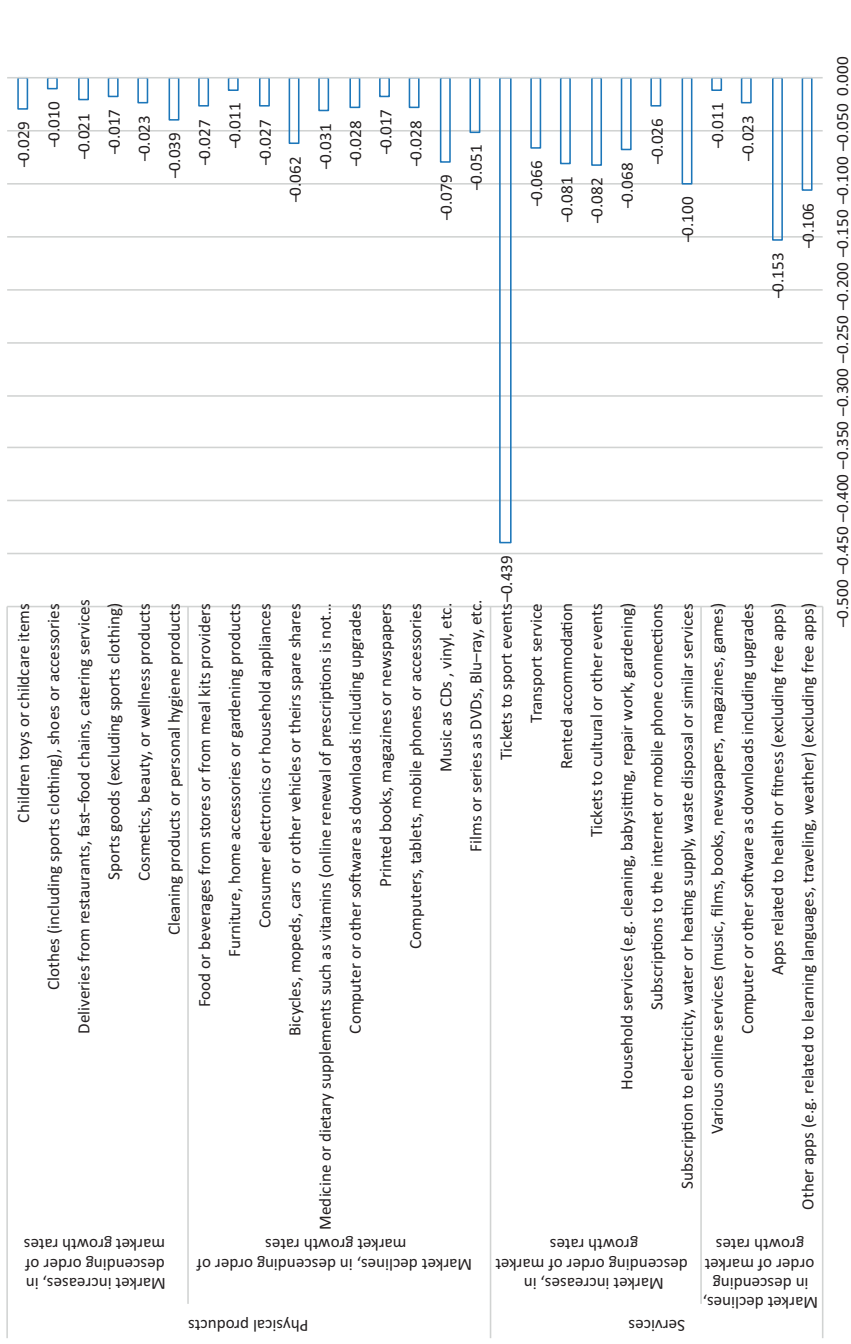


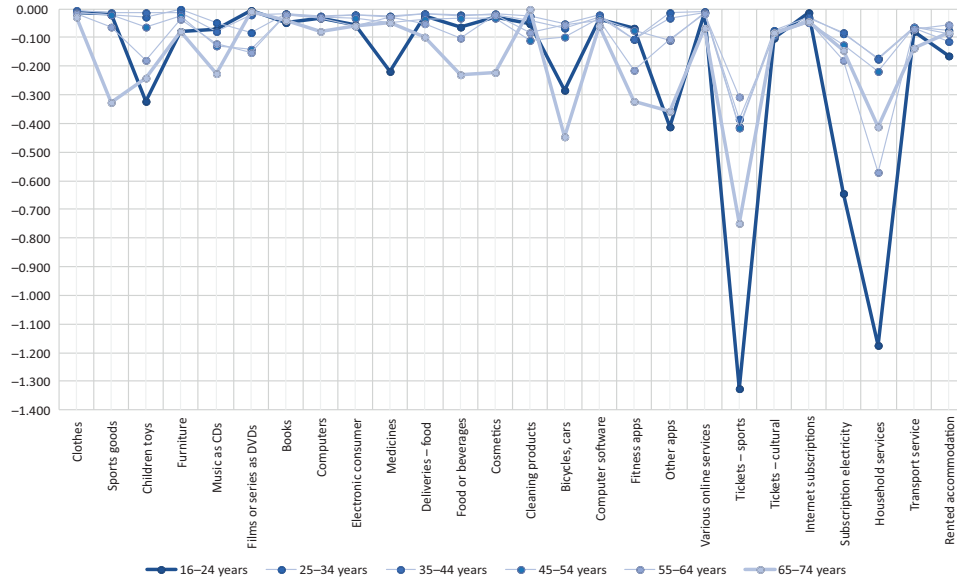

**Figure 8.** The result of β convergence (the value of the coefficient β from the regression equation) testing for EU-27 e-commerce market, by product category, in EU-27, from the perspective of the share of the population that made online purchases in 2020 and 2022 (source: own processing according to Eurostat, 2023)

**Table 4.** Convergence recorded in the EU e-commerce market, by products, from the perspective of the share of the population that made purchases online, by population category by age, in the period 2020–2022 (σ convergence (σ 2022 – σ 2020) and β convergence) (source: own processing according to Eurostat, 2023)

| Products / Services | Age | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16–24 years | | | 25–34 years | | | 35–44 years | | | 45–54 years | | | 55–64 years | | | 65–74 years | | |
| | σ – conv. | β – conv. | | σ – conv. | β – conv. | | σ – conv. | β – conv. | | σ – conv. | β – conv. | | σ – conv. | β – conv. | | σ – conv. | β – conv. | |
| | | β | Sig . | | β | Sig . | | β | Sig . | | β | Sig . | | β | Sig . | | β | Sig . |
| Clothes | –2.144 | –0.011 | 0.000 | –2.175 | –0.013 | 0.000 | –1.278 | –0.007 | 0.000 | –1.159 | –0.011 | 0.000 | 0.659 | –0.017 | 0.001 | 0.303 | –0.028 | 0.002 |
| Sports goods | 0.166 | –0.018 | 0.097 | 0.443 | –0.022 | 0.021 | 0.858 | –0.012 | 0.124 | 0.315 | –0.021 | 0.014 | 1.154 | –0.064 | 0.168 | 0.539 | –0.325 | 0.104 |
| Children toys | –0.015 | –0.322 | 0.086 | –0.358 | –0.030 | 0.001 | 0.291 | –0.013 | 0.043 | 1.255 | –0.062 | 0.195 | 0.132 | –0.180 | 0.018 | 0.425 | –0.241 | 0.011 |
| Furniture | 0.743 | –0.078 | 0.034 | 0.339 | –0.003 | 0.599 | –0.658 | –0.011 | 0.128 | –0.717 | –0.023 | 0.007 | 0.044 | –0.038 | 0.011 | 0.173 | –0.080 | 0.076 |
| Music as CDs | 0.719 | –0.070 | 0.219 | –0.046 | –0.046 | 0.121 | –0.754 | –0.077 | 0.076 | –0.722 | –0.130 | 0.037 | –0.675 | –0.121 | 0.033 | –0.210 | –0.226 | 0.125 |
| Films or series as DVDs | –0.042 | –0.006 | 0.802 | –0.566 | –0.084 | 0.020 | –1.476 | –0.022 | 0.329 | –0.944 | –0.141 | 0.086 | –0.785 | –0.153 | 0.026 | –0.180 | –0.008 | 0.955 |
| Books | 0.335 | –0.046 | 0.023 | –1.048 | –0.017 | 0.022 | –1.287 | –0.015 | 0.019 | –0.788 | –0.022 | 0.001 | –1.146 | –0.022 | 0.039 | –1.089 | –0.041 | 0.007 |
| Computers | –0.871 | –0.033 | 0.001 | –0.761 | –0.030 | 0.000 | –1.434 | –0.026 | 0.001 | –0.437 | –0.027 | 0.010 | 0.176 | –0.031 | 0.143 | –0.661 | –0.080 | 0.123 |
| Electronic consumer | –0.005 | –0.057 | 0.020 | 1.218 | –0.020 | 0.053 | 0.545 | –0.020 | 0.049 | –0.436 | –0.034 | 0.006 | 0.010 | –0.058 | 0.009 | –0.145 | –0.059 | 0.072 |
| Medicines | 1.030 | –0.219 | 0.005 | 1.783 | –0.024 | 0.015 | 0.436 | –0.027 | 0.003 | –0.581 | –0.047 | 0.022 | 0.383 | –0.028 | 0.015 | 0.254 | –0.049 | 0.047 |
| Deliveries – food | –0.876 | –0.023 | 0.002 | 0.519 | –0.015 | 0.001 | 1.113 | –0.018 | 0.001 | 0.974 | –0.036 | 0.003 | 1.344 | –0.053 | 0.005 | 0.910 | –0.099 | 0.193 |
| Food or beverages | 1.627 | –0.065 | 0.078 | 1.209 | –0.020 | 0.130 | 0.449 | –0.023 | 0.026 | 0.424 | –0.032 | 0.008 | 0.261 | –0.103 | 0.010 | –0.094 | –0.229 | 0.043 |
| Cosmetics | 1.081 | –0.028 | 0.018 | 0.384 | –0.020 | 0.007 | 0.538 | –0.018 | 0.012 | –0.321 | –0.033 | 0.002 | 0.570 | –0.020 | 0.216 | 0.603 | –0.221 | 0.111 |
| Cleaning products | 1.361 | –0.050 | 0.111 | 1.372 | –0.039 | 0.012 | 1.336 | –0.024 | 0.064 | 0.235 | –0.108 | 0.003 | 0.241 | –0.083 | 0.039 | –0.156 | –0.001 | 0.976 |
| Bicycles, cars | 0.240 | –0.283 | 0.001 | –0.209 | –0.067 | 0.004 | –0.207 | –0.053 | 0.014 | 0.617 | –0.098 | 0.030 | 0.264 | –0.056 | 0.179 | 0.038 | –0.447 | 0.099 |
| Computer software | 0.862 | –0.037 | 0.024 | –0.478 | –0.029 | 0.020 | –0.610 | –0.022 | 0.072 | –0.304 | –0.031 | 0.045 | –0.081 | –0.039 | 0.149 | –0.477 | –0.058 | 0.215 |
| Fitness apps | 0.184 | –0.068 | 0.247 | 0.309 | –0.104 | 0.071 | –0.065 | –0.105 | 0.005 | –0.206 | –0.074 | 0.058 | 0.210 | –0.216 | 0.158 | 0.028 | –0.321 | 0.191 |
| Other apps | 1.049 | –0.410 | 0.056 | 0.948 | –0.011 | 0.712 | –0.285 | –0.034 | 0.224 | –0.052 | –0.111 | 0.074 | –0.281 | –0.107 | 0.164 | 0.251 | –0.358 | 0.311 |
| Various online services | 17.147 | –0.013 | 0.012 | –2.175 | –0.009 | 0.005 | –2.358 | –0.011 | 0.002 | –0.799 | –0.013 | 0.002 | 1.011 | –0.016 | 0.097 | 0.354 | –0.068 | 0.083 |
| Tickets – sports | 3.305 | –1.327 | 0.002 | 1.708 | –0.410 | 0.000 | 0.877 | –0.386 | 0.000 | 1.318 | –0.415 | 0.012 | 1.298 | –0.306 | 0.044 | 0.313 | –0.748 | 0.083 |
| Tickets – cultural | 10.922 | –0.101 | 0.001 | –0.209 | –0.074 | 0.000 | –0.206 | –0.094 | 0.000 | 0.899 | –0.092 | 0.003 | 0.556 | –0.082 | 0.012 | 0.958 | –0.082 | 0.105 |
| Internet subscriptions | 11.302 | –0.013 | 0.327 | 4.290 | –0.028 | 0.271 | 3.936 | –0.031 | 0.354 | 2.583 | –0.047 | 0.310 | 2.086 | –0.044 | 0.332 | 1.088 | –0.045 | 0.570 |
| Subscription electricity | 3.426 | –0.644 | 0.064 | 1.911 | –0.086 | 0.104 | 2.126 | –0.083 | 0.175 | 1.545 | –0.124 | 0.168 | 0.870 | –0.178 | 0.102 | –0.834 | –0.146 | 0.369 |
| Household services | 0.808 | –1.174 | 0.007 | 1.295 | –0.171 | 0.220 | 0.763 | –0.175 | 0.175 | –0.220 | –0.217 | 0.014 | 0.133 | –0.570 | 0.153 | 0.184 | –0.412 | 0.192 |
| Transport service | 12.935 | –0.079 | 0.004 | 2.311 | –0.065 | 0.002 | 1.936 | –0.067 | 0.002 | 1.892 | –0.063 | 0.003 | 2.317 | –0.071 | 0.002 | 0.692 | –0.138 | 0.022 |
| Rented accommodation | 6.361 | –0.165 | 0.000 | 2.560 | –0.075 | 0.000 | 0.705 | –0.113 | 0.001 | 1.624 | –0.087 | 0.001 | 2.221 | –0.057 | 0.006 | 0.327 | –0.084 | 0.058 |

Markets where the phenomenon of convergence did not occur.
Markets where the phenomenon of convergence has manifested.

*Note*: the meaning of the different product categories as presented in an abbreviated version is shown in Table 3.




*Note*: the meaning of the different product categories as presented in an abbreviated version on the chart is shown in Table 3.

**Figure 9.** Convergence test result (the value of the coefficient β in the regression equation) recorded in the EU e-commerce market, by products, from the perspective of the share of the population that made purchases online, by population category by age, in the period 2020–2022 (source: own processing according to Eurostat, 2023)

As previously mentioned, with reference to the data from Table 2, age was identified as the factor with the widest disparities among e-consumer segments in terms of convergence levels. Therefore, we examined the convergence in various product markets, categorized by consumer age groups, as detailed in Table 4 and Figure 9. According to the information presented, we note markets of different product categories in which the convergence was manifested at the level of many consumer segments, but also product markets where the phenomenon manifests itself in isolation, at the level of one or two consumer segments.

## 4.2. The e-commerce market from a value perspective

From a value perspective (the share of e-commerce in GDP), the e-commerce market also experienced growth in EU countries in the year before the pandemic (from 2.84% in 2018 to 3.26% in 2019), growth which during the pandemic reached 3.99% (the year 2021). In the context where the GDP dynamics at the EU level was in the period 2018–2019 101.8%, and in the period 2019–2021, 99.5% (according to our own processing based on the data provided by Eurostat), the growth rates of the share of e-commerce in GDP clearly attest to the expansion in value terms of the targeted market. The changes recorded in the two periods (before and after the peak period of the pandemic) in the e-commerce share in GDP indicator were significant in EU 27 according to the results of the GLM-RM analysis (Table 5), for a value of $p = 0.000$.

n comparing the evolution of the e-commerce market in terms of its value with the trend in the percentage of the population making online purchases, a notably accelerated pace was observed during the period from 2018 to 2021. In addition, in the case of the share of the population that made online purchases, although the EU average in the period 2021–2022 indicates a slight increase on average, according to the results presented in Table 1 no significant changes were registered at the level of the countries. In the case of the evolution of the e-commerce market in terms of value, we do not have data for the year 2022, but according to Statista estimates, European retail e-commerce will increase in 2022 compared to 2021 by approximately 14.7%, and the estimated annual increases are also for the following years (2023, 2024) of more than 10% (Statista, 2022). So, according to the evolution of recent years, and especially that of 2022, for the next period we cannot expect spectacular increases from the perspective of the number of e-consumers, but the e-commerce market will continue to grow from a value perspective, a suggested fact by the dynamics of previous years and confirmed by estimates according to the one previously indicated.

**Table 5.** Testing the changes over time, in EU countries, of the share of e- commerce in GDP (GLM – RM) (source: own processing according to the European E-commerce Report, 2021)

| Indicator | 2018–2019 – before | | | | 2019–2021 – COVID | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tests of Within-Subjects Effects | | Pairwise Comparisons | | Tests of Within-Subjects Effects | | Pairwise Comparisons | | | |
| | | | 2019–2018 | | | | 2020–2019 | | 2021–2019 | |
| | Sig. | Partially Eta Squared | Mean Difference | Sig. | Sig. | Partially Eta Squared | Mean Difference | Sig. | Mean Difference | Sig. |
| E-GDP | 0.000 | 0.532 | 0.369 | 0.000 | 0.000 | 0.504 | 0.431 | 0.002 | 0.790 | 0.000 |

Using also in this case σ convergence and β convergence (Table 6), we note that we are not witnessing a phenomenon of convergence in EU countries from the perspective of the value of the e-commerce market.

**Table 6.** Convergence recorded in the EU e-commerce market, from the perspective of market value (E-GDP)*, in the period 2018–2021 (σ convergence and β convergence) (source: own processing according to the European E-commerce Report, 2021)

| The indicator | σ – convergence | β – convergence | | |
|---|---|---|---|---|
| | σ 2021 – σ 2018 | R Square | β | Sig. |
| E-GDP | 259.0 | 0.609 | –0.0001 | 0.609 |

*Note*: *the market value was determined based on the e-commerce share in GDP and the GDP value provided by the European E-commerce Report 2021.

On the other hand, analyzing comparatively the values of E-GDP recorded in different EU states in 2018, and also the dynamics of the e-commerce market from a value perspective, we find that, although there is no convergence phenomenon at this level, there are countries that in 2018 recorded relatively low values of the E-GDP and also experienced a dynamic that surpassed the average dynamic from the period 2018–2021.

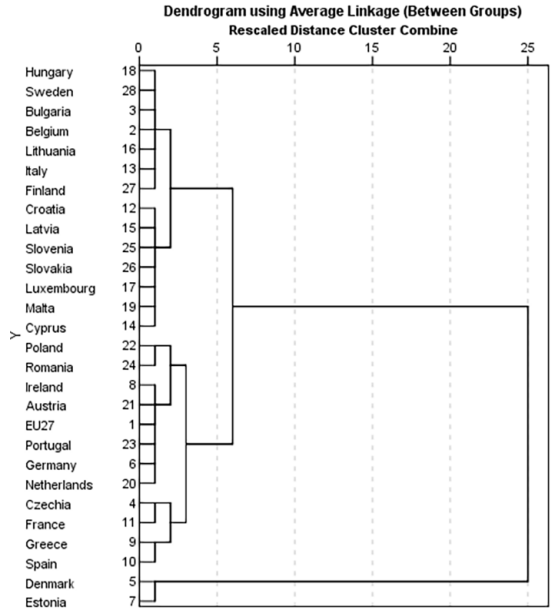



**Figure 10.** Dendrogram of EU countries based on the shares of e-commerce in GDP in 2018 and the dynamics of the value e-commerce market from 2018 to 2021
(source: own processing according to the European E-commerce Report, 2021)

Countries with above-average values of the E-GDP recorded lower market dynamics, but the phenomenon is not a generalized one. The dendrogram built on the basis of the stated indicators highlights the fact that the EU states can be divided into 7 clusters, among which the following attract attention (Figure 10):

- the cluster represented by: Croatia, Latvia, Slovenia, Slovakia, Luxembourg, Malta and Cyprus, countries that recorded E-GDP in 2018 between 0.64% and 0.91% (the lowest of the EU), but with a market dynamic that was ahead of the European average (except Luxembourg);
- the cluster represented by: Poland and Romania, countries that recorded values of E-GDP in 2018 of 2.20% each (below the EU average), but were at the top of the EU countries from the perspective of market dynamics;
- the cluster represented by: Denmark and Estonia, countries that recorded values of E-GDP in 2018 of 6.31% and 5.70% respectively (the highest in the EU), with a dynamic below / close to the EU average and much lower than other countries that recorded a reduced E-GDP in 2018.

## 5. Conclusions

In conclusion, the share of the population who made online purchases has increased during the pandemic, manifesting, consequently, a phenomenon of convergence in the e-commerce market from this perspective, the hypothesis on which the present analysis was based and is therefore confirmed. Convergence manifested itself differently by consumer category, depending on different socio-economic and demographic criteria, the biggest gaps between

the different population categories being registered according to the age criterion. Thus, in the population categories from the younger segments, the convergence registered a higher level, the countries where prior to the pandemic period lower levels were registered in terms of online purchases registering a more accentuated dynamic during the analyzed period and, thus, reducing the gaps between countries. By product category, there are differences compared to the e-commerce market as a whole, in the sense of increases, but also decreases of the market during the considered period, and the phenomenon of convergence was characteristic only of the markets of certain products and, to a greater extent, in the population segments located in the first half of the age pyramid.

Regarding the evolution over time, it is found that the indicator of the share of the population that made online purchases experienced growth in the period 2016–2019 (before-COVID), followed by more accelerated growth in the period 2019–2021 (maximum-COVID) and later, in the period 2021–2022 (post-COVID), a slight increase, but statistically insignificant in EU countries. Thus, the absence of significant changes in the year 2022 compared to the year 2021, attests that the pandemic has led to the development of the e-commerce market, viewed exclusively from the perspective of the actual number of e-consumers to a level close to the potential it has at this moment (2022), and spectacular increases, in the next period, of this indicator (in the absence of other factors with major influence on the phenomenon) are not expected.

Referring to the evolution of the market in terms of value, it experienced a faster dynamic than that of the number of e-consumers, starting from the year before the pandemic and later, during its peak period (2018–2021), and the forecasts realized the (Statista) regarding this, attests that a positive dynamic will be maintained in the coming years, so we expect an increase from this point of view of the e-commerce market. However, referring to the phenomenon of convergence, it was found that during the considered period it manifested itself only from the perspective of the number of e-consumers, but not from the value perspective. However, there are groups of countries whose e-commerce market in the year before the pandemic registered low relative values compared to the European average and which during the pandemic recorded a dynamic above the European average and countries with developed markets and whose dynamics were much slower, a situation which led to a reduction of the gap between these states (a phenomenon which, however, as stated, was not a generalized one).

## Theoretical and practical implications

The study employs the concept of convergence to assess how disparities between EU countries in e-commerce adoption have diminished over time. It uses σ-convergence and β-convergence as analytical tools, adding empirical weight to these theories. Also, the study provides a framework for understanding how external shocks like pandemics can accelerate existing trends, in this case, e-commerce adoption. The research explores the intricacies of buying patterns among various demographic groups, adding to the existing body of knowledge on the impact of external variables on online shopping behaviors.

The use of General Linear Model – Repeated Measures (GLM-RM) adds to the methodological literature, demonstrating how to measure changes over time in complex phenomena.

In terms of practical implications, the study can guide EU policymakers in understanding which demographic segments are lagging in e-commerce adoption and need targeted interventions. Also, e-commerce businesses can use these insights to tailor their marketing

strategies for different EU countries and demographic segments. For older age groups and those with lower income and education levels who are less likely to engage in e-commerce, targeted educational programs could be developed.

The study suggests that e-commerce has been a bright spot during the pandemic, which could influence economic planning and resource allocation.

The study is rich in data and employs rigorous statistical methods, making it a valuable resource for both academics and practitioners interested in the digital economy, consumer behavior, and the impact of external shocks on market dynamics.

## 6. Limits and further research

The present study has some limitations, which from our point of view do not influence research results. First, the indicators extracted from the Eurostat database for *Last online purchase in the 12 months* depending on the "income" variable are available up to the year 2020, thus the analysis of the convergence of the e-commerce market from this perspective was not possible for the post-COVID period. Secondly, the chronological series related to the extracted Eurostat indicators for some EU27 member states data are *low reliability*, *estimated*, *not available* or shows break in time series. Thirdly, the values related to the E-GDP indicator taken over from the European E-commerce Report publication are until 2021, since the related ones of 2022 are considered confidential in the European E-commerce Report 2022.

We believe that in the future this study can be developed with an analysis of the convergence of the e-trade in a regional profile (NUTS-2), identifying the factors that could determine the dynamics of e-commerce markets, factors from the digital economy and society: connection to the internet and computer use, internet use, e-government, e-business, ICT usage in enterprises, digital skills etc.

### Final Thoughts

As we reflect on the transformative impact of the COVID-19 pandemic on the European Union's e-commerce landscape, several key insights emerge. Firstly, the pandemic has undeniably accelerated the digital shift, broadening the consumer base and reshaping purchasing habits. This surge in online consumerism, however, was not uniform across all demographics or product categories. Younger consumers, in particular, demonstrated a more pronounced shift towards e-commerce, a trend that speaks to the deeper integration of digital technology in their lives.

The increase in e-commerce activity, though substantial, shows signs of plateauing post-pandemic. This stabilization suggests that the market may have reached a saturation point in terms of the number of e-consumers, a crucial insight for future market strategies. In contrast, the market value of e-commerce continued to grow at a robust pace, indicating that while the number of consumers may have stabilized, the overall spending and market potential continue to expand. Interestingly, the pandemic-induced growth in e-commerce did not lead to a uniform convergence across the EU. While some countries with initially smaller e-commerce sectors experienced rapid growth, reducing the disparity with more established markets, this was not a universal phenomenon. This uneven growth pattern highlights the ongoing diversity in market maturity and consumer behavior across the EU. As we look ahead, these insights provide a foundation for understanding the evolving e-commerce landscape. The pandemic has acted as a catalyst for change, but the trajectory of this change varies

significantly across different sectors and regions. For policymakers, understanding these nuances is crucial in shaping effective digital market policies. For businesses, these trends offer a roadmap for adapting to the evolving consumer behaviors and market dynamics in the post-pandemic era.

In conclusion, while the pandemic has reshaped the EU's e-commerce landscape in significant ways, the future of this sector will be defined by how businesses and policymakers respond to these changes. Adapting to the new normal will require a nuanced understanding of the varied growth patterns and consumer preferences that have emerged during this unprecedented period.

## Author contributions

AS and LT conceived the study and were responsible for the design and development of the data analysis. AS, LT and BN were responsible for data collection and analysis. LZ and BN were responsible for literature review. MD and EH were responsible for connecting the article parts, check the article coherence and write first draft.

## Disclosure statement

Authors don't have any competing financial, professional, or personal interests from other parties.

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