DETERMINANTS OF ONLINE SHOPPING ADOPTION IN THE EUROPEANUNION: AN ECONOMETRIC PERSPECTIVE

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Abstract
The rapid expansion of digitization has transformed e-commerce into a key driver of economic modernization and competitiveness in the European Union (EU). However, there are significant differences between Member States in terms of the uptake of online shopping. This study analyzes the main determinants of e-commerce in the EU-27, using a cross-sectional econometric model that includes digital and socio-economic factors. The analysis is based on data extracted from the Eurostat platform for the year 2024 and considers four variables: the share of people who have made at least one online purchase in the last 12 months, the frequency of internet use, gross domestic products at market prices, and the participation rate in education and training. In addition, a brief bibliometric analysis is carried out using Web of Science to highlight current trends in literature. The results indicate that digital inclusion and the development of digital skills have a significant impact on consumer participation in e-commerce, with their influence being stronger in the short term than that of economic prosperity. The study highlights the need to reduce digital divides and support the Digital Single Market, while also providing directions for future research.

Key words: *online shopping; digital inclusion; e-commerce adoption; econometric modeling; digital skills.*

JEL Classification: *L81; B23; C01*

I.INTRODUCTION

In recent decades, e-commerce has become a defining feature of the digital economy (Ivanova & Sceulovos, 2018), transforming the way both individuals and companies interact in the economic space (Sharma et al., 2023).

In the context of accelerating technological progress, e-commerce is no longer just an alternative to traditional commerce but a basic component of the competitiveness of modern economies. For the European Union (EU), e-commerce is of strategic importance, being a key instrument for stimulating competitiveness and deepening economic integration (Laitsou et al., 2020; Volkova et al., 2021). By supporting the Digital Single Market, e-commerce contributes to the creation of a borderless economic space in which connectivity becomes a fundamental resource for development (Broome, 2016). However, a study by Răileanu Szeles & Simionescu (2020) shows that the degree of e-commerce adoption varies significantly between Member States, with differences explained by economic, digital, and educational factors that shape each economy's ability to integrate new technologies.

In this context, the present study aims to analyze the determinants of e-commerce adoption in the European Union using an econometric model based on cross-sectional data for 2024. The study investigates the relationship between the level of e-commerce (dependent variable) and a set of explanatory variables: frequency of internet use, gross domestic product (GDP), and participation rate in education and continuing training. The main objective of the article is to identify and quantify the impact of economic, technological, and educational factors on the degree of e-commerce adoption in European Union member states. It also aims to highlight the roles of digitization and human capital in stimulating online purchasing behavior, thereby providing valuable insights for the formulation of European public policies in the field of digital transformation.

At the end of the literature analysis section, a bibliometric analysis was introduced, conducted using the Web of Science database to identify the main research trends. This mixed approach (quantitative and qualitative) provides a comprehensive picture of the chosen topic.

Therefore, this paper contributes to the literature by integrating digital, economic, and educational dimensions into an econometric model applied at the EU-27 level for the year 2024, providing a comparative perspective on the determinants of e-commerce in a continuously expanding digital economy.

II. LITERATURE REVIEW

E-commerce has become a symbol of the digitization of the economy (Bănescu et al., 2022), changing the way consumers purchase goods and services, compare alternatives, and search for information. From a business perspective, e-commerce expands the market potential, reduces information costs, and can open new sales channels (Vargas-Hernández, 2015; Šaković Jovanović et al., 2020; Rosário & Raimundo, 2021). From the consumers' point of view, there are lower search costs, offering convenience, personalization, and greater transparency (Wu et al., 2004; Su, 2008; Molla & Heeks, 2007). Thus, businesses are forced to reorganize, with implications for the entire technological flow. In fact, e-commerce refers to transactions involving both goods and services conducted online (Gupta, 2014). Over time, e-commerce has expanded beyond traditional commercial transactions to include online financial services, digital content, electronic public services, and mobile commerce (Antepli & Erbaş Selvi, 2025).

For European Union member states, this type of commerce has a dual importance: it stimulates domestic consumption and contributes to the Digital Single Market by reducing barriers between states (Ahi et al., 2023; Gómez-Herrera et al., 2014). Savrul et al. (2014) also believe that e-commerce supports business productivity, thereby facilitating innovation and expanding opportunities for SMEs that would otherwise have limited access to international markets through traditional trade.

From the consumers' point of view, there are numerous advantages, such as convenience (24/7 access), product diversity, the ability to compare prices easily, and often lower costs (Baubonienė & Gulevičiūtė, 2015; Kusumawardani & Aulia, 2024). Several authors (Bădîrcea et al., 2022; Pousttchi & Dehnert, 2018) emphasize that the development of e-commerce is a direct consequence of the digitization of consumption, with effects on how consumers search for product information and compare alternatives. In addition, the shopping experience can be personalized using recommendation algorithms (Liu, 2022). On the other hand, there are challenges related to trust, transaction security, personal data protection, and reluctance to purchase certain goods (such as food, medicine, luxury goods, etc.) (Okeke, 2013; Morić, 2024).

From a business perspective, e-commerce enables market expansion, lower distribution costs, and, most importantly, the opportunity to build new business models on digital platforms (Wang et al., 2018). However, adopting this model requires investment in digital infrastructure, logistics, and human capital, and online competition can be more intense than in traditional commerce (Jurla, 2024).

Thus, e-commerce is an integral part of the digital transformation of economies, being closely linked to the development of ICT infrastructure, the evolution of digital payments, and the emergence of emerging technologies such as artificial intelligence, blockchain, and the Internet of Things.

An econometric study conducted between 2010 and 2021 for European Union countries found that several variables are significantly associated with the share of online shopping. These are: the quality of digital network connections, frequency of internet use, product information searches, GDP per capita, education, and human capital (Huterska & Huterski, 2022). Similar results at the national level show that individual income and digital skills increase the likelihood of purchasing goods and/or services online (Perez-Amaral et al., 2020). In addition, global studies confirm that economic development, education, and ICT infrastructure are positively correlated with higher e-commerce adoption (Păun et al., 2024).

The literature suggests that e-commerce is not just a consumer phenomenon but is closely linked to productivity and performance at the company and industry levels. For example, growth in online sales is associated with increased labor productivity in Europe (Falk & Hagsten, 2015).

A study conducted by Dominici et al. (2021) demonstrated that income, individual digital skills, age, and education level significantly influence the likelihood of purchasing goods or services online, suggesting that social and demographic factors remain key drivers.

Overall, the literature identifies four pillars underlying e-commerce: technology, economic factors (GDP/capita), human capital (education and digital skills), and spatial-logistical context (urbanization). Bauerová & Klepek (2018), Li et al. (2019), Göksu & Göçoğlu (2023) showed that there are positive effects present with each pillar, confirming with econometric models that online purchases are explained by internet usage, GDP/capita, urbanization rate, and population education.

III. BIBLIOMETRIC ANALYSIS OF LITERATURE ON E-COMMERCE ADOPTION

To complement this qualitative analysis of the literature, a quantitative study was also conducted, specifically a bibliometric exploration of existing research on e-commerce adoption. On November 12, 2025, a query was performed in the Web of Science Core Collection database, using the search terms "e-commerce adoption" OR "online shopping adoption" AND "European Union." This search identified 707 scientific

documents published between 1999 and 2025 across economics, management, business, and information science.

These scientific documents were downloaded and subsequently processed using VOSviewer.

Table 1. Methodological aspects of bibliometric analysis.

Criteria	Results
Number of WoS-indexed publications	707 publications corresponding to the keywords
Number of keywords	2,365 keywords associated with the 707 publications
Required minimum occurrences of a keyword	3 occurrences
Number of keywords that meet the threshold	399 keywords met the occurrence threshold
Share of keywords that meet the threshold	16.87%

The results highlight that the central term in the literature is "e-commerce adoption," located at the semantic core of the map, confirming the scientific interest in its determinants and implications. Related topics such as "information technology," "innovation," "trust," "prevent risk," and "digital transformation" appear around this term, outlining the main dimensions of analysis: technological, economic, and behavioral.

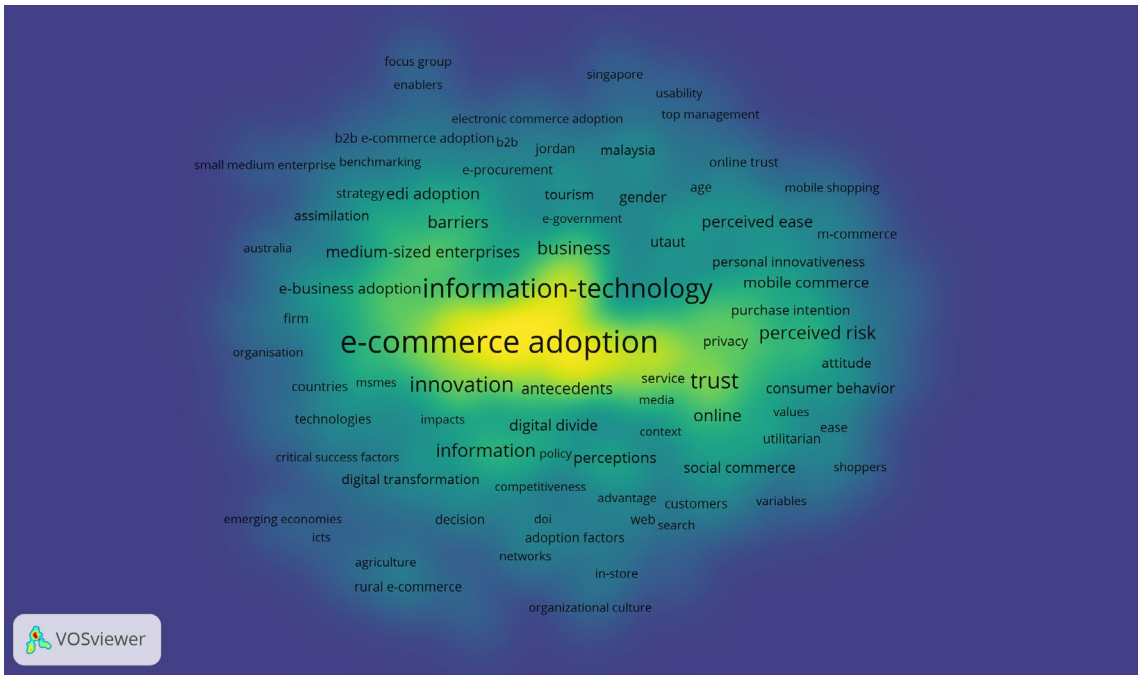

Figure 1 – Keyword Co-Occurrence Map for E-Commerce Adoption Research

At the same time, terms such as "consumer behavior," "mobile commerce," and "social commerce" are emerging, indicating a trend toward researching the interactions between the digital environment and consumer behavior. In parallel, the keywords "digital divide" and "information policy" suggest researchers' concern with digital inequalities and the role of public policies in facilitating digital transformation.

These research directions support the theoretical framework of this study, which examines the influence of the digital dimension and economic and educational factors on e-commerce levels across EU member states.

IV. RESEARCH METHODOLOGY

This paper uses a multiple linear regression model applied to cross-sectional data, estimated by least

squares. The econometric model aims to identify the main technological and socio-economic factors influencing the degree of e-commerce adoption across the 27 member states of the European Union in 2024.

The main reasons for choosing this research method are: a) this type of analysis allows the identification of differences between countries at a given point in time (2024), providing a clear picture of the structural disparities in the adoption of e-commerce; b) the use of the least squares method facilitates the estimation of the degree to which each independent variable explains the variation in the rate of participation in e-commerce at the level of EU member states.

This research method is frequently encountered in the literature on the digital economy, e-commerce, and beyond (Almeida de Figueiredo, 2024; Kalveram et al., 2024; Gheorghe, 2024).

The equation of the econometric model is:

$$\ln(Ecommerce) = \beta_0 + \beta_1 InternetUse_i + \beta_2 \ln(GDP_I) + \beta_3 Education_i + \varepsilon_i \quad (1)$$

Where:

ln(Ecommerce) = natural logarithm of the share of individuals who have made at least one online purchase in the last 12 months (ISOC_EC_IB20)

InternetUsei = frequency of internet use (ISOC_CI_IFP_FU)

ln(GDPi) = natural logarithm of GDP at market prices, expressed per capita (NAMA_10_GDP)

Educationi = participation rate in education and training in the last 12 months (TRNG_LFS_17)

β0 = free term (intercept)

β1, β2, β3 = coefficients of explanatory variables

εi = random error

i = Member State (1…27)

The use of these variables allows us to capture the relationships among digital connectivity, economic development, and human capital, providing a broad perspective on how these factors contribute to e-commerce adoption across the EU.

The data used in the analysis were collected from the Eurostat platform for 2024 and cover all 27 EU Member States. The indicators were chosen for their theoretical and empirical relevance to the theme's objective.

The data sets are as follows:

- Internet purchases by individuals (2020 onwards) – cod indicator: isoc_ec_ib20;
- Individuals – frequency of internet use – cod indicator: isoc_ci_ifp_fu;
- Gross domestic product at market prices – cod indicator: nama_10_gdp;
- Participation rate in education and training (last 12 months) – cod indicator: trng_lfs_17.

The datasets were processed and statistically analyzed using JASP software, version 0.95.3.0.

V. DISCUSSION

Before presenting the econometric model estimates, descriptive statistics were calculated to summarize the main characteristics of the model's variables. Table 2 summarizes the mean, median, dispersion, and distribution indicators.

Table 2. Descriptive Statistics

Descriptive Statistics	log_e-commerce	Individuals - frequency of internet use	Participation rate in education and training	log_GDP
Valid	27	27	27	27
Missing	0	0	0	0
Median	4.259	92.19	39.3	10.18
Mean	4.265	91.78	37.74	10.2
Std. Deviation	0.167	4.550	13.9	0.587
Skewness	-0.179	-0.379	-0.066	0.328

Std. Error of Skewness	0.448	0.448	0.448	0.448
Kurtosis	-0.378	-0.163	-0.548	-0.385
Std. Error of Kurtosis	0.872	0.872	0.872	0.872
Minimum	3.908	81.92	10.5	9.117
Maximum	4.551	99.22	64	11.45

Descriptive statistics indicate significant differences across the 27 EU Member States in e-commerce adoption levels and in the determinants of e-commerce adoption. Countries in northern and western Europe, such as Ireland, the Netherlands, Denmark, and Sweden, have the highest rates of online shopping, with over 88% of individuals having purchased something online in the last 12 months. These countries also stand out for their high GDP per capita and high frequency of internet use, highlighting the link between economic development, digital inclusion, and online consumer behavior.

At the opposite end of the spectrum are Bulgaria, Romania, Italy, and Croatia, which have the lowest levels of e-commerce adoption, below the 60% threshold. These economies are characterized by lower GDP per capita, except for Italy (31,090 GDP/capita), limited digital skills, and low adult participation in continuing education programs.

The variable relating to participation in education and training shows the most significant variation between Member States, ranging from 10.5% in Bulgaria, 18.5% in Croatia, and 19.8% in Romania to 64% in Sweden, thus illustrating significant differences in human capital development at the European level.

The distributions of the analyzed variables were evaluated using the Skewness and Kurtosis asymmetry indicators. The Skewness values range from -0.379 to 0.328, indicating an almost symmetrical distribution; thus, there are no extreme or significant values. The Kurtosis coefficients are negative for all variables, indicating platykurtic distributions with flatter peaks and less pronounced tails.

Table 3. Pearson Correlation Matrix

Variable 1	Variable 2	Pearson's r	p
log_GDP	log_e-commerce	0.71	< .001
log_GDP	Gross domestic product at market prices	0.945	< .001
log_GDP	Participation rate in education and training	0.491	0.009
log_e-commerce	Gross domestic product at market prices	0.652	< .001
log_e-commerce	Participation rate in education and training	0.704	< .001
Gross domestic product at market prices	Participation rate in education and training	0.375	0.054

As regards Pearson correlation coefficients, they highlight the existence of positive and statistically significant relationships between the variables analyzed in the model. There is a strong correlation between GDP and e-commerce, with a value of $r = 0.71$ (significance level $p < 0.001$), confirming that economic development is closely linked to digitization and the population's ability to participate in online commercial activities. At the same time, the highest correlation ($r = 0.945$) is between GDP and internet use frequency, suggesting that more developed economies have higher levels of technological inclusion.

The variable relating to participation in education and training shows a positive, albeit moderate, correlation with GDP ($r = 0.491$) and a stronger correlation with e-commerce ($r = 0.704$).

These correlations reflect the interdependence between economic, digital, and human capital.

Table 4. Model Summary

Model	R	R^2	Adjusted R^2	RMSE
M_0	0	0	0	0.167
M_1	0.853	0.728	0.692	0.093

** Note. M_1 includes log_GDP, Participation rate in education and training, Individuals – frequency of internet use.*

The results of the regression analysis indicate a high explanatory power, as evidenced by the coefficient of determination (R2) of 0.728. This value indicates that 72.8% of the variation in e-commerce across EU countries is explained by the independent variables in the model.

Also, the low value of the standard error (RMSE = 0.093) indicates good stability of the estimates and an adequate fit of the model.

Therefore, this analysis confirms that, in 2024, differences in e-commerce adoption across the EU can be explained largely by the interaction among economic, educational, and technological factors.

Table 5. Regression Coefficients

Model	Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	t	p
M_0	(Intercept)	4.265	0.032	–	132.796	< .001
M_1	(Intercept)	< .001	0.469	–	4.149	< .001
M_1	log_GDP	0.002	0.048	0.236	1.413	< .001
M_1	Participation rate in education and training	< .001	0.002	0.274	1.791	< .001
M_1	Individuals – frequency of internet use	< .001	0.007	0.448	2.193	< .001

Following the analysis of regression coefficients, the robustness of the econometric model is confirmed, with all independent variables being statistically significant. Furthermore, the coefficients are positive, indicating that increases in GDP, internet usage frequency, and participation in education and training are associated with greater e-commerce adoption. Among these variables, internet usage frequency has the most significant impact on e-commerce (Beta = 0.448). Participation in continuing education and training has a more moderate influence (Beta = 0.274), along with GDP (Beta = 0.236).

VI. CONCLUSION

The econometric analysis of panel data for the 27 EU member states, using 2024 data extracted from the Eurostat platform, highlighted a significant relationship between e-commerce and the socio-economic and technological factors analyzed. The results emphasize that internet use frequency is the primary determinant of e-commerce adoption. Thus, the higher the frequency of internet use, the more likely someone is to purchase something online.

Participation in education and training, as well as GDP, also have a positive effect, demonstrating that economic and human capital development contribute to the strengthening of e-commerce.

The proposed econometric model is statistically valid ($p < 0.001$) and explains approximately 72% of the variation in e-commerce between Member States. This result shows that public policies focused on digitization, vocational training, and investment in digital infrastructure can accelerate the EU's digital transformation.

However, the research has certain limitations, such as the fact that this paper is based on an econometric model using cross-sectional data for 2024, which limits the observation of the phenomenon's dynamic evolution over time. Furthermore, the model uses a limited number of explanatory variables; factors such as trust in online commerce, cybersecurity, and access to digital payments could provide a more complex perspective on consumer behavior and economic competitiveness.

Future research could extend the model to a panel analysis to capture the dynamics of e-commerce evolution, and integrating other variables could provide a better understanding of the factors driving digital

transformation in the economic space.

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