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Article

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SUSTAINABLE DEVELOPMENT OF E-COMMERCE IN THE POST-COVID TIMES: A MIXED-METHODS ANALYSIS OF PESTLE FACTORS

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Abstract

E-commerce represents an essential part of modern business, with a significant growth in recent years. Recent events, such as the COVID-19 pandemic, have led to a surge in online shopping and a rapid shift towards e-commerce, creating a new normal in the retail industry. To succeed in this changing landscape, it is important for organisations to understand the Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) factors that influence e-commerce. This exploratory research applies a mixed-methods approach to identify the PESTLE factors that affect the e-commerce landscape in post COVID times. The study was conducted by developing a questionnaire for organisations that use e-commerce in their operations and was applied to a sample of 309 Romanian firms, with mixed methods such as principal component analysis (PCA) and multinomial logistic regression. The results suggest that the pandemic has intensified the adoption of e-commerce, and businesses are focused on expanding their online presence and leveraging new technologies to enhance the customer experience. The findings contribute to understanding the PESTLE factors that influence e-commerce and can provide valuable insights for policymakers, businesses, and other stakeholders seeking to make informed decisions that facilitate the sustainable development of e-commerce. Limitations of this research include restricting the sample to Romanian organisations, with results that may be less relevant for other economies. Also, the study focuses on PESTLE factors, leaving other possible influences on e-commerce in the post-COVID period unaddressed.

Keywords: e-commerce, PESTLE analysis, internet, retail

JEL Classification: L81

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Introduction

The collaborative economy has emerged as a novel channel for the exchange of products and services facilitated by technology and digital platforms. This paradigm fosters cooperation and exchange, which encompasses goods, services, and knowledge, with or without monetary transactions. Consequently, the Internet has profoundly impacted contemporary living, enabling easy access to information and a plethora of applications designed to enhance consumer experiences.

Among many other things, the Internet has influenced the way commerce is performed on both the seller and the customer. During the COVID-19 pandemic, e-commerce and retail had a crucial role for the economy and society, compelling retailers to gain expertise with online services. Thus, the value of European e-commerce increased by 13% to € 718 billion in 2021 from € 633 billion in 2020 (Lone and Weltevreden, 2022). In Romania, 91% of the population has Internet access in 2022, as compared to 70% in 2017 and it is estimated that 45% of the internet users bought goods and services online in 2022 (Lone and Weltevreden, 2022). Moreover, in 2021, online sales from Romania represented almost half of those made in Eastern Europe, estimated at 14 billion euros.

Customers are discovering an improved shopping experience, whether it is product personalisation, mobile-friendly search, rapid checkout procedures, or easy shipping, and their expectations are rising quickly as a consequence. Sellers find it easier nowadays to maintain an online store than a physical one, as the costs are significantly lower, it is easier to administrate, and the training and competencies needed by the front people are more affordable in terms of time and costs.

The rapid growth of e-commerce and recent events have also generated several disadvantages and challenges. E-commerce has increased competition and segmentation in online businesses. The pandemic increased pressure for alternatives to the typical physical store to ensure social distancing, and huge amounts of empty commercial space are now visible across Europe (Lone and Weltevreden, 2022). E-commerce still faces difficulties and hurdles as it develops, while having a great deal of potential.

Several studies aim to analyse the development of e-commerce through the PESTLE or PEST (Political, Economic, Social and Technological factors) or factor analysis, but none of them address the changes generated by the COVID-19 pandemic, and there is also no research of this type in Romania. For example, Phan (2021) investigates the impact of PESTLE factors on e-commerce development in Vietnam. His study develops a theoretical model to explain the development of B2C e-commerce and validates this model in the Vietnamese context. The results indicate the significant influence of PESTLE factors on e-commerce development, and recommendations include the need for government and private investment in technological infrastructure, expansion of electronic public services, and promotion of investment in online stores and information security. Zhao, Liu and Xue (2019) explore the development of the e-commerce industry in China and introduce a PEST analysis embedded in a SWOT analysis to better understand development strategies. The results show that the development of this industry in China represents a significant opportunity, especially for small and medium-sized enterprises under the leadership of outstanding internet companies. However, incomplete infrastructure and the absence of a relevant support system remain obvious challenges. Al-Bakri and Katsioloudes (2015) study the use of e-commerce by SMEs

in Jordan based on factor analysis using two main variables: internal organisational factors and internal organisational factors. The results indicate that the adoption of e-commerce systems in Jordanian SMEs is influenced by internal factors such as training and strategy, and external factors such as managers' perceptions and pressure from business partners. Readiness and external pressure are considered crucial to maximise the benefits of e-commerce adoption. However, the relative importance of these factors can vary depending on local conditions. Vasić, Kilibarda and Kaurin (2019) investigate e-commerce in Serbia from the aspect of customer satisfaction and the findings indicate that it depends on 6 factors (analysis variables): security, information availability, quality, transport, time, and price.

The research problem addressed in this study focuses on the influence of PESTLE factors on the development of e-commerce in the post-COVID period. The paper falls within the exploratory research paradigm and aims, starting from the need to examine the field of e-commerce in the context of recent developments and the contextual underpinnings identified in previous research, to answer the following questions:

- What are the key PESTLE factors that play a decisive role in shaping the E-Commerce landscape?
- Which PESTLE factors have an impact on the different levels of online transactions?
- How do different PESTLE factors influence the recurrence of monthly online transactions?

In this context, the analysis aims to explore and understand the broader implications of the post-COVID e-commerce landscape, including its potential impact on sustainability and sustainable development. The use of technology and digital platforms for commerce has the potential to influence environmental factors, such as resource consumption and waste generation, and social factors, including consumer behaviour and societal well-being.

Through the mixed methods approach, namely PCA and the application of multinomial logistic regression, this study provides a detailed insight into the PESTLE factors shaping the evolution of post-COVID e-commerce in Romanian organisations, a context in which e-commerce has its own particularities and challenges. This is a significant empirical novelty, as no other study has focused on this specific aspect and fills an important knowledge gap in the literature. The relevance of this research is reflected in its contribution to the development of sustainable strategies for e-commerce and policy makers, thus facilitating the sustainable development of this field in a rapidly changing environment.

The paper is further structured into the following sections: the Literature Review reviews the background and existing gaps, the Research Methodology details the data collection and analysis, the Results and Discussion presents the main findings and their implications, and the Conclusions highlight the novelty and relevance of this study in the context of sustainable e-commerce development.

1. Literature review

The number of internet users has increased worldwide as a result of the modernisation of countries, technological improvements, the development of Internet access, and the growth of smartphone use. Nearly 4.66 billion people use the internet (Johnson, 2021), representing

about 59% of the world's population. Selling through e-commerce platforms has become increasingly popular in recent times due to the convenience created and the fact that they offer high accessibility compared to traditional commerce. E-commerce is delivered through internet services and has a technical infrastructure, which means that users have a certain standard of living. In areas with a higher standard of living, there is an increased number of online transactions for home delivery or other online services, as shoppers do not have enough time to use brick-and-mortar stores, thus resorting to modern and efficient purchases to satisfy their needs (Suska, 2022). Today's information and communication technology enables organisations to communicate and share knowledge more effectively on a global scale, allowing the expansion of the e-commerce market worldwide (Cui et al., 2017). E-commerce has in this way helped increase social innovation. The analysis of PESTLE factors facilitates the understanding of how e-commerce-related development strategies are established (Zhao et al., 2019), highlighting the specific dynamics of international business, the evolution of e-commerce and other relevant elements related to market competitiveness. (Kardes et al., 2021).

1.1. Political factors

Political instability causes a disincentive to online sales (Phan, 2021). Increasing taxes influence the volume of online sales as the tax impact needs to be quantified, and appropriate strategies developed to cope with tax changes. Customer protection regulations and the emergence of lockdowns, imposed as measures following the outbreak of the COVID-19 pandemic, are important because of its spontaneous emergence and the need for all to accept and adapt to the climate generated by this phenomenon.

1.2. Economic factors

The economic downturn is having an impact in terms of massive income reductions, investment restrictions, and digital decline. Inflation is impacting on e-commerce by increasing the cost of services and goods traded. Together with these increases, inflation can also translate into a decrease in consumer purchasing power, with a negative effect on the volume of online sales and the profits of the selling companies. However, the benefits for consumers are numerous: quick identification of competitively priced products, easy tracking of discount periods, use of various vouchers, coupons, loyalty points, etc.

The level of inflation is important because price increases for products/services effect a reduction in demand due to a reluctance to spend. Consequently, purchasing power is decreasing, transport, logistics and storage costs are increasing, and a complete restructuring of marketing strategies is taking place. Increased monthly consumer spending has a significant impact on sales as purchasing power decreases, consumer preferences change substantially, and companies are forced to streamline their marketing strategies in order to attract new customers or increase sales volume. The high level of competition is aimed at all the conditions generated by increasing diversity, competitive prices, high quality of services offered, opportunities for innovation, differentiation, and product promotion.

1.3. Social factors

The cost of labour in e-commerce is an important element that is based on a series of basic pillars, such as: the wage level in the area where the business is carried out, the volume of work performed, the size and complexity of the basic activities, the necessary technical

infrastructure and other costs related to the business profile. In e-commerce, financing systems are an essential component for business development as they provide efficient solutions for processing payments and transactions online.

E-commerce offers career opportunities for employers and digitally savvy individuals. Educational attainment influences e-procurement as a minimum of professional training is required to make e-procurement. Consumer behaviour is affected by age, including decision-making (Cole et al., 2008; Goldberg, 2009; Yoon et al., 2009), but also by cognition and persuasion (Selwyn et al., 2003; Wilson, 2018), advertising (McKay-Nesbitt et al., 2011), market reactions (Silvera et al., 2012), and the purchase of luxury goods (Amatulli et al., 2015). The phenomenon of an ageing population negatively affects e-commerce, as the older population is more reluctant to use new technologies. Social habits, modified by behaviours during the COVID-19 pandemic, have clearly favoured the development of electronic purchases. E-commerce has led to a work-life balance.

1.4. Technological factors

The technical aspects also have a significant influence on the success of e-commerce. Alonso and García (2018) find that over the last 30 years, the longevity of companies has been rapidly decreasing, while independent activities have been growing at an accelerating pace due to the use of electronic infrastructure. Digital entrepreneurship represents the new form of business. The reshaping of business is mainly due to the evolution of ICT – information and communication technology (Banhidi et al., 2020), and more specifically to the integration of digital technology into all business activity.

The security and ease of access to e-commerce force companies to invest in specific technology (servers, computers, website development, secure payment platform, information encryption software, etc.). The development of information systems must be permanently on the national agenda of all countries, as this is a factor generating economic growth and development (Shahiduzzaman and Khorshed, 2014). The accessibility to a virtual market is inextricably linked to the costs of the equipment.

The return policy for products purchased online is regulated and displayed on the e-commerce platform at the time of placing the order and usually includes elements related to the product return period, conditions, fees, and return process. In the EU, consumer protection directives require that returns of purchased products must be processed within 14 calendar days, even in the absence of justification from the purchasers (Ren et al., 2021).

The development of mobile communications is significantly influencing e-commerce, as companies increasingly interact, work, and purchase via specialised apps and internet connections. The existence of a website dedicated to commerce activities, with an attractive interface, the ability to protect information in the online environment, and low delivery costs, are elements that influence how websites are built. Thus, an attractive, well-structured website that protects potential customers' data will definitely influence the growth of online sales.

1.5. Legislative factors

The trend for large companies to shift their sales online has led to the transformation of many customs into laws and regulations, as well as bans on those who do not comply with certain behaviour. In recent years, two events have had a strong political impact on the development of e-commerce in the EU and, implicitly, in Romania: (i) the adoption of rules on the

collection and processing of personal data, known as GDPR (General Data Protection Regulation), established by Regulation 679/2016 (EU, 2016) and (ii) the pandemic, with all its restrictions. Although this Regulation is in force (TFEU, 2012), its provisions have been effectively applied in our country only after the implementation of Law no. 190/2018.

Under these rules, website owners (and therefore also owners of electronic sales platforms) are responsible for the security of data collected and processed from individuals. At the same time, the GDPR rules state that when accessing websites, users should be protected from any interference with their privacy (EUCJ, 2019), and their consent should be unambiguously collected. Retailers have an obligation to clearly and fully inform users so that they can easily determine the consequences of the consent they give and the functioning of the cookies displayed (EUCJ, 2019).

Given that the majority of payments for online transactions are made by card directly on the website, the provider must ensure both access to payment services and information security. The rights and obligations of payers and service providers are set out in Law 209/2019, which transposes certain provisions of Directive (EU) 2015/2366. Although e-commerce concerns the sale and purchase of goods, various other economic areas are affected, such as: gambling, taxation, copyright, consumer protection (EUCJ, 2020).

The increasing number of transactions through online services and platforms has led to the adoption of Regulation (EU) 2019/1150, which introduces rules governing the relationships, the links between these platforms and their users, i.e., the companies that use them, the measures that can be taken by EU states in various situations, such as breaches of time and conditions requirements and the protection of the identity of traders. Thus, in Romania, the provisions of the Regulation led to GEO No. 23/2021, which amended the Competition Law (No. 21/1996).

An easy, clear, and quick return policy for products sold has a positive impact on sales. With a limited physical presence in traditional stores since March 2020, retailers have had to explore innovative ways to engage directly with customers, leading to a notable increase in online transactions (Sardjono et al., 2021). Legislative changes are of importance because, during the time period under review, legislation has been constantly updated, its application has required very quick and consistent decisions to be taken by all stakeholders.

1.6 Environmental factors

Environmental factors play a crucial role in the e-commerce industry, where long-term sustainability is of utmost importance, even though the direct environmental impact of individual companies may be minimal. Investing in sustainability can yield significant benefits in various areas of e-commerce, encompassing sustainable packaging, waste reduction, and the adoption of renewable energy sources. (Rahayu and Day, 2015; Nandonde, 2019).

E-commerce has both positive and negative environmental impacts, as revealed by transportation-related research in the field. Studies (Carrillo et al., 2014; Chueamuangphan et al., 2019) suggest that e-commerce contributes to congestion, vehicle fuel consumption, and emissions due to increased shipments and transportation, especially in car traffic (Mangiaracina et al., 2015). However, there is a potential environmental benefit as well, with home delivery reducing emissions from consumers' own vehicle journeys to physical stores (Carrillo et al., 2014).

E-commerce packaging has a detrimental environmental impact, contributing to plastic waste generation. Integrating e-commerce into environmental sustainability is essential to mitigate its negative effects (Nisar and Prabhakar, 2017; Nia et al., 2018; Wang and Huang, 2018). As consumer purchasing behaviour shifts significantly with increased Internet use (Wagner et al., 2020), the COVID-19 pandemic has further accelerated the adoption of online shopping. Many businesses faced challenges transitioning to e-commerce during this period, attracting new and inexperienced customers to online platforms (Usas et al., 2021). Sustainability policies, an integrated element of environmental factors, are also important because it is necessary to identify combined methods to minimise the environmental impact of product sales.

2. Research methodology

This study aims to investigate the impact of PESTLE factors on e-commerce in post-COVID times in Romania. A questionnaire comprising 32 closed-ended questions on the Likert scale was developed and distributed to organisations with online presence. To ensure the clarity and relevance of the questions, the questionnaire was pretested with a pilot sample of 16 respondents. The final version was distributed via an online platform between September and November 2022. The final sample was selected using a probability sampling method that aimed to include organisations from all geographical regions of the country and from different sectors of activity. The questionnaires were addressed to managers in firms, which may indicate that the results may reflect the perspectives and experiences of this specific group of respondents.

The survey received responses from 309 organisations, a sample size considered sufficient for factor analysis, as it follows the rule of thumb for this type of analysis, which suggests at least five times the number of cases of the variables entered into the analysis plus 10 (Sreejesh, Mohapatra and Anusree, 2014; Veith et al., 2022). Data collected from the survey were analysed using descriptive statistics and advanced statistical methods such as principal component analysis (PCA) and multinomial logistic regression analysis to answer the research questions stated above.

The choice of methods aimed to explore the relevance of the PESTLE theoretical framework for e-commerce. First, we aimed to assess whether a component structure, inferred from responses to questionnaire items, corresponds to the PESTLE dimensions (theoretically constructed), using PCA as the extraction method and Promax as the rotation method, both implemented in SPSS.

Then, using the components obtained corresponding to the PESTLE dimensions, we assessed their explanatory power on the response variables showing the categories of online transactions with the help of multinomial logistic regression, implemented in the *nnet* R package. To do this, we eliminated companies that did not report any transactions online. The categorical response variables, denoted by *Y*, on which the impact of the PESTLE dimensions was assessed were the number of reported online transactions and the share of online transactions in total transactions. The categories for these variables are specified in detail in Table no. 1, and the base/reference categories used in the estimation of the multinomial logistic regression models were 1 to 49 online transactions and 0 to 20% of total transactions, respectively.

The multinomial logistic regressions used in our analysis have the following general form (James et al., 2021) (1):

$$\log \left(\frac{\Pr(Y = k|X = x)}{\Pr(Y = K|X = x)} \right) = \beta_{ko} + \sum_{j=1}^p \beta_{kj} x_j \quad (1)$$

where X is the matrix of components (x_1, x_2, \dots, x_p) used as explanatory variables, and the left-hand side of the equation represents the log odds of belonging to the category of online transactions under analysis, k ($\Pr(Y=k|X=x)$) over the probability of belonging to the baseline category K ($\Pr(Y=K|X=x)$). For example, for the categorical variable, the probability of having a share of online transactions between 20 and 40% can be written as

$$\Pr(Y \in 20 - 40\%|X = x)/(\Pr(Y \in 0 - 20\%|X = x)) \quad (2)$$

Regression results are transformed from the log-odds, or logit form, corresponding to the left-hand side term of equation (1), to odds ratios by exponentiating the regression coefficients β , e.g. $e^{\beta_{k1}}$, for the effect of an increase of 1 unit in the value of Factor 1.

Thus, in the context of the logistic regression, the odds ratios shown in formula (3)

$$OR = \Pr(Y=k | X=x)/\Pr(Y=K | X=x) \quad (3)$$

calculated from the regression coefficients, represent the probabilities of the occurrence of a certain category over the probabilities of occurrence of the reference/baseline category, following an increase by one of the value of the component X_i , with $i \in (1, p)$. A value exceeding 1 means a higher odds of the outcome, whereas a value below 1 means a lower odds for the outcome (Szumilas, 2010).

3. Results and discussion

The data obtained from the questionnaire were analysed in SPSS, obtaining the results presented below (the variables used in the questionnaire are presented in Annex 1). Table no. 1 presents the descriptive statistics for the demographic questions. The majority of surveyed companies, accounting for 55% of the total, have been in operation for over ten years. Most companies reported having less than 10 employees and an annual turnover below 250,000 lei. Around 40% of companies indicated having between 1 and 49 online transactions per month, with a relatively low percentage of returning customers. Only 8% of respondents mentioned that over 60% of their customers place more than two orders per month. Furthermore, 78% of the surveyed companies stated that their customers primarily consist of individuals and private organisations.

Table no. 1. Descriptive Statistics

		Frequency	Percent (%)	Cumulative Percent (%)
Age of company (years)	3<	43	13.9	13.9
	3 - 5	28	9.1	23.0
	5 - 10	66	21.4	44.3
	>10	172	55.7	100.0
	Total	309	100.0	
Number of employees	10<	141	45.6	45.6
	10 - 49	61	19.7	65.4
	50 - 250	49	15.9	81.2
	>250	58	18.8	100.0
	Total	309	100.0	
Turnover (lei)	>250000	116	37.5	37.5
	250000 - 500000	51	16.5	54.0
	500000 - 1000000	21	6.8	60.8
	1000000 - 5000000	38	12.3	73.1
	>5000000	83	26.9	100.0
	Total	309	100.0	
Number of online transactions (monthly)	0	65	21.0	21.0
	1 - 49	123	39.8	60.8
	50 -99	47	15.2	76.1
	100 - 499	25	8.1	84.1
	>500	49	15.9	100.0
	Total	309	100.0	
Clients with more than two transactions per month (%)	0 - 20%	147	47.6	47.6
	20 - 40%	44	14.2	61.8
	40 - 60%	35	11.3	73.1
	>60%	26	8.4	81.6
	NA	57	18.4	100.0
	Total	309	100.0	
Type of clients	Mostly public institutions	68	22.0	22.0
	Mostly private customers	241	78.0	100.0
	Total	309	100.0	

To provide an answer to the first research question, components were associated with the PESTLE dimensions based on the correlations between variables and principal components loading vectors, as shown in the structure matrix table (Table no. 2). Component 1 showed positive correlations for factors related to technology (TEH1 – TEH5) and moderate positive correlations for economic (EC1 - EC6) and environmental factors (ENV1 - ENV3). Component 2 demonstrated strong positive correlations for social factors (SOC2 - SOC4). Component 3 had substantial positive correlations for political factors (POL1 - POL3). Component 4 exhibited strong positive correlations for factors related to technology for legal factors (LEG1, LEG2). These findings provide insight into the relationships between the PESTLE factors and the identified components, offering valuable implications for understanding the influence of the external macro-environment on e-commerce development

Table no. 2. Structure Matrix

	Component					
	1	2	3	4	5	6
8) POL1	0.138	-0.054	0.026	0.802	-0.045	0.093
8) POL2	0.099	0.09	0.258	0.773	-0.095	-0.055
8) POL3	-0.209	0.423	0.283	0.438	0.188	0.213
9) EC1	0.127	-0.001	0.122	0.39	0.298	0.558
9) EC2	0.126	-0.136	0.749	0.06	0.032	0.107
9) EC3	0.136	-0.018	0.762	0.253	0.024	0.152
9) EC4	0.049	0.376	0.288	0.106	-0.142	0.527
9) EC5	0.089	0.509	0.027	0.359	0.128	0.011
9) EC6	0.081	0.54	-0.026	0.236	0.248	0.603
10) SOC2	0.182	0.653	-0.032	-0.076	0.03	0.158
10) SOC3	0.168	0.679	0.272	0.015	0	0.07
10) SOC4	0.126	0.585	-0.044	0.008	0.138	0.008
11) TEH1	0.696	0.097	0.065	0.078	-0.058	0.299
11) TEH2	0.76	0.127	0.086	0.088	0.086	0.183
11) TEH3	0.536	0.022	0.052	0.174	0.457	-0.264
11) TEH4	0.758	0.101	-0.06	0	0.249	0.147
11) TEH5	0.625	0.189	0.29	0.085	0.019	-0.105
12) ENV1	0.095	0.03	0.207	-0.162	0.724	0.158
12) ENV2	0.321	-0.061	0.282	-0.268	0.085	0.669
12) ENV3	0.112	0.132	-0.02	0.029	0.84	0.052
13) LEG1	0.031	0.39	0.598	0.034	0.174	0.087
13) LEG2	-0.011	0.314	0.579	0.094	0.474	0.135

Notes: Extraction Method: PCA. Rotation Method: Promax. The values highlighted in bold represent the statistically significant values, obtained from the influence of the analysed factors (from POL 1 to LEG 2) on components 1-6.

The PCA showed that the six components extracted from the PESTLE factors (components) explained a total cumulative variance of 60.458% (Table no. 3). The first component accounted for 24.181% of the variance, demonstrating the highest explanatory power. The second, third, and fourth components contributed 9.489%, 7.747%, and 7.497% of the variance, respectively. The remaining two components each explained around 5% of the variance. These results indicate that the identified components capture a substantial proportion of the total variance in the data, providing valuable insights into the underlying patterns and associations among the PESTLE factors in the context of e-commerce development. The factor structure only partially supports the theory, revealing that factor influences can be intertwined, and that the factors and phenomena they quantify do not exist in complete isolation. For example, policy regulations can target environmental actions that firms take to comply with legislation.

Table no. 3. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.32	24.181	24.181	5.32	24.181	24.181	2.667
2	2.088	9.489	33.671	2.088	9.489	33.671	2.364
3	1.704	7.747	41.418	1.704	7.747	41.418	2.009
4	1.649	7.497	48.915	1.649	7.497	48.915	1.869
5	1.426	6.483	55.398	1.426	6.483	55.398	1.948
6	1.113	5.06	60.458	1.113	5.06	60.458	1.806

Notes: Extraction Method: PCA. Rotation method: Promax. a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

The influence of the political factor on online sales is significant due to the unpredictability of economic developments resulting from political instability. Political instability is an important subfactor ($POL1/4 = 0.802$) that acts as a hindrance to e-commerce. Political decisions regarding online commerce are influenced by actions and issues in the online environment. High taxes on online sales lead to buyer reluctance and a reduction in transaction volume ($POL3/4 = 0.438$).

Online sales during economic downturns have a major impact on the entire economy. The most relevant economic factors affecting online commerce are the inflation level and monthly expenses allocated to consumption and current needs ($EC2/3 = 0.749$). Monthly consumption expenses and sales volume are interconnected, with the former having a decisive impact on the latter ($EC3/3 = 0.762$). Additionally, the level of competition among firms and competition policies contribute to the growth of electronic transactions ($EC6/6 = 0.603$). According to the findings of the study on social factors (F2), the use of e-commerce contributes to the improvement of the work-life balance, as indicated by $SOC2/2 = 0.653$.

It is predicted to be highly crucial $SOC3/2 = 0.679$ in the context of the influence that the amount of training level and preparation employees have on sales. According to the respondents, the number of elderly people in a population has a moderate impact on internet commerce ($SOC4/2 = 0.585$).

From the analysis of the technical factor, it is observed that the presentation and interface of the website have a significant impact on the customer's decision to make an online purchase ($TEH2/1 = 0.76$). The accessibility of the website and the ease of understanding the purchase process will attract an increasing number of customers. Owning a dedicated website provides immediate benefits compared to the offline system, as it eliminates several costs associated with managing physical commercial space and having on-site staff ($TEH4/1 = 0.76$).

Online orders typically require additional $ENV2/6 = 0.669$ shipping packaging, resulting in more packaging waste than in-store purchases. Products must be protected during transport, requiring the use of cardboard boxes, bubble wrap, air cushions, and paper fillers, packaging,

which is mostly environmentally friendly and regulated. This aspect can be seen from the analysis of the environmental factor (F5), $ENV1/5 = 0.724$.

Online retailers should strive to reduce packaging pollution through initiatives such as right-sized packaging and the use of eco-friendly materials. For this, the interviewed companies answered that they implement sustainability policies. $ENV3/5 = 0.84$.

The legal factor is represented by the product return policy, which impacts both economic and legal activities, as it reinforces customers' trust in the company's reliability, leading to an increase in reputation ($LEG1/3 = 0.598$). The element related to safety and health rules is combined with legal and economic elements, resulting in a set of essential ideas: it is important for return policies to ensure increased attention to the health of employees and customers, as well as the security of online transactions ($LEG2/6 = 0.135$).

Table no. 4 presents the associations between the estimated proportion of recurrence of online transactions and the PESTLE factors investigated in the study. The odds ratio (OR) represents the exponential of the parameter associated with the logistic model predictor, as described by Peng et al. (2002). It provides an estimate of the effect of each PESTLE factor on the odds of observing a specific proportion of online transactions' recurrence (De Jong and Heller, 2008). The Wald test in R software was used to calculate the P-values.

Table no. 4. Odds ratios of the influence of PESTLE factors on the estimated proportion of online transactions

Factors	Odds ratios			P-values		
	20-40%	40-60%	» 60%	20-40%	40-60%	» 60%
(Intercept)	0.324	0.181	0.217	0.000	0.000	0.000
F1 Technical	0.646	0.578	1.172	0.041	0.024	0.500
F2 Social	0.797	0.611	0.821	0.285	0.027	0.345
F3 Legal + economic	0.791	1.465	1.014	0.273	0.173	0.947
F4 Political	1.128	3.250	1.674	0.557	0.000	0.036
F5 Environmental	0.991	1.231	1.386	0.966	0.381	0.153
F6 Economic	1.754	1.221	0.980	0.007	0.345	0.929

Notes: Reference level: 0-20%. The ordering of factors is based on the statistical significance of the results (proportion of variance explained), which may be different from the theoretical one.

Under an increase of 1 of the F4 (Political factor), the odds of having between 40 and 60% customers who place more than 2 online orders per month are 3.250 times greater than the odds of the reference level (0-20% of customers have more than 2 orders per month) and the odds of having more than 60% of customers who place more than 2 orders per month are 1.674 times greater than the odds of the reference level. Also, under the influence of F6 (Economic factor), the odds of having between 20-40% customers with more than 2 orders per month are 1.754 times greater than the odds of the reference level. It can be inferred that government policies, regulations, and socio-political conditions play a significant role in shaping customer behaviour in online transactions in the case of recurring orders. Economic considerations, such as purchasing power, consumer confidence, and market conditions, play a significant role in shaping online transaction behaviour in the post-COVID e-commerce landscape in the case of a smaller percentage of recurring orders. Significant values were also

recorded in the case of the technical factor (F1), specifically for the: 20-40% category: $p=0.041$, and the 40-60% category: $p=0.007$, highlighting the importance of robust technical implementations to enhance the online shopping experience and gain a competitive advantage. Also, F2 (Social factor) recorded statistically significant values for the 40-60% category, implying that the influences of consumer behaviour, preferences, and trust in online transactions impacts the success and growth of online businesses.

Although the identified factor structure shows cross-loadings, where some variables are also strongly correlated with other factors in addition to the dominant factors (e.g., EC1 and EC6 with factor 6), this highlights the complex reality and limitations of the theory when tested empirically. In statistical analysis, perfect results are rarely obtained, and a recognised drawback of factor analysis is the frequent indistinguishability of factors, which is confirmed by our analysis. However, in general, we can say that the results broadly confirm the PESTLE theory, which is confirmed by the validity of the Bartlett test and the KMO statistic (>0.76).

Table no. 5 presents the associations between the estimated number of monthly online transactions and the PESTLE factors investigated in the study. The grouping of the results was done according to the values obtained for the answer options of question 5 in the questionnaire. Registration responses to the first option (0 monthly orders) were not included in the analysis due to the insignificant contribution to this research question. A maximum significance level of 0.1 (10%) was considered, which, although relatively low, confirms the existence of statistical significance of the results (Ross, 2017).

Table no. 5. Odds ratios of the influence of PESTLE factors on the number of online transactions

Factors	Odds ratios			P-values		
	50-99	100-499	»500	50-99	100-499	»500
(Intercept)	0.391	0.200	0.359	0.000	0.000	0.000
F1 Technical	1.438	1.370	1.720	0.041	0.193	0.005
F2 Social	0.665	0.650	0.479	0.032	0.070	0.000
F3 Legal + economic	0.824	0.794	0.919	0.248	0.324	0.652
F4 Political	1.119	1.208	0.881	0.530	0.410	0.500
F5 Environmental	1.054	1.498	1.496	0.771	0.095	0.030
F6 Economic	0.759	1.174	0.976	0.128	0.493	0.895

Notes: Reference level: 1-49 orders per month. The ordering of factors is based on the statistical significance of the results (proportion of variance explained), which may be different from the theoretical one.

The results indicate that F1 has a significant influence when companies record between 50-99 orders per month and over 500 orders per month. The odds of having over 500 orders per month are 1.720 times greater than the odds of the reference level (1-49 orders per month). This emphasises the significance of prioritising resilient technical implementations, optimising website usability, and offering advanced features to improve the overall online shopping experience. F2 has a significant influence for all response categories ($p<0.1$), while F5 has an influence when companies record more than 100 and more than 500 monthly orders ($p<0.1$). Factors related to societal dynamics, customer preferences, and online interactions play a critical role in shaping online transaction behaviour. To succeed in the e-commerce market, businesses must pay close attention to social aspects and adopt a holistic approach that considers multiple dimensions of consumer behaviour to develop effective strategies and engage with their target audience more effectively.

Also, environmentally conscious practices and sustainable approaches can positively impact online transaction volumes in certain contexts. Incorporating environmentally friendly practices in e-commerce operations can resonate with customers who prioritise sustainability, thus providing a competitive advantage and boosting customer loyalty. By integrating eco-friendly initiatives into their business models, e-commerce companies can align with growing consumer demands for environmentally responsible products and services, contributing to their long-term success.

Conclusions

Recently, e-commerce has seen a significant evolution, and, according to current trends, a considerable increase in activities specific to this sector is forecast. The use of large-scale IT applications, the increasing influence of artificial intelligence, the use of chatbots and applications in the field of virtual reality, the investments created in logistics, the increasing access to IT infrastructure are clear elements that point us to the growing development directions that will facilitate and more the online purchase process.

The research highlighted the importance of political stability in shaping customer behaviour in recurring online transactions. A politically stable environment instils confidence in consumers, reassuring them of the continuity and reliability of online transactions. As a result, customers are more likely to feel secure in making recurring orders, contributing to the sustained growth and stability of e-commerce in the country.

Additionally, economic factors, such as purchasing power and consumer confidence, influenced online transaction behaviour in the case of a smaller percentage of recurring orders, due to their direct impact on consumer spending patterns. When purchasing power is limited or consumer confidence is low, people can become more cautious about their expenses, resulting in fewer recurring online transactions. Economic uncertainties may lead to reduced disposable income and a reluctance to commit to regular purchases, and customers may prioritise essential or one-time purchases, rather than engaging in frequent online transactions. Ensuring a stable and prosperous economic environment is crucial for encouraging consumer spending and fostering a higher percentage of recurring online orders in Romania.

The technical factor was found to be crucial for companies recording higher monthly online orders, emphasising the significance of robust technical implementations to enhance the online shopping experience. Well-designed websites, fast loading times, and user-friendly interfaces, enhance the overall customer experience and satisfaction. In addition, advanced technical features, such as secure payment gateways and personalised recommendations, can further engage customers and build loyalty.

The study emphasised the significance of sustainability in the e-commerce industry, as environmental factors were shown to play a role in influencing online transaction volumes. Businesses seeking socially and environmentally responsiveness should place an increasing emphasis on environmental factors such as sustainable packaging and logistics.

According to the results of the factor analysis, some variables load on different components than initially assumed and show significant cross-loadings, which highlights the real complexity and limitations of the theory when approached empirically. Perfect results are rarely obtained, and a known drawback of factor analysis is the frequent indistinguishability

of factors, which is confirmed by the results presented, suggesting the need for future research to build on the empirical aspects revealed by our analysis. The usefulness of the results lies in confirming the influence of some factors on the online commerce variables, not in obtaining an exhaustive model, a situation often found in the literature.

Overall, the study illustrates how important it is for organisations and policy makers in Romania to properly consider external PESTLE issues when formulating e-commerce development strategies. Organisations and government should ensure that they are well positioned to succeed in this rapidly evolving industry by adopting a holistic approach that takes into account the political, economic, social, technological, legal, and environmental issues that impact on e-commerce in Romania. The results of this study are relevant for organisations, policy makers, and researchers interested in the growth of e-commerce and can deepen our understanding of the external factors influencing this rapidly changing sector.

Although there are no studies addressing this issue in the post-COVID period, studies on e-commerce analysis have considered factors other than those covered in this article. They focus on a specific country or region (Vietnam, China, Jordan, Serbia, etc.), so the geographical and cultural context differs significantly and leads to differences in the influence of factors determining the development of e-commerce. For example, the Vietnam study places greater emphasis on political factors, while the China study stresses the importance of orienting the industry according to national macroeconomic policies. Although there are links in terms of critical factors and their impact, there are also significant differences due to the specific context of each country or region. These highlight the originality and uniqueness of the present research, which differs from existing publications in the field.

Limitations of this research include the size and restriction of the sample to Romanian organisations, which may limit the generalisation of the results for other countries and may exclude issues specific to other international markets. The study also focuses on PESTLE factors, leaving other possible influences on e-commerce in the post-COVID period, such as the impact of emerging technologies or other global events, unaddressed. Also, the use of mixed methods of analysis, such as PCA and multinomial logistic regression, may have limitations in terms of interpreting complexity and delving into certain causal relationships.

Future research can explore the influence of e-commerce in various economic sectors and its implications for the behaviour of sellers and buyers. Given that the study highlighted that political and social factors play a significant role in shaping customer behaviour in online transactions in the case of recurring orders, in-depth investigation of these sub-factors can contribute to setting regulatory directions and socio-political conditions for the sustainable development of e-commerce. Future research can address the distinction between the positive (opportunities) and negative (threats) influences of external environmental factors on e-commerce, thus contributing to a deeper understanding of how these factors shape the specific dynamics of e-commerce.

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Annex 1. Questionnaire variables

Political Factor	
POL 1	Political instability discourages sales.
POL 2	Tax increases affect online sales volume.
POL 3	Customer protection regulations negatively impact online sales.
Economic Factor	
EC1	The economic downturn is driving down online sales.
EC2	The level of inflation has led to an increase in the prices of products/services provided by the company.
EC3	Increased monthly expenditure on consumption and current needs influences sales volume.
EC4	Expenditure on staff salaries is one reason for the growth in online sales.
EC5	Financing, credit and guarantee systems are not properly adapted to the needs of the sector.
EC6	High level of competition drives the company to implement online sales.
Social Factor	
SOC2	The influence of work-life balance is reflected in the growth of e-commerce.

SOC3	The level of professional training and skills among employees influences online trade.
SOC4	Ageing population negatively influences e-commerce.
Technical Factor	
TEH1	The development of mobile communications contributes to the growth of online sales.
TEH2	The volume of online sales is influenced by the website interface.
TEH3	Customers trust that by accessing the company's website their personal data is safe.
TEH4	It is cost-effective to have your own e-commerce website compared to traditional sales.
TEH5	Delivery costs influence the value of products.
Environmental Factor	
ENV1	The packaging of products ordered for dispatch is made of environmentally friendly materials.
ENV2	More packaging is used for online orders than for physical sales of products.
ENV3	The company has sustainability policies in place.
Legal Factor	
LEG1	The return policy for products sold online makes it difficult for the company.
LEG2	In the case of e-commerce, health and safety rules impose new conditions.