sustainability

MDPI

Article

Toward a Sustainable Development of E-Commerce in EU: The Role of Education, Internet Infrastructure, Income, and Economic Freedom on E-Commerce Growth

Nicolae Marius Jula [1], Gabriel Ilie Staicu [2], Liviu Cătălin Moraru [2] and Dumitru Alexandru Bodislav [2,*]

[1] Faculty of Business and Administration, University of Bucharest, 030018 Bucharest, Romania; marius.jula@faa.unibuc.ro
[2] Faculty of Theoretical and Applied Economics, The Bucharest University of Economic Studies, 010374 Bucharest, Romania; gabriel.staicu@economie.ase.ro (G.I.S.); liviu.moraru@economie.ase.ro (L.C.M.)
* Correspondence: alex.bodislav@ase.ro; Tel.: +40-721-569-757

Abstract: The emergence of e-commerce reshaped the traditional trade models, also playing a significant role in meeting the UN sustainable development goals. According to the UN, sustained growth and social development must include resilient infrastructure, foster innovation, allow for better access to information and communications technology, and universal and affordable internet infrastructure. This study explores a multidimensional analysis of e-commerce development in the EU generated by the following factors: education, internet infrastructure, income, and economic freedom. We use an ARDL econometric model and Eurostat data. Additionally, we analyze the time responsiveness of e-commerce growth to changes in these factors. In the long run, our findings identify a stable and positive relationship between e-commerce and all these factors. However, in the short run, our results illustrate significant dynamics between two variables and e-commerce. Specifically, the level of internet access and the percentage of individuals who use the internet daily exhibit a positive short-run impact on e-commerce sales, with the system absorbing shocks within a short period. This research advocates for targeted policies that support innovation, fair competition, and consumer protection in the digital economy. This research provides valuable guidance for policymakers and stakeholders in improving the institutional framework to promote a sustainable development of e-commerce in the EU.

Keywords: sustainable development; e-commerce; ADRL model; education; internet infrastructure; economic growth; economic freedom; institutional quality

Citation: Jula, N.M.; Staicu, G.I.; Moraru, L.C.; Bodislav, D.A. Toward a Sustainable Development of E-Commerce in EU: The Role of Education, Internet Infrastructure, Income, and Economic Freedom on E-Commerce Growth. *Sustainability* **2024**, *16*, 3809. https://doi.org/10.3390/su16093809

Academic Editors: Gomaa Agag, Ziad H. Abdelmoety and Mansour Alyahya

Received: 18 March 2024
Revised: 20 April 2024
Accepted: 30 April 2024
Published: 1 May 2024

1. Introduction

The landscape of commerce has undergone a systemic shift in recent decades, transitioning from traditional brick-and-mortar trade to the boundless realm of e-commerce. This rapid expansion of internet-related services has profoundly reshaped the role of technology within the business environment, as the online market redefines the parameters of trade. The adoption of information and communication technologies (ICT), particularly e-commerce, offers myriad benefits to businesses, including increased sales, reduced transactional costs, and enhanced understanding of customer preferences, product availability, and market dynamics. Moreover, ICT integration improves operational efficiency, accelerates processes, targets advertising efforts more effectively, and fosters the creation of virtual communities that serve as potential markets [1]. This creates an augmented relationship between e-commerce and digitalization [2–4].

With the help of the internet, previously inefficient markets have become more streamlined, affording small businesses the potential opportunities to compete with large competitors in different local and international markets. This shift towards efficiency and accessibility has positioned e-commerce as a disruptive challenge for traditional paradigms.

However, according to OECD [5], large firms are more than twice as likely as small and medium enterprises (SMEs) to participate in e-commerce in most countries, and, more importantly, this gap tends to increase on average. In this regard, Grandon et al. [6] identified a causal relationship between the perceived strategic value of e-commerce and e-commerce adoption by SMEs. Related to exogenous factors, enterprises embracing the selling channel of e-commerce face economic, legal, technological, infrastructure, and social impediments while entering into e-commerce [7]. These factors might inhibit the SMEs in meeting the challenge of integrating e-commerce into their businesses; therefore, growth in these SMEs have not been as rapid as other large firms [8].

However, disparities in integrating e-commerce continue to exist not only among firms. According to The E-Commerce and Development Report [9], the United Nations suggests that the majority of developing countries face limitations in the advancement of their digital economies. These limitations stem largely from low income levels, low literacy rates, a lack of secure payment systems that can support online transactions, and cultural resistance to online transaction-making [10]. Other studies consider that institutional quality, governmental policies, and economic freedom indicators can be crucial to the accessibility of ICT and e-commerce development. For instance, Baliamoune-Lutz (2003) explores the nature and direction of the links between ICT diffusion, per capita income, trade and financial liberalization, literacy and education, and freedom indicators including economic freedom, civil liberties, and political rights [11].

The COVID-19 pandemic acted as an accelerator for online sales, as e-commerce quickly responded to the challenges of the COVID-19 pandemic by ensuring continued access to producers and services to consumers [12]. Having a presence in the digital market has become a matter of survival for most of the enterprises around the world. According to the European E-Commerce Report (2022), before the pandemic, 70% of small retailers in the European Union had no e-commerce offering or online presence. From a supply-side perspective, the proportion of e-shoppers grew from 55% in 2012 to 75% in 2022. On demand, the highest shares of internet users who bought or ordered goods or services over the internet in 2022 were recorded in the Netherlands (92%), Denmark (90%), and Ireland (89%). On the other hand, fewer than 50% had shopped online in Bulgaria (49%) [12].

The divergent trajectories in the adoption of e-commerce among nations, particularly in the EU, underscore the complex interplay of socio-economic, technological, and regulatory factors. The abovementioned findings consistently reveal a spectrum of disparities, ranging from disparities in internet penetration rates and digital infrastructure to variations in formal or informal institutions that prevail in different countries. Within these multidimensional influences, certain variables stand out as significant drivers of e-commerce development, fostering the dynamics of digital trade.

The study aims to investigate the relationship between some key socio-economic variables and the development of e-commerce in EU countries. This approach provides a structured framework for understanding how various factors contribute to the growth of e-commerce and its penetration into the business environment.

In this paper, we focus on five particular factors of e-commerce expansion in EU countries: (1) *Educational factor*: the share of the population aged 25–34 who have successfully completed tertiary studies. (2) *Infrastructure autonomy factor*: the percentage of individuals who use a portable computer or a handheld device to access the internet away from home or work. (3) *The intensity of internet usage factor*: (a) the percentage of individuals who use the internet daily and (b) the percentage of individuals who have ever used the internet. (4) *Income factor*: the gross domestic product, as real expenditure per capita. (5) *Institutional quality factor*: the economic freedom index. The e-commerce expansion is estimated with the help of the percentage of enterprises with e-commerce sales (10 persons employed or more). This indicator was preferred to the percentage of e-commerce sales out of total sales due to its better illustration of e-commerce penetration into the business environment.

The contribution of our research to specific literature and, more importantly to policymakers, has two dimensions.

Firstly, this multifactorial analysis illustrates the *intensity effect of these factors* in driving the growth and sustainability of e-commerce in the EU. An examination of the existing literature within the realm of e-commerce indicates a predominant focus on single-country studies [13–17], often exploring individual factors [18–22]. Many of these studies predominantly emphasize technical elements such as infrastructure, cybersecurity, marketing strategies, and business models [7].

To address this notable research gap in the literature, the present study aims to construct an integrative ARDL model by exploring multidimensional factors, aiming to elucidate how these drivers interact to shape the e-commerce development within EU members.

Secondly, it analyzes the *time responsiveness of e-commerce growth* to changes in these factors. Our results provide useful insights into the short-run vs. long-run relationship between e-commerce and these factors. For example, our model identified a significant short-term causality between the level of internet access and e-commerce, while other variables are significant in long run.

This research gap in the specific literature related to time responsiveness might play a guiding role in designing EU short-run and long-run policies to better achieve its 2030 Digital Agenda. In the preceding years, the European Union has shown a commitment to advancing its Digital Agenda, as evidenced by the introduction of revised competition regulations such as the Digital Services Act, the Digital Market Act, and a new Digital Economy and Society Index (DESI) which tracks the progress made in EU member states in the digital environment. The EU admits that digital transformation is an unprecedented opportunity to accelerate digitalization, increase the Union's resilience, and reduce external dependencies with both reforms and investments [23].

Therefore, the results of our research not only contribute to developments in e-commerce literature, but might also help EU policymakers to redesign short-run and long-run policies to foster a digital environment that promotes innovation, upholds principles of fair competition, and maintains adequate levels of consumer protection.

The next part is structured as follows. Section 2 provides an extended literature review of e-commerce development, with a special focus on the factors mentioned above. Section 3 describes the data and the methodology employed in this paper. Sections 4 and 5 discusses the results and potential limitations of our work. The Section 6 presents conclusions and proposes future research.

2. Literature Review and Hypotheses Development

In this paper, we analyze the relationship between the development of e-commerce and key socio-economic variables, with a keen focus on distinct factors such as education, internet infrastructure, internet usage, income level, and institutional quality. Therefore, the present review of e-commerce literature is structured considering these independent variables.

2.1. E-Commerce and Education

One pivotal factor that has exerted a profound impact on the trajectory of e-commerce is the population aged 25–34 who have successfully completed tertiary studies. Often referred to as digital natives or millennials, this population epitomizes the tech-savvy generation, characterized by a high degree of digital literacy and a proclivity towards online engagement. Recent studies have consistently shown a strong correlation between educational attainment and e-commerce adoption, with college-educated individuals exhibiting higher rates of online purchasing behavior [24]. Understanding the consumption patterns and preferences of these individuals is thus paramount in understanding e-commerce development. Some research findings show that, for this educated segment, the variety and quickness of internet shopping are valuable characteristics of internet shopping [25]. In relation to consumers' age, studies emphasize that younger people can adapt faster to

newer technologies, so they are more open to adopting the internet as shopping tool than others [26].

Educational attainment influences consumer behavior patterns, including preferences for online shopping and digital transactions. Research findings suggest that individuals with higher levels of education tend to exhibit a more favorable attitude toward e-commerce, viewing it as a convenient and efficient shopping channel [27]. Among other social factors enhancing human capital, education still plays a crucial role in equipping individuals with the necessary digital skills and literacy to navigate the complexities of e-commerce platforms; [28,29] found that higher levels of education are positively correlated with greater digital literacy, enabling individuals to engage more effectively in online transactions [30]. When addressing digital divides, some authors suggest that education plays a critical role in bridging digital divides and ensuring equitable access to e-commerce opportunities. Recent research highlights the importance of educational programs in narrowing disparities in e-commerce adoption rates across different demographic groups and geographic regions [31,32].

Studies aiming to link educational level and openness in promoting regulatory compliance highlighted that educated consumers and businesses are better equipped to understand and comply with the regulatory frameworks governing e-commerce transactions. These findings underscore the role of education in promoting adherence to consumer protection laws, data privacy regulations, and cybersecurity practices in the e-commerce ecosystem [33,34]. Last, but not the least, education plays an important role in fostering entrepreneurship in the e-commerce sector. Education empowers aspiring entrepreneurs with the knowledge and skills needed to establish and operate successful e-commerce ventures. Recent research findings show that accessibility to a better-quality education significantly contributes to the emergence of innovative e-commerce startups and promotes entrepreneurial activities in the digital marketplace [35].

In conclusion, education seems to be a relevant, long-term factor in the promotion and advancement of e-commerce, empowering individuals, businesses, and societies to harness the transformative potential of digital commerce. By investing in education and fostering digital literacy, policymakers, and stakeholders can pave the way for inclusive e-commerce growth and sustainable economic development in the digital age. Thus, the first hypothesis we developed is stated below.

Hypothesis 1 (H1): *Level of education of the population aged 25–34, who have successfully completed tertiary studies, is a factor positively correlated to e-commerce development.*

2.2. E-Commerce and Infrastructure Autonomy

In the era of digital commerce, the accessibility of the internet has emerged as a fundamental driver, reshaping consumer behavior, transforming business models, and fostering the expansion of e-commerce. In particular, the wide usage of portable computers and handheld devices has revolutionized the way individuals access the internet, extending autonomy and connectivity beyond the limits of home or workplace infrastructure. The development of telecommunications and wireless internet have led to the emergence of a new phase of electronic commerce called mobile commerce [36].

The widespread availability of mobile internet access has democratized online connectivity, empowering individuals to access e-commerce platforms anytime, anywhere. Recent studies [37,38] demonstrate that the convenience of mobile internet access significantly enhances consumer engagement with e-commerce, leading to increased browsing, shopping, and transactional activities on mobile devices. Other research papers emphasize that the ubiquity of smartphones and tablets has not only facilitated seamless connectivity but has also engendered a paradigm shift in consumer behavior, fostering a culture of on-the-go shopping and instant gratification [39].

Mobile internet access facilitates effortless and intuitive shopping experiences, enabling consumers to browse products, compare prices, and make purchases while on the

move. Recent research findings [40] highlight the role of mobile devices in capturing spontaneous purchase opportunities and capitalizing on moments of consumer intent, thereby driving impulsive buying behavior in e-commerce settings. An increased autonomy infrastructure and an affordable accessibility of internet connection have broadened the reach of e-commerce, extending market penetration to underserved segments of the population and more isolated regions [41]. Some authors [42] suggest the proliferation of smartphones and mobile internet connectivity as factors that have helped small businesses and entrepreneurs tap into previously untapped consumer segments, fostering inclusive economic growth and reducing digital divides.

The infrastructure autonomy also contributes to creating a personalized and contextualized customers' experience in the e-commerce environment. Mobile internet access enables e-commerce platforms to deliver personalized and contextually relevant experiences, leveraging location-based services, push notifications, and real-time data analytics. Recent research findings [43,44] underscore the importance of mobile-driven personalization strategies in enhancing user engagement, loyalty, and conversion rates in the e-commerce market. However, the causal relationship between infrastructure and e-commerce proves to be bi-univocal [45]. The growth in e-commerce has fueled technological advancements and innovation. Continued advancements in mobile technology and internet infrastructure, such as the rollout of 5G networks and the emergence of progressive web applications (PWAs), are poised to further revolutionize the e-commerce landscape. Related to this topic, some findings [46,47] highlight the transformative potential of next-generation mobile technologies in stimulating immersive shopping experiences, augmented reality (AR) commerce, and safer transactions.

In conclusion, by leveraging the transformative potential of mobile technology, businesses can unlock new opportunities for growth, innovation, and market inclusivity in the dynamic digital commerce landscape. The proliferation of portable computers and handheld devices has emerged as a transformative force in catalyzing the growth of e-commerce. Reviewing the literature in this field, the second hypothesis we consider is the following.

Hypothesis 2.1 (H2.1): *Infrastructure autonomy, illustrated as the percentage of individuals who use a portable computer or a handheld device to access the internet away from home or work, is a determinant factor that fosters e-commerce development.*

Hypothesis 2.2 (H2.2): *Infrastructure autonomy, illustrated as the percentage of households who have internet access at home, contributes significantly to e-commerce development.*

2.3. E-Commerce and the Intensity of Internet Usage

Closely linked to the previous factor, this part of the literature review is focused on analyzing the intensity of internet usage, identified as another crucial determinant of e-commerce growth. Both indicators, the percentage of individuals who use the internet daily and the overall percentage of individuals who have ever used the internet, inform us about the market size and the potential for online sales. A regular usage of the internet suggests a consumer base that is familiar with online navigation and, therefore, more likely to participate in e-commerce activities.

Daily internet users tend to exhibit higher levels of engagement with e-commerce platforms, contributing to increased website traffic, prolonged session durations, and higher conversion rates. Related to consumer engagement in e-commerce, recent research highlights that intensive internet usage fosters deeper consumer interactions with online retailers, resulting in heightened brand loyalty and repetitive purchases [30,48]. Moreover, customer engagement can also be estimated by an individual's involvement within the social networks of online brand communities [49]. With a focus on the non-economic determinants of customer engagement, researchers analyzed the emotional or psychological dimension of engagement that consumers develop towards a particular com-

pany or brand, resulting in recurrent interactions that extend beyond simple transactional motivation [50,51].

Other studies aim to research the expansion of the digital market reach level. The prevalence of daily internet usage expands the reach of e-commerce platforms, enabling businesses to get into broader and more diverse consumer segments. According to [52,53], the active participation of daily internet users in online communities, social media platforms, and digital marketplaces facilitates word-of-mouth referrals, viral marketing, and organic brand advocacy, thereby amplifying the visibility and reach of e-commerce brands. Intensive internet usage influences the purchase decision-making process, empowering consumers with access to comprehensive product information, user reviews, and price comparisons. Ref. [54] underscores the role of daily internet users in conducting extensive pre-purchase research, leading to informed buying decisions and reduced perceived risks associated with online transactions.

Moreover, the intensity of internet usage is augmented by the adoption and utilization of mobile devices for e-commerce transactions. Ref. [55] highlights the correlation between daily internet users and mobile commerce engagement, as these individuals prefer smartphones and tablets to access e-commerce platforms on the go, driving the growth of mobile commerce ecosystems. These developments naturally fuel ongoing technological innovation and advancements within the e-commerce industry. Ref. [56] emphasize the role of intensive internet usage in driving investments in user experience optimization, personalized recommendations, and emerging technologies such as augmented reality and virtual reality, thereby enhancing the overall shopping experience and fostering consumer satisfaction.

In conclusion, the intensity of internet usage, particularly among individuals who engage with the internet on a daily basis, serves as a key driver of e-commerce growth, fueling consumer engagement, expanding market reach, and stimulating technological innovation. Therefore, e-commerce businesses should continuously develop tailored sales strategies, optimize digital experiences, and capitalize on emerging opportunities to drive sustained e-commerce expansion in the digital era. For this purpose, we present below the third hypothesis outlined in our model.

Hypothesis 3.1 (H3.1): *The intensity of internet usage, as the percentage of individuals who use the internet daily, has a positive effect in fostering e-commerce.*

Hypothesis 3.2 (H3.2): *The basic digital skills, as the overall percentage who have ever used the internet, have a positive effect on the potential development of e-commerce.*

2.4. E-Commerce and Income

Following a macroeconomic perspective, income level stands out as a critical determinant influencing consumer behavior, market dynamics, and the overall expansion of digital commerce. However, the relationship between gross domestic product (GDP) and e-commerce growth is rather bi-univocal than univocal. Firstly, a vast part of the literature demonstrates that e-commerce development has a significant impact on the dynamics of economic growth [57–62].

Secondly, some authors consider that real GDP, as a measure of a nation's economic output, serves as a barometer of purchasing power and consumer confidence. Countries with robust GDP growth often witness a corresponding surge in e-commerce activities, as consumers exhibit a greater propensity to engage in online transactions [63,64]. For instance, wealthier economies have more resources to invest in the necessary internet infrastructure and the population has more disposable income for online purchases [65,66]. Focused on the distribution of wealth, other researchers have tested the contribution of digitalization in reducing income inequality in G20 countries [67], as well as in increasing the GDP level [68].

Countries with higher GDP per capita often favor greater access to digital infrastructure, financial services, and internet connectivity, fostering an environment conducive to e-commerce adoption and engagement. Ref. [69] suggests that increased income levels enhance market accessibility and affordability, driving e-commerce penetration rates and transaction volumes. Technological adoption rates and innovation capacities within a country, empowered by higher GDP per capita, are also shaping the development and sophistication of e-commerce ecosystems. Relevant research findings [70] highlight the role of higher income levels in driving investments in digital infrastructure, mobile technologies, and emerging e-commerce platforms, thereby fueling technological advancements and market competitiveness.

Moreover, high income countries often exhibit greater market maturity and consumer confidence levels, facilitating the growth and sustainability of e-commerce businesses. Therefore, rising income levels contribute to increased trust in online transactions, reduced perceived risks, and a greater willingness to experiment with new e-commerce platforms and services [71,72]. Additionally, GDP per capita growth is closely linked to broader socio-economic development and inclusive economic growth, which, in turn, promote digital inclusion and e-commerce participation among diverse customer segments. In other studies, [73–75] emphasize the role of income redistribution policies and inclusive economic strategies in narrowing digital divides and expanding e-commerce access for various income categories.

Since GDP per capita emerges as a macroeconomic driver of e-commerce growth, exerting a multidimensional influence on consumer behavior, market dynamics, and technological innovation, this factor is of particular importance in the present paper. By understanding the nuanced relationship between income level and digital commerce expansion, policymakers, businesses, and stakeholders can formulate targeted strategies to foster inclusive e-commerce ecosystems and leverage the transformative potential of digital commerce in driving sustainable economic development. The fourth hypothesis extracted from the above literature is the following.

Hypothesis 4 (H4): *The income level, measured as real GDP per capita in purchasing power parity, has a positive effect in fostering e-commerce.*

2.5. E-Commerce and Institutional Quality

The institutional framework plays a significant role in shaping the regulations, market conditions, and the development trajectory for e-commerce. The index used in this paper as a proxy for institutional quality is the economic freedom index (EFI), which has been developed by the Fraser Institute [76] since 1996. Economic freedom, meaning promoting a free-market environment with minimal government intervention, has been studied for its influence on entrepreneurial ventures, including the e-commerce sector. Recent findings illustrate that economic policies favoring free trade and business operations contribute to the flourishing of e-commerce [77–80]. Conversely, if political choice is substituted for personal choice, restrictive regulatory frameworks can inhibit the potential growth of the digital market [81].

Factors such as property rights protection, contract enforcement, and regulatory efficiency are essential to fostering a favorable climate for the business environment, particularly for e-commerce entrepreneurial endeavors. Related to this, different studies [82] suggest that countries with higher levels of economic freedom tend to have streamlined regulatory processes, lower bureaucratic burdens, and greater legal predictability, which are conducive to e-commerce investment and entrepreneurship.

Economic freedom fosters market competition and encourages innovation in countries that promote it. Some research [83] suggests that countries with robust institutional frameworks and open market policies experience greater levels of competition among e-commerce firms, leading to enhanced product diversity, service quality, and technological advancements. Moreover, economic freedom is linked to the protection of property rights

and the enforcement of contracts, which are essential for building consumer trust and confidence in e-commerce transactions. Aiming to evaluate e-commerce readiness, ref. [84] highlights the role of institutional quality in safeguarding intellectual property rights, data privacy, and consumer rights, thereby bolstering trust in online platforms and fostering e-commerce adoption.

The institutional quality of the business environment, as illustrated by the economic freedom level, influences the investment climate and attractiveness of countries for foreign direct investment (FDI) in the e-commerce sector. According to research by [85], countries with higher levels of economic freedom are more likely to attract FDI inflows in infrastructure, technology, and logistics, driving industry growth and market expansion.

Therefore, with respect to this factor, we can conclude that institutional quality, particularly illustrated by economic freedom level, serves as a benchmark in promoting e-commerce growth, providing the necessary sound regulation system, fair competition, and investment incentives for digital commerce expansion. By identifying the appropriate institutional reforms, policymakers and stakeholders can create an enabling free-market environment that stimulates innovation, entrepreneurship, and sustainable economic development in the digital era. Based on this vast empirical analysis and theoretical research findings, we formulate the following hypothesis.

Hypothesis 5 (H5): *The quality of the institutional framework, with the economic freedom index as a proxy, has a positive influence on e-commerce development.*

3. Research Data

The sample includes the EU 27 countries and data used in this paper are provided by Eurostat, respectively, Fraser Institute. The selected variables and data sources are illustrated in Table 1.

Table 1. Variables and data sources.

Variables	Symbol	Data Source
Percentage of enterprises with e-commerce sales (10 persons employed or more).	ECOM	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/isoc_ec_esels/default/table?lang=en
The share of the population aged 25–34 who have successfully completed tertiary studies (ISCED 2011, levels 5–8), population from 25 to 34 years.	TEA	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/sdg_04_20/default/table
Percentage of individuals who used a portable computer or a handheld device to access the internet away from home or work.	IPIU	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_ifp_pu$defaultview/default/table
Level of internet access: percentage of households.	LIA	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/tin00134/default/table
Percentage of individuals who used the internet daily.	IWUI	Eurostat, https://ec.europa.eu/eurostat/databrowser/product/view/isoc_ci_ifp_fu
Internet use by individuals: Percentage of individuals who have ever used the internet.	IUI	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/tin00028/default/table
Gross domestic product, volume indices of real expenditure per capita (PPS_EU27_2020 = 100).	GDPc	Eurostat, https://ec.europa.eu/eurostat/databrowser/view/tec00114/default/table
Economic Freedom Rankings, overall score (out of 10).	EFR	Fraser Institute, https://www.fraserinstitute.org/economic-freedom/dataset?geozone=world&page=dataset&filter=1&sort-field=country&sort-reversed=0&date-type=range&max-year=2021&min-year=2010

For all data sources: accessed on 6 January 2024.

4. Methodology and Results

As a preliminary method, we tested panel models, and the results were statistically insignificant. Also, due to the small time series size and strong correlations in the data series (with possible multicollinearity effects) it was not possible to construct a cointegration model between the percentage of enterprises with e-commerce sales (ECOM) and all/several exogenous variables. We chose the PMG/ARDL technique because it has the advantage of identifying and preventing problems related to the estimation of short time series data. It also allows the simultaneous estimation of the parameters from the long-term stable relationship and from the short-term dynamic equation, which helps to avoid the problems generated by the non-stationarity of the time series. The econometric tests that have been developed to improve the quality of our research findings are the following.

For these variables, specific tests do not reject the unit root hypothesis, both as common unit root process, i.e., Levin, Lin, and Chu test [86] and Breitung test [87], and as individual unit root process, i.e., Im, Pesaran, and Shin [88], ADF–Fisher, and Philips–Perron tests [89], while the Hadri stationarity test [90] rejects the null (all tests are subject to the small size of the time series). All tests reject the unit root for the differenced series. As a result, we accept that the analyzed time series are non-stationary, integrated of the 1st order, that is, they are I(1). As the first step of analysis, we test causal relationships, in the short run, between *ECOM* and selected variables. Since the series are I(1), we applied the Toda–Yamamoto version of the Granger causality test [91]. Technically, all information criteria (Akaike, Schwartz, Hannan–Quin) select a VAR(1) model.

According to the Toda–Yamamoto methodology [92], we estimate the VAR(1) model in which we included as exogenous variables the 2nd order lags of the analyzed series. The results of the causality tests are presented in Table 2.

Table 2. Granger causality test—Toda–Yamamoto version. VAR Granger Causality/Block Exogeneity Wald Tests. Sample: 2010–2023. Included observations: 155.

Dependent Variable: ECOM			
Excluded	**Chi-sq**	**df**	**Prob.**
TEA	1.257259	1	0.2622
IPIU	0.570617	1	0.4500
IWUI	9.253724	1	0.0024
GDPc	1.981208	1	0.1593
EFR	1.449184	1	0.2287
LIA	7.577376	1	0.0059
IUI	1.266025	1	0.2605
All	21.22833	7	0.0034

Source: data estimated in EViews.

Except for the *percentage of individuals who used the internet daily* (IWUI) and *level of internet access: percentage of households* (LIA) variables, the Granger tests (Toda–Yamamoto version) reject the hypothesis of causality relationships, in the short term, between the time series analyzed and *percentage of enterprises with e-commerce sales* (ECOM). We therefore test for the existence of long-term relationships (cointegration).

We tried to build a model that includes all the variables. But, between some explanatory variables there is a strong and statistically significant (according to the t-statistical test) linear correlation. The coefficients of linear correlation (Pearson) are in Table 3:

Table 3. Coefficients of linear correlation (Pearson) between the exogenous variables. Sample: 2010 2023. Included observations: 378. Pairwise samples (pairwise missing deletion).

Correlation (t-Statistic)	ECOM	TEA	IPIU	IWUI	GDPC	EFR	LIA	IUI
ECOM	1							
TEA	0.4005 (8.154)	1						
IPIU	0.6133 (11.252)	0.4892 (8.129)	1					
IWUI	0.5918 (14.198)	0.5060 (10.942)	0.8637 (24.831)	1				
GDPC	0.3307 (6.279)	0.4733 (9.640)	0.4913 (8.175)	0.5256 (11.068)	1			
EFR	0.3599 (6.911)	0.2516 (4.664)	0.4562 (7.428)	0.3621 (6.960)	0.4693 (9.129)	1		
LIA	0.5904 (13.022)	0.4177 (7.869)	0.8590 (24.312)	0.9395 (48.909)	0.5420 (11.041)	0.3708 (6.525)	1	
IUI	0.6251 (14.326)	0.4656 (9.020)	0.8466 (23.053)	0.9424 (50.487)	0.5497 (11.283)	0.4518 (8.276)	0.9523 (55.678)	1

Source: data estimated in EViews.

All the coefficients of linear correlation are statistically significant at a $<10^{-5}$ level (according to the t-statistic tests). There were several linear correlation coefficients that exceed the threshold of 0.80, i.e., the coefficients between *percentage of individuals who used a portable computer or a handheld device to access the internet away from home or work* (IPIU), *level of internet access* (LIA), *percentage of individuals who used the internet daily* (IWUI) and *internet use by individuals* (IUI)—and between the last three variables, the coefficients are even (above 0.94).

Due to the small time series size and strong correlations in the data series (with possible multicollinearity effects) it was not possible to construct a cointegration model between the *Percentage of enterprises with e-commerce sales* (ECOM) and all/several exogenous variables. Consequently, we tested the existence of long-run relationships between the variable ECOM and each explanatory variable individually. For this purpose, we used Pooled Mean Group/Autoregressive Distributed Lag Models (PMG/ARDL). The PMG/ARDL technique was originally proposed by Pesaran, Shin, and Smith [93] and has the advantage of identifying and preventing problems related to the estimation of short time series data. It also allows the simultaneous estimation of the parameters from the long-term stable relationship and from the short-term dynamic equation, which helps to avoid the problems generated by the non-stationarity of the time series. The components in the PMG/ARDL model structure are the following:

- Cointegration: If the error correction term is statistically significant, it suggests that a long-run relationship (cointegration) exists between the variables in the model.
- Long-run effects: These are the impacts of changes in independent variables on the dependent variables over a longer period. They are represented by the coefficients of the levels of the variables. A positive coefficient indicates that an increase in the independent variables leads to an increase in the dependent variables in the long run, while a negative coefficient suggests the opposite.
- Short-run effects: These are the immediate impacts of changes in independent variables on the dependent variables. They are represented by the coefficients of the lagged differences of the variables. A positive coefficient indicates that an increase in the independent variables leads to an increase in the dependent variables in the short run, while a negative coefficient suggests the opposite.

- Error correction term (ECT): The ECT measures the speed at which the dependent variable returns to equilibrium after a change in the independent variable. A negative and statistically significant ECT indicates that any short-run disequilibrium will converge back to the long-run equilibrium.

The results of the cointegration relationships between the *percentage of enterprises with e-commerce sales* (ECOM) and each explanatory variable (PMG/ARDL) models are presented in Tables 2 and 4.

Table 4. Relationships between the percentage of enterprises with e-commerce sales and economic factors. Dependent variable: d(ECOM).

Variable	Coeff.	Std. Error	Prob.	Variable	Coeff.	Std. Error	Prob.
Exogenous variable: TEA Sample: 2011–2022 Included observations: 322				Exogenous variable: IPIU Sample: 2013–2019 Included observations: 183			
Long-Run Equation				Long Run Equation			
TEA	0.19262	0.05007	0.0001	IPIU	0.36975	0.00531	0.0000
Short-Run Equation				Short Run Equation			
Cointegr.	−0.25218	0.07476	0.0009	Cointegr.	−0.47159	0.11612	0.1021
d(TEA)	−0.12146	0.09274	0.1914	d(IPIU)	0.00677	0.10373	0.6714
intercept	3.71011	0.97641	0.0002	trend	−0.31587	0.12629	0.0136
Exogenous variable: IWUI Sample: 2011–2023 Included observations: 347				Exogenous variable: GDPc Sample: 2012–2022 Included observations: 295			
Long-Run Equation				Long Run Equation			
IWUI	0.20564	0.01332	0.0000	GDPc	0.14439	0.00315	0.0000
Short-Run Equation				Short Run Equation			
Cointegr.	−0.37023	0.06798	0.0000	Cointegr.	−0.48555	0.07270	0.0000
d(IWUI)	0.01208	0.02868	0.6739	d(GDPc)	−0.03236	0.09414	0.7313
intercept	2.17017	0.46385	0.0000	trend	0.47483	0.07271	0.0000
Exogenous variable: LIA Sample: 2013–2023 Included observations: 290				Exogenous variable: IUI Sample: 2013–2023 Included observations: 293			
Long-Run Equation				Long Run Equation			
LIA	0.19895	0.00382	0.0000	IUI	0.22273	0.00404	0.0000
Short-Run Equation				Short Run Equation			
Cointegr.	−0.19678	0.07916	0.0135	Cointegr.	−0.45924	0.07239	0.0000
d(LIA)	0.18122	0.09130	0.0482	d(IUI)	−0.08151	0.12005	0.4978
				trend	0.24112	0.07871	0.0024
Exogenous variable: EFR Sample: 2011–2023 Included observations: 295				Symbols: ECOM—Enterprises with E-commerce sales TEA—Tertiary education IPIU—Percentage of individuals who used a portable computer or a handheld device to access the internet IWUI—Percentage of individuals who used the internet daily. LIA—Level of internet access: percentage of households GDPc—Gross domestic product per capita IUI—Internet use by individuals EFR—Economic Freedom Rankings			
Long-Run Equation							
EFR	1.90530	0.07150	0.0000				
Short-Run Equation							
Cointegr.	−0.33850	0.05979	0.0000				
d(EFR)	−0.28077	1.93059	0.8845				
trend	0.30440	0.06433	0.0000				

Source: Econometric models estimated in EViews. Method: ARDL. Model selection method: Akaike info criterion (AIC). Selected models: ARDL(1,1).

5. Discussions

The seven models identify the existence of stable, positive, long-term cointegration relationships between *percentage of enterprises with e-commerce sales* (ECOM) and the explanatory variables selected in the analysis. Except for the relationship between ECOM and IPIU (significant at 0.10 level), the other six cointegration relationships are statistically significant at the 0.0001 level. All the relationships are stable (cointegration coefficients are negative, sub-unitary and significantly different from zero). Generally, the occurrence of a shock in the error variable (of the size equal to one standard deviation) is absorbed within two (for the IPIU, GDPc and IUI equations), up to five periods (for the LIA equation).

Consistent with the results of Granger (Toda–Yamamoto version) causality tests (see Table 2), the ARDL model identifies, in addition to a long-term relationship (cointegration), a significant short-term relationship between *Enterprises with E-commerce sales* (ECOM) and *level of internet access: percentage of households* (LIA). The error correction form of the model is the following:

$$d(ECOM_t) = \underbrace{-0.196778}_{\substack{cointergration \\ coefficient}} \times \underbrace{[0.198945 \times LIA_t]}_{long\ run\ relationship} + \underbrace{[0.181223 \times d(LIA_t)]}_{short\ term\ equation} \quad (1)$$

(the short-term coefficient is significant at 0.05 level; other parameters are significant at the 0.01 level). The output of the model suggests that the *level of internet access* (LIA) had a positive impact on ECOM—*percentage of enterprises with e-commerce sales (10 persons employed or more)*, both as a short-term dynamic and as a long-run stable relationship. The system absorbs a shock of one standard deviation in about five periods.

The Granger (Toda–Yamamoto version) causality test (Table 2) also identifies a similar causal relationship between *Enterprises with E-commerce sales* (ECOM) and *percentage of individuals who used the internet daily* (IWUI), in the VAR model with lag = 2. The ARDL model (Table 4) does not identify such a relationship—the short-term impact coefficient is not significant (the probability associated with the null hypothesis in the t-statistic test is 0.6739, much higher than the standard level of 0.05). But, by building an ARDL(1,1) model with the IWUI series lagged by one period (i.e., $IWUI_{t-1}$), a short-term relationship between the respective variables can be identified (in addition to the long-term relationship—cointegration). The ARDL model is the following:

$$\begin{aligned} d(ECOM_t) = & \underbrace{-0.772396}_{\substack{cointergration \\ coefficient}} \cdot \underbrace{[0.180074 \cdot IWIU_{t-1}]}_{long\ run\ relationship} + \\ & + \underbrace{[0.063165 \cdot d(IWUI_{t-1}) + 3.702659 + 0.273839 \cdot trend]}_{short\ term\ equation} \end{aligned} \quad (2)$$

In the ARDL equation, the short-term impact coefficient, $d(IWUI_{t-1})$, is significant at the 0.10 level and all other parameters are significant at the 0.0001 level.

The output of the model suggests that the *percentage of individuals who used the internet daily* from the previous period ($IWUI_{t-1}$) had a positive impact on *percentage of enterprises with e-commerce sales (10 persons employed or more)*, both as a short-term dynamic and as a long-term stable relationship.

The model also includes a trend variable with a positive impact, our results being consistent with other findings in the e-commerce literature [55]. The system absorbs a shock of one standard deviation in less than two periods ($1/0.77 \approx 1.3$).

Similarly, consistent with Granger (Toda–Yamamoto version) causality tests, the ARDL models do not identify an econometrically significant short-run dynamics relationship for the links between *Enterprises with E-commerce sales* (ECOM) and the other variables (for

TEA, IPIU, GDPc, IUI and EFR, the coefficients in the short-run regression equations are not significant at the standard level). The cointegration relationships are the following:

- For the long-run relationship between the ECOM—*Percentage of enterprises with e-commerce sales (10 persons employed or more)* and TEA—*The share of the population aged 25–34 who have successfully completed tertiary studies* (ISCED 2011, levels 5–8), population from 25 to 34 years:

$$\text{ECOMt} = 0.19262 \cdot \text{TEA coefficient of cointegration} = -0.25218$$

The variable TEA had a positive impact on ECOM, with similar results being identified in other research papers [94–96]. Similar findings illustrate a positive and significant impact of education level on the development of e-commerce [97]. A shock was absorbed in four periods. In the short-term equation, only the intercept is significant.

- For the long-run relationship between the ECOM—*percentage of enterprises with e-commerce sales (10 persons employed or more)* and IPIU—*percentage of individuals who used a portable computer or a handheld device to access the internet away from home or work*:

$$\text{ECOMt} = 0.36975 \cdot \text{IPIU coefficient of cointegration} = -0.47159$$

The variable IPIU had a positive impact on ECOM, supporting other research findings [98–100], a shock was absorbed in about two periods. In the short-term equation, only the intercept is significant.

- For the long-run relationship between the ECOM—*percentage of enterprises with e-commerce sales (10 persons employed or more)* and GDPc—*gross domestic product, volume indices of real expenditure per capita* (PPS_EU27_2020 = 100):

$$\text{ECOMt} = 0.14439 \cdot \text{GDPc coefficient of cointegration} = -0.48855$$

The variable GDPc had a positive impact on ECOM, consistent with other research results [57–60], a shock was absorbed in about two periods. In the short-term equation, only the intercept is significant.

- For the long-run relationship between the ECOM—*percentage of enterprises with e-commerce sales (10 persons employed or more)* and IUI—*internet use by individuals (percentage of individuals who have ever used the internet)*:

$$\text{ECOMt} = 0.22273 \cdot \text{IUI coefficient of cointegration} = -0.45924$$

The variable IUI had a positive impact on ECOM, digital skills being long-run determinant force in fostering e-commerce development [101]. A shock was absorbed in about two periods. In the short-term equation, only the (positive) trend is significant.

- For the long-run relationship between the ECOM—*percentage of enterprises with e-commerce sales (10 persons employed or more)* and EFR—*Economic Freedom Rankings, overall score (out of 10)*:

$$\text{ECOMt} = 1.90530 \cdot \text{EFR coefficient of cointegration} = -0.33850$$

The variable EFR had a positive impact on ECOM in accordance with the cited literature findings [77,78], a shock was absorbed in about three periods. In the short-term equation, only the (positive) trend is significant.

In summary, all seven starting hypotheses are verified, as illustrated in Table 5:

Table 5. Validation of the hypotheses.

Hypothesis	Short-Term Relation	Long-Term Relation	Coefficient of Cointegration	Probability
H1: TEA positively influences ECON	Not significant	ECOMt = 0.19262·TEA	−0.25218	0.0009
H2.1: IPIU positively influences ECON	Not significant	ECOMt = 0.36975·IPIU	−0.47159	0.1000

Table 5. *Cont.*

Hypothesis	Short-Term Relation	Long-Term Relation	Coefficient of Cointegration	Probability
H2.2: LIA positively influences ECON	0.181223 × d(LIA)	ECOMt = 0.198945·LIA	−0.196778	0.0001
H3.1: IWUI positively influences ECON	0.063165 × d(IWUI) + 3.70 + 0.273839 × trend	ECOMt = 0.180074·IWUI	−0772396	0.0001
H3.2: IUI positively influences ECON	Not significant	ECOMt = 0.22273·IUI	−0.45924	0.0001
H4: GDPc positively influences ECON	Not significant	ECOMt = 0.14439·GDPc	−0.48855	0.0001
H5: EFR positively influences ECON	Not significant	ECOMt = 1.90530·EFR	−0.33850	0.0001

Source: data estimated in EViews.

The variables in the analyzed system are expressed in different measurement units and have different volatilities (variances).

Given these circumstances, the estimators cannot be compared directly. Instead, we adopted a different approach that is recommended in such cases. It is worth noting that we did not find this approach in other similar papers. In (Table 6) we calculated the coefficients standardized by the ratio between the standard deviations of the endogenous and the exogenous variable, for each model (the extent to which the variability of the dependent variable is associated with the variability of the regressor, both variabilities are evaluated in terms of standard units).

Table 6. Standardized coefficients for the long-run relationships.

Variable	Coefficient	Standardized Coefficient	Elasticity at Means
TEA	0.192624	0.236494	0.393723
IPIU	0.369753	1.016403	1.130767
IWUI	0.205641	0.411326	0.725394
GDPC	0.144390	0.828002	0.739876
LIA	0.198945	0.265359	0.822629
IUI	0.222725	0.283840	0.931964
EFR	1.905299	0.084265	0.774517

Source: data estimated in EViews using ARDL(1,1) models.

Also, Table 6 shows the coefficients scaled as elasticity at means (scaling is achieved by the ratio between the mean of the endogenous variable and the mean of the regressor).

If the exogenous variable values change by one standard deviation, then the ranking of impacts, in terms of standard deviations of the ECOM variable (*percentage of enterprises with e-commerce sales*), goes from 1.02 for IPIU (*percentage of individuals who used a portable computer or a handheld device to access the internet away from home or work*) and 0.83 for GDPc (*gross domestic product, volume indices of real expenditure per capita*), to only 0.08 for EFR (*Economic Freedom Rankings*).

Given that the inertia (difficulty to register a substantial change) is different for various economic and social processes, we must consider the fact that a change with one standard deviation of GDPc, TEA, or EFR is harder to achieve than a change with one standard deviation in IPIU, IWUI, or IUI.

Starting from such findings, we calculated the percentage change (relative to its mean) of the ECOM variable, when the explanatory variables change by a percentage (the same, relative to their mean). This approach represents another innovative contribution to e-commerce research regarding the time responsiveness of e-commerce dynamics to changes in various influencing factors. All elasticities are positive. The dynamics of the ECOM variable (*percentage of enterprises with e-commerce sales*) is elastic with respect to IPIU (*percentage of individuals who used a portable computer or a handheld device to access the internet away from home or work*), and inelastic with respect to all the other analyzed variables. The

smallest impact is the one induced by TEA (+0.39), a value located at half of the elasticities at means recorded for the other factors.

For the robustness of the analysis, we verified the existence of cointegrating relationships between *Enterprises with E-commerce sales* (ECOM) and the variables under analysis by constructing the corresponding equations solved by the Panel Fully Modified Least Squares (FMOLS) [102] and Panel Dynamic Least Squares (DOLS) methods [103]. The results confirm the conclusions deduced from the analysis of the estimates in Table 4 (in terms of the dimension and significance—sign of the estimators).

Limitations

While this study provides valuable insights into the e-commerce trends in the European Union and the factors influencing its growth, several limitations should be acknowledged. All tests conducted in this study are subject to the relatively small size of the time series data. The limited periods available for some factors may constrain the robustness of the findings and the ability to draw definitive conclusions about short- and long-term trends in e-commerce growth. Moreover, the models utilized in this study excluded other potentially relevant variables, such as The Digital Economy and Society Index (DESI), due to lack of data since it has been recently developed by European Commission. Finally, another limitation that we are aware of is that the sample used in our study includes only EU member states, which are subject to European digital policy. Consequently, the national policies governing e-commerce within these countries may be shaped by broader European policies and regulations. This may limit the applicability of the findings to other regions or countries outside the European Union that might have some specific particularities at the national level. Acknowledging these limitations is essential for interpreting the results of this study accurately and understanding the implications. Future research in this field could address these limitations by employing larger time series data, incorporating additional relevant variables, and exploring the exhaustive impact of e-commerce policies at the national level. The limitations presented above shall be seen as opportunities for further research developments. For instance, in the future, research could incorporate DESI to identify determinants and e-commerce trends and growth within the EU. Also, longitudinal analysis of e-commerce growth trends over a larger time series data might be considered to identify the long-term patterns and additional relevant determinants of e-commerce growth in EU. Another research area could focus on a comparative analysis of e-commerce trends and policies in the European Union versus non-EU countries. Further research could explore the differences in e-commerce growth factors and policies between EU member states and countries outside the EU to understand the impact of national and regional regulations on e-commerce development.

6. Conclusions

The findings of our research offer valuable insights into the e-commerce trends in the European Union, highlighting *the intensity effect* of education, internet infrastructure autonomy and usage, income, and economic freedom on e-commerce growth. Additionally, by identifying the periods needed in absorbing the shocks, we provide useful insights about the *time responsiveness of e-commerce growth* to changes in these factors.

We have identified a stable, positive, long-term relationship between ECOM and all the explanatory variables considered. Furthermore, the occurrence of a shock in the error variable is absorbed within a relatively short period, ranging from two to five periods across different equations.

The ARDL model revealed both long-term stable relationships and significant short-term dynamics between ECOM and certain explanatory variables. Specifically, the level of internet access (LIA) demonstrated a positive impact on e-commerce sales, both in the short-term and long-term. Similarly, the percentage of individuals who used the internet daily (IWUIt-1) exhibited a positive influence on e-commerce sales, with the system absorbing shocks within less than two periods (in our model, 1, 3 years).

Additionally, the Granger causality tests indicated significant positive impacts of variables such as TEA, IPIU, GDPC, IUI, and EFR on e-commerce sales. While these variables did not show significant short-term dynamics in the ARDL models, they nonetheless contributed positively to e-commerce growth over the long term.

By addressing the implications of these results, policymakers, businesses, and stakeholders can formulate targeted strategies to harness the full potential of e-commerce for driving economic development, innovation, and digital inclusion across the EU member states [104].

Therefore, to reach the EU-level targets set out in the Digital Decade, our findings provide the necessary empirical support for EU policymakers in designing short-run targeted strategies to foster sustainable development:

(a) Prioritizing significant resources for investment in ICT infrastructure, especially in emerging economies to facilitate the technological catching-up process;
(b) Creating EU-funded programs and dedicated courses aimed to improve digital skills of vulnerable groups;
(c) Allocating funding and technical support for the expansion of internet infrastructure in rural and underdeveloped areas to bridge the digital divide and ensure equal access to e-commerce opportunities;
(d) Implementing regulations, commercial practices, and standards to protect consumers and businesses in the e-commerce sector, including measures to combat fraud, protect personal data, and ensure fair competition;
(e) Collaborating with national stakeholders to develop targeted strategies and initiatives aimed at maximizing the economic benefits of e-commerce for all EU member states, fostering innovation, and promoting digital inclusion.

In the long run, our findings illustrate the social benefits of redesigning the European institutional model in accordance with free-market principles [105]. By enhancing the level of economic freedom in the European market and by promoting inclusive economic growth [106], the EU can create a favorable environment for sustainable development and technological progress [107]. Specifically, there are a few economic policy directions that should be considered:

(a) Implementing policies to promote low and stable inflation rates: The EU should focus on implementing sound monetary policies that create a conducive and predictable business environment, especially under the circumstances of high levels of public deficit and external debt in many EU countries.
(b) Lower marginal tax rates: The EU should consider implementing tax policies that aim to reduce the tax burden on disadvantaged groups such as low-income earners and small businesses. Lowering marginal tax rates for these groups can help promote economic inclusivity and stimulate entrepreneurship and innovation.
(c) Increase digitalization of public services: The EU should prioritize efforts to increase the digitalization of public services to enhance efficiency, accessibility, and transparency. By investing in digital infrastructure and technology, the EU can improve the delivery of public services, streamline administrative processes, and create new opportunities for innovation and growth in the digital economy.

At the macroeconomic policy level, all member states should intensify their efforts in the field of research by allocating greater financial resources to achieve the EU target of investing 3% of EU GDP in R&D [108]. It is research and development (R&D) that contributes to gross domestic product (GDP) growth and, in turn, to e-commerce growth. This is a two-way relationship, as demonstrated by the studies cited in this paper.

The EU should focus on promoting digital inclusion and accessibility in the EU through various targeted initiatives for disadvantaged groups, such as the elderly and people with disabilities. These efforts in funding research and innovation projects to develop technologies and solutions that improve digital access and usability for all citizens, ensure equal opportunities in the European digital landscape.

To ensure equal and non-discriminatory access, AI can effectively translate content into native languages through natural language processing. Consequently, the innovations discovered should be shared with EU researchers by uploading them to the European cloud for open science, facilitating synergies with other researchers and enhancing global competitiveness.

A legal framework should be enacted to offer financial support to those companies, aimed at developing specific applications for people with disabilities or vulnerable individuals, so that they can also engage in e-commerce.

To foster e-commerce within the EU, the European Commission should prioritize the allocation of grants through the European Social Fund (ESF), to support projects that enhance digital skills and literacy among disadvantaged groups, such as the unemployed, migrants, and people with disabilities. Through training and education programs, the ESF can empower these groups to engage in the digital economy, including e-commerce.

Overall, these policies can help the EU achieve its goals of promoting economic freedom, inclusive growth, and technological advancement in the long run. In particular, by considering these policy directions, the EU can position itself as a global leader in sustainable development and capitalize on the transformative opportunities offered by e-commerce.

Author Contributions: Conceptualization, N.M.J., G.I.S., L.C.M. and D.A.B.; methodology, N.M.J.; software, N.M.J.; validation, N.M.J., G.I.S., L.C.M. and D.A.B.; formal analysis, L.C.M.; investigation, G.I.S.; resources, N.M.J., G.I.S. and L.C.M.; data curation, N.M.J.; writing—original draft preparation, N.M.J., G.I.S. and L.C.M.; writing—review and editing, N.M.J., G.I.S. and L.C.M.; visualization, N.M.J., G.I.S., L.C.M. and D.A.B.; supervision, D.A.B.; project administration, G.I.S. and L.C.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The raw data are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Cui, M.; Pan, S.L. Developing Focal Capabilities for E-commerce Adoption: A Resource Orchestration Perspective. *Inf. Manag.* **2015**, *52*, 200–209. [CrossRef]
2. Santos-Jaén, J.M.; Gimeno-Arias, F.; León-Gómez, A.; Palacios-Manzano, M. The Business Digitalization Process in SMEs from the Implementation of e-Commerce: An Empirical Analysis. *J. Theor. Appl. Electron. Commer. Res.* **2023**, *18*, 1700–1720. [CrossRef]
3. Rupeika-Apoga, R.; Petrovska, K.; Bule, L. The Effect of Digital Orientation and Digital Capability on Digital Transformation of SMEs during the COVID-19 Pandemic. *J. Theor. Appl. Electron. Commer. Res.* **2022**, *17*, 669–685. [CrossRef]
4. Ziółkowska, M.J. Digital Transformation and Marketing Activities in Small and Medium-Sized Enterprises. *Sustainability* **2021**, *13*, 2512. [CrossRef]
5. OECD. *Unpacking E-Commerce: Business Models, Trends and Policies*; OECD Publishing: Paris, France, 2019. [CrossRef]
6. Grandon, E.E.; Pearson, J.M. Electronic commerce adoption: An empirical study of small and medium US businesses. *Inf. Manag.* **2004**, *42*, 197–216. [CrossRef]
7. Jehangir, M.; Dominic, P.; Naseebullah, N.; Khan, A. Towards digital economy: The development of ICT and e-commerce in Malaysia. *Mod. Appl. Sci.* **2011**, *5*, 71–78. [CrossRef]
8. Pool, P.W.; Parnell, J.A.; Spillan, J.E.; Carraher, S.; Lester, D.L. Are SMEs meeting the challenge of integrating e-commerce into their businesses? A review of the development, challenges and opportunities. *Int. J. Inf. Technol. Manag.* **2006**, *5*, 97–113. [CrossRef]
9. UN. *E-Commerce and Development Report*; UN: New York, NY, USA, 2003; ISBN 9211126029. ISSN 9211126029.
10. Ho, S.C.; Kauffman, R.J.; Liang, T.P. A growth theory perspective on B2C e-commerce growth in Europe: An exploratory study. *Electron. Commer. Res. Appl.* **2007**, *6*, 237–259. [CrossRef]
11. Baliamoune-Lutz, M. An analysis of the determinants and effects of ICT diffusion in developing countries. *Inf. Technol. Dev.* **2003**, *10*, 151–169. [CrossRef]
12. Lone, S.; Weltevreden, J.W.J. *European E-Commerce Report 2022*; Amsterdam University of Applied Sciences & Ecommerce Europe: Amsterdam, The Netherlands; Brussels, Belgium, 2022.

13. Ahmed, J.U.; Hasan, H. Barriers to E-Commerce Adoption in Syria: An Empirical Detection. *World J. Bus. Manag.* **2016**, *2*, 41. [CrossRef]
14. Kutlu, B.; Özturan, M. The Usage and adoption of IT among SMEs in Turkey: An exploratory and longitudinal study. *J. Inf. Technol. Manag.* **2008**, *19*, 12–24.
15. Quayle, M. E-commerce: The challenge for UK SMEs in the twenty-first century. *Int. J. Oper. Prod. Manag.* **2002**, *22*, 1148–1161. [CrossRef]
16. Samadi, B.; Gharleghi, B.; Syrymbetova, M. An Analysis of Consumers' Trust, Logistic Infrastructure and Brand Awareness towards E-Commerce Implementation in Kazakhstan. *Int. J. Bus. Manag.* **2015**, *10*, 96. [CrossRef]
17. Wong, P.K. Global and national factors affecting e-commerce diffusion in Singapore. *Inf. Soc.* **2003**, *19*, 19–32. [CrossRef]
18. Blythe, S.E. Armenia's Electronic Document and Electronic Signature Law: Promotion of Growth in E-Commerce via Greater Cyber-Security. *Armen. Law Rev.* 2008. Available online: https://law.aua.am/files/2012/03/esignaturelaw.pdf (accessed on 2 February 2024).
19. Fianyi, I.D. Curbing cyber-crime and Enhancing e-commerce security with Digital Forensics. *Int. J. Comput. Sci. Issues (IJCSI)* **2015**, *12*, 78.
20. Kyobe, M. The impact of entrepreneur behaviours on the quality of e-commerce security: A comparison of urban and rural findings. *J. Glob. Inf. Technol. Manag.* **2008**, *11*, 58–79. [CrossRef]
21. Litondo, K.O.; Ntale, F. Determinants of mobile phone usage for e-commerce among micro and small enterprises in the informal sector of Kenya. *Int. J. Appl. Sci. Technol.* **2013**, *3*, 16–21.
22. Toraskar, K.V.; Lee, P.C.B. A contextualist approach to the development of e-commerce education: An analysis of key issues and challenges. *J. Inf. Technol. Manag.* **2006**, *17*, 1.
23. European Commision. Report on the State of the Digital Decade. 2023. Available online: https://digital-strategy.ec.europa.eu/en/library/2023-report-state-digital-decade (accessed on 10 January 2024).
24. Manlove, J.; Whitacre, B. Understanding the trend to mobile-only internet connections: A decomposition analysis. *Telecommun. Policy* **2019**, *43*, 76–87. [CrossRef]
25. Järveläinen, J. Online Purchase Intentions: An Empirical Testing of a Multiple-Theory Model. *J. Organ. Comput. Electron. Commer.* **2007**, *17*, 53–74. [CrossRef]
26. Mübin, K. Internet Shopping Behavior of College of Education Students. *Turk. Online J. Educ. Technol.* **2012**, *11*, 202–214.
27. MacGregor, R.; Vrazalic, L. The Role of Education in E-Commerce Adoption: Does the CEO's Level of Education Affect E-Commerce Adoption? In *E-Commerce in Regional Small to Medium Enterprises*; IGI Global: Hershey, PA, USA, 2007; pp. 291–327. [CrossRef]
28. Bowles, M. *Digital Literacy and E-Skills: Participation in the Digital Economy*; December 2012 ed.; DIISRTE & Innovation and Business Skills Australia: Cremorne, VIC, Australia, 2012.
29. Barker, N.; Harris, L. A Survey of Digital Literacy in General Education Degree Requirements at Southern Utah University Peer Institutions. In Proceedings of the 2017 International Conference on Computational Science and Computational Intelligence (CSCI), Las Vegas, NV, USA, 14–16 December 2017; pp. 1172–1175. [CrossRef]
30. Singh, C.; Dash, M.K.; Sahu, R.; Kumar, A. Investigating the acceptance intentions of online shopping assistants in E-commerce interactions: Mediating role of trust and effects of consumer demographics. *Heliyon* **2024**, *10*, e25031. [CrossRef] [PubMed]
31. Cruz-Jesus, F.; Vicente, M.R.; Bacao, F.; Oliveira, T. The education-related digital divide: An analysis for the EU-28. *Comput. Hum. Behavior.* **2016**, *56*, 72–82. [CrossRef]
32. Sánchez-Torres, J.A. Moderating effect of the digital divide of e-commerce. *Int. J. Soc. Econ.* **2019**, *46*, 1387–1400. [CrossRef]
33. Zhu, R.; Srivastava, A.; Sutanto, J. Privacy-deprived e-commerce: The efficacy of consumer privacy policies on China's e-commerce websites from a legal perspective. *Inf. Technol. People* **2020**, *33*, 1601–1626. [CrossRef]
34. Rizal, S.; Alnoor, F.; Laily, K. Education on the Legal Aspects of Consumer Protection in Buying and Selling Transactions in the Electronic-based Millennial 5.0 Era (E-Commerce). *IJECA Int. J. Educ. Curric. Appl.* **2022**, *5*, 196. [CrossRef]
35. Wibowo, A.; Narmaditya, B.S.; Suparno; Sebayang, K.D.A.; Mukhtar, S.; Shafiai, M.H.M. How does digital entrepreneurship education promote entrepreneurial intention? The role of social media and entrepreneurial intuition. *Soc. Sci. Humanit. Open* **2023**, *8*, 100681. [CrossRef]
36. Mollick, J.; Cutshall, R.; Changchit, C.; Pham, L. Contemporary Mobile Commerce: Determinants of Its Adoption. *J. Theor. Appl. Electron. Commer. Res.* **2023**, *18*, 501–523. [CrossRef]
37. Japutra, A.; Molinillo, S.; Utami, A.F.; Ekaputra, I.A. Exploring the effect of relative advantage and challenge on customer engagement behavior with mobile commerce applications. *Telemat. Inform.* **2022**, *72*, 101841. [CrossRef]
38. Utami, A.F.; Ekaputra, I.A.; Japutra, A.; Van Doorn, S. The role of interactivity on customer engagement in mobile e-commerce applications. *Int. J. Mark. Res.* **2022**, *64*, 269–291. [CrossRef]
39. Chaffey, D.; Ellis-Chadwick, F.; Mayer, R.; Johnston, K. *Digital Marketing: Strategy, Implementation, and Practice*; Pearson: London, UK, 2019.
40. Gulfraz, M.B.; Sufyan, M.; Mustak, M.; Salminen, J.; Srivastava, D.K. Understanding the impact of online customers' shopping experience on online impulsive buying: A study on two leading E-commerce platforms. *J. Retail. Consum. Serv.* **2022**, *68*, 103000. [CrossRef]

41. Middleton, C.; Veenhof, B. *Intensity of Internet Use in Canada: Understanding Different Types of Users*; Working Papers; Statistics Canada—Business Special Surveys and Technology Statistics Division: Ottawa, ON, Canada, 2010.
42. Bruce, E.; Shurong, Z.; Ying, D.; Yaqi, M.; Amoah, J.; Egala, S.B. The Effect of Digital Marketing Adoption on SMEs Sustainable Growth: Empirical Evidence from Ghana. *Sustainability* **2023**, *15*, 4760. [CrossRef]
43. Daoud, M.K.; Al-Qeed, M.; Ahmad AY, B.; Al-Gasawneh, J.A. Mobile marketing: Exploring the efficacy of user-centric strategies for enhanced consumer engagement and conversion rates. *Int. J. Membr. Sci. Technol.* **2023**, *10*, 1252–1262. [CrossRef]
44. Gefen, D. Customer loyalty in e-commerce. *J. Assoc. Inf. Syst.* **2002**, *3*, 2. [CrossRef]
45. Bălăcescu, A.; Pătrașcu, A.; Tănăsescu, A. Analysis of Disparities in Internet Purchases by Individuals at the EU State Level. *Electronics* **2023**, *12*, 982. [CrossRef]
46. Al-Ani, M.S. Next Generation Digital Commerce Technologies. *Int. J. Interact. Mob. Technol. (iJIM)* **2009**, *3*, 58–62. [CrossRef]
47. Yim, M.Y.C.; Chu, S.C.; Sauer, P.L. Is augmented reality technology an effective tool for e-commerce? An interactivity and vividness perspective. *J. Interact. Mark.* **2017**, *39*, 89–103. [CrossRef]
48. Molinillo, S.; Anaya-Sánchez, R.; Liébana-Cabanillas, F. Analyzing the effect of social support and community factors on customer engagement and its impact on loyalty behaviors toward social commerce websites. *Comput. Hum. Behav.* **2020**, *108*, 105980. [CrossRef]
49. Zheng, X.; Cheung, C.M.K.; Lee, M.K.O.; Liang, L. Building brand loyalty through user engagement in online brand communities in social networking sites. *Inf. Technol. People* **2015**, *28*, 90–106. [CrossRef]
50. Rather, R.A.; Hollebeek, L.D.; Islam, J.U. Tourism-based customer engagement: The construct, antecedents, and consequences. *Serv. Ind. J.* **2019**, *39*, 519–540. [CrossRef]
51. Thakur, R. Customer engagement and online reviews. *J. Retail. Consum. Serv.* **2018**, *41*, 48–59. [CrossRef]
52. Makki, E.; Chang, L.C. Understanding the effects of social media and mobile usage on e-commerce: An exploratory study in Saudi Arabia. *Int. Manag. Rev.* **2015**, *11*, 98–109.
53. Chiu, W.; Cho, H. E-commerce brand: The effect of perceived brand leadership on consumers' satisfaction and repurchase intention on e-commerce websites. *Asia Pac. J. Mark. Logist.* **2021**, *33*, 1339–1362. [CrossRef]
54. Liebermann, Y.; Stashevsky, S. Perceived risks as barriers to Internet and e-commerce usage. *Qual. Mark. Res. Int. J.* **2002**, *5*, 291–300. [CrossRef]
55. Bigné, E.; Ruiz, C.; Sanz, S. Key Drivers of Mobile Commerce Adoption. An Exploratory Study of Spanish Mobile Users. *J. Theor. Appl. Electron. Commer. Res.* **2007**, *2*, 48–60. [CrossRef]
56. Hazarika, A.; Rahmati, M. Towards an Evolved Immersive Experience: Exploring 5G- and Beyond-Enabled Ultra-Low-Latency Communications for Augmented and Virtual Reality. *Sensors* **2023**, *23*, 3682. [CrossRef]
57. Couture, V.; Faber, B.; Gu, Y.; Liu, L. *E-Commerce Integration and Economic Development: Evidence from China. NBER Working Paper No. 24384*; National Bureau of Economic Research: Cambridge, MA, USA, 2018.
58. Karpunina, E.K.; Isaeva, E.A.; Galieva, G.F.; Sobolevskaya, T.G.; Rodin, A.Y. E-Commerce as a Driver of Economic Growth in Russia. In *Modern Global Economic System: Evolutional Development vs. Revolutionary Leap. ISC 2019*; Popkova, E.G., Sergi, B.S., Eds.; Lecture Notes in Networks and Systems; Springer: Cham, Switzerland, 2021; Volume 198. [CrossRef]
59. Parishev, A.; Hristovski, G.; Jolakoski, P.; Stojkoski, V. *E-Commerce Impact on Economic Growth*; Faculty of Economics—Skopje, Ss Cyril and Methodius University: Skopje, North Macedonia, 2020. [CrossRef]
60. Pantelimon, F.V.; Georgescu, T.M.; Posedaru, B.Ş. The impact of mobile e-commerce on GDP: A comparative analysis between Romania and Germany and how COVID-19 influences the e-commerce activity worldwide. *Inform. Economica.* **2020**, *24*, 27–41. [CrossRef]
61. Yang, L.; Liu, J.; Yang, W. Impacts of the Sustainable Development of Cross-Border E-Commerce Pilot Zones on Regional Economic Growth. *Sustainability* **2023**, *15*, 13876. [CrossRef]
62. Criveanu, M.M. Investigating Digital Intensity and E-Commerce as Drivers for Sustainability and Economic Growth in the EU Countries. *Electronics* **2023**, *12*, 2318. [CrossRef]
63. Agudo-Peregrina, A.; Hernández-García, Á.; Acquila-Natale, E. *The Effect of Income Level on E-Commerce Adoption: A Multigroup Analysis*; Western Illinois University: Macomb, IL, USA, 2016. [CrossRef]
64. Luo, X.; Niu, C. *E-Commerce Participation and Household Income Growth in Taobao Villages*; The World Bank Policy Research Working Paper Series 8811; World Bank Group: New York, NY, USA, 2019.
65. Walczak, K.; Cellary, W. Challenges for higher education in the era of widespread access to Generative AI. *Econ. Bus. Rev.* **2023**, *9*, 71–100. [CrossRef]
66. Chen, H.; Zhang, L. GDP Per Capita and E-commerce Spending: Evidence from Cross-country Analysis. *Int. J. Electron. Commer.* **2021**, *25*, 591–607.
67. Yin, Z.H.; Choi, C.H. Does digitalization contribute to lesser income inequality? Evidence from G20 countries. *Inf. Technol. Dev.* **2023**, *29*, 61–82. [CrossRef]
68. Fanea-Ivanovici, M.; Muşetescu, R.-C.; Pană, M.-C.; Voicu, C. Fighting Corruption and Enhancing Tax Compliance through Digitization: Achieving Sustainable Development in Romania. *Sustainability* **2019**, *11*, 1480. [CrossRef]
69. Alderete, M.V. Explaining e-commerce adoption at country level. *Int. J. Technol. Learn. Innov. Dev.* **2021**, *13*, 318–340. [CrossRef]
70. Volkova, N.; Kuzmuk, I.; Oliinyk, N.; Klymenko, I.; Dankanych, A. Development trends of the digital economy: E-business, e-commerce. *IJCSNS Int. J. Comput. Sci. Netw. Secur.* **2021**, *21*, 186–198.

71. Owens, T.R.; Sarov, M.G. Determinants of consumer attitudes towards e-commerce. *Issues Political Econ.* **2010**, *19*, 19–50.
72. Szalonka, K.; Sadowa, A.; Wicka, A.; Wicki, L. E-commerce Purchasing Behaviour and the Level of Consumers' Income in Poland and Great Britain. *Eur. Res. Stud. J.* **2020**, *23*, 552–568. [CrossRef]
73. Xun, Z.; Guanghua, W.; Jiajia, Z.; Zongyue, H. Digital economy, financial inclusion and inclusive growth. *China Econ.* **2020**, *15*, 92–105.
74. Alhassan, M.D.; Adam, I.O. The effects of digital inclusion and ICT access on the quality of life: A global perspective. *Technol. Soc.* **2021**, *64*, 101511. [CrossRef]
75. Stevenson, S. Digital Divide: A Discursive Move Away from the Real Inequities. *Inf. Soc.* **2009**, *25*, 1–22. [CrossRef]
76. Gwartney, J.; Lawson, R.; Hall, J.; Murphy, R. *Economic Freedom of the World: 2022 Annual Report*; Fraser Institute: Vancouver, BC, Canada, 2022.
77. Chatterjee, D.; Grewal, R.; Sambamurthy, V. Shaping up for E-Commerce: Institutional Enablers of the Organizational Assimilation of Web Technologies. *MIS Q.* **2002**, *26*, 65–89. [CrossRef]
78. Darley, W.K. Public policy challenges and implications of the Internet and the emerging e-commerce for sub-Saharan Africa: A business perspective. *Inf. Technol. Dev.* **2003**, *10*, 1–12. [CrossRef]
79. Renz, A.; Hilbig, R. Digital Transformation of Educational Institutions Accelerated by COVID-19: A Digital Dynamic Capabilities Approach. In *Beyond the Pandemic? Exploring the Impact of COVID-19 on Telecommunications and the Internet*; Whalley, J., Stocker, V., Lehr, W., Eds.; Emerald Publishing Limited: Leeds, UK, 2023; pp. 103–119. [CrossRef]
80. Yin, Z.H.; Choi, C.H. Does e-commerce narrow the urban–rural income gap? Evidence from Chinese provinces. *Internet Res.* **2022**, *32*, 1427–1452. [CrossRef]
81. Lund, M.J.F.; McGuire, S. Institutions and Development: Electronic Commerce and Economic Growth. *Organ. Stud.* **2005**, *26*, 1743–1763. [CrossRef]
82. Díaz-Casero, J.; Díaz-Aunión, D.; Sánchez-Escobedo, M.; Coduras, A.; Hernández-Mogollon, R. Economic freedom and entrepreneurial activity. *Manag. Decis.* **2012**, *50*, 1686–1711. [CrossRef]
83. Lubacha, J.; Mäihäniemi, B.; Wisła, R. (Eds.) *The European Digital Economy. Drivers of Digital Transition and Economic Recovery*; Routledge Open Business and Economics, Routledge: London, UK, 2024.
84. Oxley, J.; Yeung, B. E-Commerce Readiness: Institutional Environment and International Competitiveness. *J. Int. Bus. Stud.* **2001**, *32*, 705–723. [CrossRef]
85. Tag, M.N.; Degirmen, S. Economic Freedom and Foreign Direct Investment: Are They Related? *Econ. Anal. Policy* **2022**, *73*, 737–752. [CrossRef]
86. Levin, A.; Lin, C.-F.; Chu, C.-S.J. Unit root tests in panel data: Asymptotic and finite-sample properties. *J. Econom.* **2002**, *108*, 1–24. [CrossRef]
87. Breitung, J. The Local Power of Some Unit Root Tests for Panel Data. In *Advances in Econometrics*; JAI Press: Amsterdam, The Netherlands, 2000; pp. 161–178.
88. Im, K.S.; Pesaran, H.M.; Shin, Y. Testing for unit roots in heterogeneous panels. *J. Econom.* **2003**, *115*, 53–74. [CrossRef]
89. Maddala, G.S.; Wu, S. A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxf. Bull. Econ. Stat.* **2002**, *61*, 631–652. [CrossRef]
90. Hadri, K. Testing for Stationarity in Heterogeneous Panel Data. *Econom. J.* **2000**, *3*, 148–161. [CrossRef]
91. Toda, H.Y.; Yamamoto, T. Statistical inference in vector autoregressions with possibly integrated processes. *J. Econom.* **1995**, *66*, 225–250. [CrossRef]
92. Jula, D.; Jula, N.-M. *Econometria Seriilor de Timp (Time Series Econometrics)*; Mustang: Bucharest, Romania, 2019.
93. Pesaran, H.M.; Shin, Y.; Smith, R.P. Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *J. Am. Stat. Assoc.* **1999**, *94*, 621–634. [CrossRef]
94. Gogonea, R.M.; Moraru, L.C.; Bodislav, D.A.; Păunescu, L.M.; Vlăsceanu, C.F. Similarities and Disparities of e-Commerce in the European Union in the Post-Pandemic Period. *J. Theor. Appl. Electron. Commer. Res.* **2024**, *19*, 340–361. [CrossRef]
95. Foster, A.C. New education classification better reflects income and spending patterns in the Consumer Expenditure Survey. In *Beyond the Numbers*; Bureau of Labor Statistics: Washington, DC, USA, 2014; Volume 3, pp. 1–9.
96. Eurostat—E-Commerce Statistics for Individuals. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics_for_individuals (accessed on 8 January 2024).
97. Bădîrcea, R.M.; Manta, A.G.; Florea, N.M.; Popescu, J.; Manta, F.L.; Puiu, S. E-Commerce and the Factors Affecting Its Development in the Age of Digital Technology: Empirical Evidence at EU–27 Level. *Sustainability* **2022**, *14*, 101. [CrossRef]
98. Waseem, A.; Rashid, Y.; Warraich, M.; Sadiq, I.; Shaukat, Z. Factors Affecting E-Commerce Potential of Any Country Using Multiple Regression Analysis. *J. Internet Bank. Commer.* **2019**, *14*, 1–28. [CrossRef]
99. Schoder, D.; Ding, F.; Campos, J.K. The Impact of E-Commerce Development on Urban Logistics Sustainability. *Open J. Soc. Sci.* **2016**, *4*, 1. [CrossRef]
100. Makki, E.; Chang, L.C. E-Commerce in Saudi Arabia: Acceptance and Implementation Difficulties. In Proceedings of the 2014 International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government (EEE 14), Las Vegas, NV, USA, 21–24 July 2014.
101. Valarezo, A.; López, R.; Pérez Amaral, T. Adoption of E-Commerce by Individuals and Digital-Divide. In *Applied Economics in the Digital Era*; Springer: Cham, Switzerland, 2020; ISBN 978-3-030-40600-4.

102. Phillips, P.C.; Moon, H.R. Linear Regression Limit Theory for Nonstationary Panel Data. *Econometrica* **1999**, *67*, 1057–1111. [CrossRef]
103. Kao, C.; Chiang, M.H. *On the Estimation and Inference of a Cointegrated Regression in Panel Data*; Baltagi, B.H., Fomby, T.B., Hill, R.C., Eds.; Nonstationary Panels, Panel Cointegration, and Dynamic Panels Advances in Econometrics; Emerald Group Publishing Limited: Bingley, UK, 2001; Volume 15, pp. 179–222. [CrossRef]
104. Georgescu, R.I.; Vasilescu, A.C.; Mair, A.; Andreica, C.; Sarbu, A.M. Human capital and administrative leadership. In Proceedings of the 17th Administration and Public Management International Conference, Bucharest, Romania, 15–16 October 2021; Available online: http://confcamp.ase.ro/2021/wp-content/uploads/18_Georgescu_Vasilescu_-Mair_Andreica_Sarbu.pdf (accessed on 8 January 2024).
105. Georgescu, R.I. Modern leadership in business organisations during economic disruption. *Theor. Appl. Econ.* **2023**, *30*, 73–82.
106. Burlacu, S.; Georgescu, R.I.; Moise, D.; Cretu, R.F.; Platagea Gombos, S. The tension between Adjusted Net Savings, Sustainable Growth and Resource Depletion. *Econ. Comput. Econ. Cybern. Stud. Res.* **2022**, *3*, 265–277.
107. Georgescu, R.I. *Strategii de Valorificare a Resurselor Naturale in Contextual Globalizarii (Strategies for Valuing Natural Resources in the Context of Globalization)*; Universitara Publishing: Bucharest, Romania, 2020.
108. Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2122 (accessed on 17 April 2024).