The Interplay between Digitalization and Competitiveness: Evidence from European Countries

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Abstract: In modern societies, digitalization plays a tremendously important role for people and businesses. Apart from an economic representation, competitiveness characterizes a society from political, cultural, or human points of view. In this article, we aim to highlight the role of digital development from a competitiveness perspective, as there are few studies related to this relationship. The empirical investigation is based on panel data analysis for European Union countries for 2017–2022, considering the digital economy and society index (DESI) and the index developed by International Institute for Management Development (IMD), respectively IMD world competitiveness index. The results obtained are reported both for general indices and for the components of DESI, presented separately for the groups of Central and Eastern European countries and Western European countries. They indicate different influences for the two groups of countries, with only a few common aspects. The most obvious is the case of skilled labor. This aspect demonstrates the link between the various dimensions of digitalization and changes in human capital development strategies, as they appear in the specialized literature.

Keywords: digitalization; human and technological development; DESI index; economic performance; competitiveness index

1. Introduction

European society has evolved in many aspects in recent decades. Digitalization has played a vital role in Europe's rapid development, acquiring a unique place in the social and economic system. Societies are becoming increasingly digital, a fact that influences daily activities and the ways of working, communicating, or learning. The crisis imposed by COVID-19 has speeded up the digitalization process in Europe and it has become "an integral part of society" [1].

Despite its good prospects, the speed of change and the related complexity of implications raise management and security issues. Besides these widely recognized aspects, there are differences in development and the ability to overcome obstacles between states and regions, possibly impacting countries' competitiveness. A digital gap was identified in European countries for 2008–2010 [2] when Romania and Bulgaria were placed in the cluster of laggards, while Denmark, Sweden, the Netherlands, Finland, and Luxemburg were identified as leaders in the digital domain. The current situation is reflected by the digital economy and society index (DESI); in 2022, Romania and Bulgaria are still in the last two places, while Finland, Denmark, the Netherlands, and Sweden are in the first positions. The digital divide, as defined by the Organization for Economic Cooperation and Development [3], reflects this social and economic asymmetry, even between developed economies [4]. Information and communication technology gained power in the 1990s in terms of economic growth and competitiveness [5].

Therefore, the aim of this article is to investigate the link between digitalization and competitiveness. We employed a panel data analysis for the European Union countries,

separated into two different economies: Central and Eastern European countries and Western European countries. The intention is to identify how digitalization, measured by the DESI index, influences competitiveness, as synthesized by the index developed by International Institute for Management Development (IMD), respectively IMD world competitiveness index. The analysis is carried out at the level of leading indicators but also the level of components. The results indicate the different influences of DESI and its sub-indices for the two groups of countries. The most common aspect is the positive influence on skilled labor, which highlights the link between digitalization and the need for changes in human capital development strategies.

In the Introduction section, we present the aim of the research, the broad background, and the main results and conclusions. Further on, the article is organized as follows. Section 2 summarizes the theoretical knowledge, as reflected by the economic literature. Section 3 describes the data and the methodology used in this work. Section 4 presents the results, while the discussion and conclusions are presented in Section 5.

2. Theoretical Background

Digitalization is seen as a tool for progress and is increasingly necessary for survival in more and more fields of activity. It is essential in promoting financial inclusion, especially after the pandemic [6]. By resorting to a vast level of bibliometric analysis, it was evidence of the need to improve digitalization in the travel and tourism sectors [7]. Innovation and business, in general, are more and more driven by digitalization [8]. In the context of increasing digitalization, the strategy for human capital development is changing, demanding actions in education systems, business sectors, or social and economic policies [9].

The countries of the European Union are often analyzed by splitting them into two categories. For example, the different results between the two groups of countries were obtained in studies related to research and development and financial development [10] or to climate change and income inequalities [11]. In the digital research area, European countries are categorized as old member states, new member states[1], and candidate countries; with a few minor exceptions, social and economic advances are strongly related to digital indicators [5]. A study based on a panel model regarding Central and Eastern economies for the period from 2000 to 2019 emphasizes the positive impact that digitalization has had on welfare [12], while in another work, the competitiveness of these countries in attracting European funds is analyzed [13].

The DESI index and its constituents have been used to assess digitalization's influence on the different aspects of society. This indicator highlighted digitalization's positive effect on stimulating European Union entrepreneurship by resorting to panel data [14] or by employing multivariate analysis [15]. This index constituted the basis for an analysis aimed at assessing the impact of digitalization on happiness on a European level, in the context of the COVID-19 pandemic; the results demonstrate a positive relationship between these elements, with a more robust connection in western and northern European countries [16]. Moreover, it offers a valuable tool to show the positive influence that digitalization has had on reducing the risk of poverty and social exclusion in the countries of the European Union [17].

By employing factor analysis, the hypothesis was validated that two main factors, macroeconomic stability and research and development and digitalization[2], are significant for strengthening competitiveness in European countries [18]. Digitalization (captured in a simplified manner, using information and communication technology indicators) was considered to provide a view of sustainable competitiveness for a more extensive set of 127 countries [19] and to enhance sustainability by verifying the relationship with five of the sustainable development goals of the United Nations, in the case of European Union countries [20].

When analyzing the literature, we find that digitalization and competitiveness are topics of interest for European researchers, but they have rarely been studied directly. After identifying this gap in the literature, we propose an analysis to explain how digitalization, as

measured by the DESI index and its components, influences competitiveness. We contribute to the completion of the literature by performing this analysis at the level of two groups of countries, namely, the Central and Eastern European and the Western European groups, taking into account a more comprehensive indicator that is compatible with observing society, compared to the infrastructure.

3. Materials and Methods

3.1. Data

To assess the digital performance of European countries, we have employed the DESI index, developed by the European Commission [21], considering the recommendations of the Organization for Economic Co-operation and Development for designing composite indicators [22]. This offers a country profile on an annual basis that can help to identify the weak points and support policy actions. It was launched in 2014 in a form utilizing five components (connectivity, human capital, use of the Internet, the integration of digital technology, and digital public services); in the last editions, it was adjusted to the new European digital targets and the structure was modified, comprising only four subcategories (human capital, connectivity, the integration of digital technology, and digital public services). Each component has equal weight in the calculation of the final index. The DESI index for the current year is calculated to the greatest extent using data from the previous year. Moreover, the scores of earlier years are recalculated to give the best possible picture. Based on these scores, countries are assigned ranking positions.

In the 2022 edition, several methodological improvements have taken place in all four component categories and considered modifications, until 28 April 2022. The available time coverage for the last updates is 2017–2022, the period that we considered for our analysis. The variables included in the analysis on the digitalization side are presented in Table 1.

Table 1. Description of the variables used for digitalization.

Variable	Description	Source
DESI index	A composite indicator that measures the digitalization performance of European countries. Calculated as the weighted average of the four dimensions	
Components/dimensions:		
Human capital	Assess people's skills in using the Internet, and advanced skills and the development of specialists	European Commission [21]
Connectivity	Indicates countries' broadband coverage	
Integration of digital technology	Monitors integration of new technologies in e-commerce and other businesses	
Digital public services	Assess the integration of digital technologies in public services	

The IMD world competitiveness index, was deemed appropriate for evaluation in the context of evolving digitalization [23]. It is an index published in 1989 for a maximum of 65 countries in the world, based on statistical data (approximately two-thirds) and survey data. The scores are calculated for world competitiveness, world digital competitiveness, and world talent. For our study, we considered only the first and the last because, for digitalization, we used the DESI index. The world competitiveness index is the most comprehensive, based on 333 criteria, some of them being only for background information. The world talent index is based on 32 criteria. We run our model for these two indices and some of their components, based on data availability, for annual data registered in 2017–2022[3]. The variables included in the analysis of the competitiveness factor are presented in Table 2.

Table 2. Description of the used variables for competitiveness.

Variable	Description	Source
World Competitiveness (Overall WCY)	A composite indicator based on 333 criteria (163 hard data, 92 survey data, and 78 background data) that evidence the characteristics for four factors (economic performance, government efficiency, business efficiency, infrastructure)	
Components/sub-factor:		
Gross domestic product (GDP)	USD billions. Primary sources: OECD (2022), Main Economic Indicators—complete database, national sources	
GDP (PPP) per capita	USD per capita at purchasing power parity. Primary sources: IMF World Economic Outlook April 2022, The Conference Board Total Economy Database™, December 2021	
Exports of goods	Percentage change, based on USD values. Primary sources: World Trade Organization	
Government budget surplus/deficit	Percentage of GDP. Primary sources: European Communities, 1995–2022, World Economic Outlook April 2022 (IMF), national sources	
Tax evasion	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Tax evasion is not a threat to your economy)	
Pension funding	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Pension funding is adequately addressed for the future)	
Protectionism	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Protectionism of your government does not impair the conduct of your business)	International Institute for Management Development [23]
Equal opportunity	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Equal opportunity legislation in your economy encourages economic development)	
Disposable Income	Female/male ratio. Primary sources: Euromonitor International, national sources	
Use of big data and analytics	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Companies are very good at using big data and analytics to support decision-making)	
Image abroad or branding	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: The image of your country abroad encourages business development)	
Digital transformation in companies	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Digital transformation in companies is generally well implemented)	
Scientific research legislation	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Laws relating to scientific research do encourage innovation)	
Health infrastructure	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Health infrastructure meets the needs of society)	
World Talent (Overall Talent)	A composite indicator based on 31 criteria (14 hard data and 17 survey data) that evidence the characteristics for three factors (investment and development, appeal, and readiness)	
Components/sub-factor:		
Foreign highly skilled personnel	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: Foreign, highly skilled personnel are attracted to your country's business environment)	
Skilled labor	Primary sources: IMD World Competitiveness Executive Opinion survey, based on an index from 0 to 10 (Question: skilled labor is readily available)	

Both the indicators used for digitization and those used for competitiveness are generally based on data available from the previous year. For example, the indicators from

the year 2022 are based on information from the year 2021 and are identifiable in the sources used for the year 2022. In order to facilitate the understanding of our interpretations, we have kept the same notation.

3.2. Methods

We used the method employed by Wooldridge (2009) to perform a panel data analysis, which generally relies on the following specification [24]:

$$y_{it} = X_{it}\beta + \alpha_i + \mu_{it} \text{ for } t = 1, \ldots, T \text{ and } i = 1, \ldots, N \tag{1}$$

where y_{it} is the dependent variable for each country i at moment t, X represents the independent variables, β stands for the estimated coefficients, α_i are the individual effects (country effects in our case), and μ_{it} is the idiosyncratic error.

We consider three versions of this specification: pooled ordinary least squares (OLS), fixed effects (FE), and random effects (RE) models. The pooled OLS relies on assumptions common to regular regression, among which we mention linearity, exogeneity, homoscedasticity, and a lack of autocorrelation. The exogeneity condition requires no correlation between unobserved independent variables and the explanatory variables used in the regression, i.e., $Cov(X_{it}, \alpha_i) = 0$. Additionally, α_i coefficients are prone to display serial correlation over time, violating the simple OLS specification and making the pooled OLS model unsuitable for panel data.

Therefore, we first estimate the pooled OLS and apply the White and Breusch–Pagan tests for heteroscedasticity and the Durbin–Watson test for autocorrelation, to investigate these assumptions of linear regression.

The rejection of these conditions opens the door for either the FE or the RE models. The FE model considers the country effects of unobserved variables as being constant over time, which allows for $Cov(X_{it}, \alpha_i) \neq 0$. The pitfall is that dependence can only be observed within countries. The RE model, on the other hand, allows for the possibility of the country effects of the unobserved variables to be random across time, which means that it can shift from OLS to FE to allow precedence for either the "between" or the "within" countries' dependences.

The null hypothesis of the Hausman test states that the covariance between the explanatory variables and α coefficients is zero, which is equivalent to conjecturing that the RE model is preferred to the FE model. Hence, once we have evidence that the hypotheses for the pooled OLS are violated, we perform the Hausman test to identify the suited model.

To find the best fit, we developed an algorithm that follows the steps described above, in which we verify the dependence of the DESI (aggregated) index, on the one hand, and its components, on the other hand, on several variables for Central and Eastern European and Western European countries separately.

4. Results

First, we present the results obtained for the influence of the DESI index on the competitiveness indicators and sub-factors for the two categories of countries. Since the available data was up to 2021 for some variables, and for others, up to 2022, we chose the most extended series when they exist; for this reason, the results are presented in two tables for each case considered.

The results for Central and Eastern European countries are presented in Table 3 for competitiveness indicators, underlining the situations in which data are available for 2021 and 2022, respectively. Overall, the highest significance was recorded for the (positive) influence of DESI on the export of goods and pension funding. Then, significant results were proven for the overall talent indicator (world talent) and skilled labor. Tax evasion and scientific research legislation are also significantly influenced by the DESI. According to the results produced by specific tests, except in the case of gross domestic product, where the fitted model is a random effect, the model type is the pooled OLS model for the other cases.

The results for Western European countries are presented in Table 4 for competitiveness indicators, presented distinctly for data that are available up to 2021, and respectively for data series up to 2022. The highest significance was recorded for the (positive) influence of DESI on skilled labor, gross domestic product, and the export of goods. Then, significant results were registered for the overall competitiveness indicator (world competitiveness) and digital transformation in companies, showing, respectively, a negative and a positive influence. A negative impact was also evidenced in the case of image abroad and scientific research legislation. The results of the specific tests suggest that except for gross domestic product per capita, where the fitted model is a random effect for all the other cases, the fitted model type is a pooled OLS.

When comparing the results obtained for Central and Eastern European countries with those of Western European countries, we observed that the export of goods is the commonest indicator that is most significantly influenced by DESI. Another indicator that reacts positively to digitalization for both groups of countries is skilled labor, a sub-factor of the talent word index.

The second part of the analysis is detailed on DESI's four components: human capital, connectivity, the integration of digital technology, and digital public services.

The results for Central and Eastern European countries are presented in Table 5 for competitiveness indicators, using data available up to 2021, and for series that are one year longer. Significant results are obtained only in the case of connectivity and the integration of digital technology. More precisely, we have the most significant results (positive influence) for the export of goods, in the case of connectivity, and pension funding for the integration of digital technology. In the second position is the sub-factor of skilled labor for both dimensions of DESI; pension funding, equal opportunity, image abroad or branding, digital transformation in companies, and health infrastructure for the connectivity side; overall talent (the world talent index) for the integration of digital technology. There is a common positive influence for these two dimensions of DESI on skilled labor, or at least on the perception that skilled labor is available, as the primary data are obtained from a survey.

The results for Western European countries are presented in Table 6 for the competitiveness indicators for both categories of data—those available up to 2021 and those for which data are published that includes 2022. Different from the group of Central and Eastern European countries, in the case of Western European countries, we have significant results for all four dimensions, even if, in some cases, the influences are negative. The highest significance was recorded for connectivity's (positive) influence on the gross domestic product, gross domestic product per capita, and the export of goods. High significance was also obtained in the case of digital public services but, this time, a negative influence was seen for the previous three macroeconomic indicators. A negative influence was observed in the case of overall talent (world talent) for human capital and connectivity, in terms of DESI's dimensions, and government budget surplus/deficit in the case of digital public services. On the other side, connectivity significantly influences government budget surplus/deficit and disposable income, and the integration of digital technologies into skilled labor. The human capital dimension positively influences the competitiveness index (world competitiveness).

When comparing the results obtained for Central and Eastern European countries with those of Western European countries, we observed that the export of goods is the most frequent sub-factor for which significant results were obtained for the components of DESI; only, this time, skilled labor joined them. While the overall talent index is positively influenced by the dimension integration of digital technology in Central and Eastern economies, it has a negative influence in the case of Western economies, but under the dimensions of human capital and connectivity. The perception of pension funding adequacy in the future is positively influenced in the case of Central and Eastern European countries, while the macroeconomic indicators are more frequently influenced in the case of Western European countries in either direction.

Table 3. Results for the scenario when the DESI total is considered for Central and Eastern European countries.

Indicator (for Competitiveness)	DESI Total	White LM	White F	Breusch–Pagan LM	Breusch–Pagan F	Durbin–Watson	Hausman	Model Type
For data on competitiveness, available up to 2021								
Overall (Talent)	1.88 **	3.73	1.89	3.61 *	3.72 *	2.59		Pooled OLS
Foreign highly skilled personnel (Talent)	−0.15	0.04	0.02	0.03	0.03	2.36		Pooled OLS
Skilled labor (Talent)	2.46 **	0.19	0.09	0.11	0.10	2.23		Pooled OLS
Gross domestic product (GDP) (WCY)	0.86	8.63 **	4.84 **	8.04 ***	9.08 ***	2.32	0.56	Random Effects
GDP (PPP) per capita (WCY)	0.44	5.60 *	2.95 *	5.19 **	5.52 **	2.70		Pooled OLS
Exports of goods—growth (WCY)	2.64 ***	2.55	1.26	2.43	2.45	1.59		Pooled OLS
Government budget surplus/deficit (%) (WCY)	−0.32	2.09	1.03	2.07	2.07	2.54		Pooled OLS
Disposable Income (WCY)	−1.31	5.81 *	3.07 *	5.64 **	6.06 **	2.04		Pooled OLS
For data on competitiveness, available up to 2022								
Overall (WCY)	0.03	2.47	1.23	1.23	1.22	1.59		Pooled OLS
Tax evasion (WCY)	1.49 *	1.57	0.77	0.01	0.01	2.73		Pooled OLS
Pension funding (WCY)	2.57 ***	0.28	0.14	0.15	0.14	2.62		Pooled OLS
Protectionism (WCY)	0.79	0.30	0.15	0.30	0.29	2.64		Pooled OLS
Equal opportunity (WCY)	1.35	3.25	1.63	1.27	1.26	2.54		Pooled OLS
Use of big data and analytics (WCY)	1.17	0.14	0.06	0.08	0.08	2.11		Pooled OLS
Image abroad or branding (WCY)	1.25	3.08	1.54	1.75	1.75	2.46		Pooled OLS
Digital transformation in companies (WCY)	1.55	0.74	0.36	0.02	0.02	2.27		Pooled OLS
Scientific research legislation (WCY)	1.96 *	0.48	0.23	0.20	0.20	2.09		Pooled OLS
Health infrastructure (WCY)	1.48 **	0.75	0.36	0.26	0.25	2.56		Pooled OLS

* stands for significance at a *p*-value of lower than 10%, ** signals significance with a *p*-value lower than 5%, and *** flags situations where the *p*-value is lower than 1%.

Table 4. Results for the scenario when the DESI total is considered for Western European countries.

Indicator (for Competitiveness)	DESI Total	White LM	White F	Breusch–Pagan LM	Breusch–Pagan F	Durbin–Watson	Hausman	Model Type
For data on competitiveness, available up to 2021								
Overall (Talent)	0.11	2.21	1.09	0.19	0.18	2.45		Pooled OLS
Foreign highly skilled personnel (Talent)	−1.36	0.76	0.37	0.38	0.37	2.29		Pooled OLS
Skilled labor (Talent)	1.53 ***	3.66	1.85	0.30	0.29	2.38		Pooled OLS
Gross domestic product (GDP) (WCY)	1.17 ***	5.80 *	3.04 *	5.78 **	6.14 **	2.11		Pooled OLS
GDP (PPP) per capita (WCY)	0.91	7.02 **	3.75 **	6.78 ***	7.34 ***	2.60	0.98	Random Effects
Exports of goods—growth (WCY)	2.20 ***	4.58	2.35	4.52 **	4.71 **	1.79		Pooled OLS
Government budget surplus/deficit (%) (WCY)	−0.17	3.79	1.92	3.75 *	3.86 *	2.69		Pooled OLS
Disposable income (WCY)	−0.01	5.39 *	2.80 *	5.09 **	5.36 **	2.28		Pooled OLS
For data on competitiveness, available up to 2022								
Overall (WCY)	−0.86 **	2.40	1.19	2.19	2.19	2.21		Pooled OLS
Tax evasion (WCY)	0.23	1.98	0.98	1.65	1.64	2.68		Pooled OLS
Pension funding (WCY)	0.85	0.50	0.25	0.21	0.20	2.39		Pooled OLS
Protectionism (WCY)	−0.01	1.06	0.52	0.01	0.01	2.34		Pooled OLS
Equal opportunity (WCY)	−0.70	0.26	0.13	0.09	0.08	2.51		Pooled OLS
Use of big data and analytics (WCY)	0.49	2.38	1.18	2.34	2.34	2.29		Pooled OLS
Image abroad or branding (WCY)	−1.14 *	2.05	1.01	0.02	0.02	2.66		Pooled OLS
Digital transformation in companies (WCY)	1.33 **	1.53	0.75	0.07	0.07	2.32		Pooled OLS
Scientific research legislation (WCY)	−1.21 *	0.93	0.46	0.93	0.92	2.47		Pooled OLS
Health infrastructure (WCY)	−0.78	0.51	0.25	0.09	0.09	2.57		Pooled OLS

* stands for significance at a *p*-value lower than 10%, ** signals significance with a *p*-value lower than 5%, and *** flags situations where the *p*-value is lower than 1%.

Table 5. Results for the scenario when DESI components are considered for Central and Eastern European Countries.

Indicator (for Competitiveness)	Human Capital	Connectivity	Integration of Digital Technology	Digital Public Services	White LM	White F	Breusch–Pagan LM	Breusch–Pagan F	Durbin–Watson	Hausman	Model Type
For data on competitiveness available up to 2021											
Overall (Talent)	−4.28	7.34	9.00 **	0.13	12.05	0.80	7.84 *	2.08 *	2.55		Pooled OLS
Foreign highly skilled personnel (Talent)	−0.15	−1.15	1.42	−0.50	8.73	0.54	0.81	0.19	2.37		Pooled OLS
Skilled labor (Talent)	−2.30	14.25 **	10.88 **	−1.55	10.35	0.66	2.60	0.62	2.26		Pooled OLS
Gross domestic product (GDP) (WCY)	−1.07	7.31	2.91	−0.64	25.64 **	2.49 **	13.94 ***	4.24 ***	2.24	0.87	Random Effects
GDP (PPP) per capita (WCY)	0.91	5.80	0.89	−1.01	15.69	1.14	9.91**	2.75**	2.63		Pooled OLS
Export of goods—growth (WCY)	2.08	20.51 ***	6.72	−2.43	6.61	0.39	3.26	0.79	1.50		Pooled OLS
Government budget surplus/deficit (%) (WCY)	−1.05	0.31	0.05	−0.35	14.66	1.04	4.59	1.14	2.53		Pooled OLS
Disposable income (WCY)	7.40	−5.08	−8.63	−0.64	22.83 *	2.03 **	13.01 **	3.87 ***	2.10	6.21	Random Effects
For data on competitiveness available up to 2022											
Overall (WCY)	6.58	6.34	−4.06	−2.51	11.12	0.74	1.24	0.29	1.56		Pooled OLS
Tax evasion (WCY)	−1.88	5.61	5.94	−0.60	8.44	0.53	0.42	0.10	2.66		Pooled OLS
Pension funding (WCY)	−3.71	9.21**	10.62 ***	−0.87	11.77	0.79	1.20	0.28	2.55		Pooled OLS
Protectionism (WCY)	−0.65	5.16	2.24	−0.81	9.86	0.64	0.51	0.12	2.59		Pooled OLS
Equal opportunity (WCY)	3.54	9.66 **	0.79	−1.88	7.90	0.50	1.88	0.45	2.44		Pooled OLS
Use of big data and analytics (WCY)	0.41	7.76	−0.64	−0.09	5.09	0.30	0.40	0.09	2.02		Pooled OLS
Image abroad or branding (WCY)	5.05	10.99 **	−1.54	−2.09	15.96	1.16	6.59	1.69	2.45		Pooled OLS
Digital transformation in companies (WCY)	−0.65	12.20 **	4.95	−2.67 **	13.25	0.91	2.43	0.58	2.17		Pooled OLS
Scientific research legislation (WCY)	5.16	11.28 **	1.24	−1.88	6.30	0.38	1.46	0.34	2.05		Pooled OLS
Health infrastructure (WCY)	−0.01	6.69 **	3.21	−0.49	6.40	0.39	0.69	0.16	2.56		Pooled OLS

* stands for significance at a *p*-value lower than 10%, ** signals significance with a *p*-value lower than 5%, and *** flags situations where the *p*-value is lower than 1%.

Table 6. Results for the scenario when DESI components are considered for Western European countries.

Indicator (for Competitiveness)	Human Capital	Connectivity	Integration of Digital Technology	Digital Public Services	White LM	White F	Breusch–Pagan LM	Breusch–Pagan F	Durbin–Watson	Hausman	Model Type
For data on competitiveness, available up to 2021											
Overall (Talent)	−12.68 **	−13.55 *	6.35	14.01 *	11.88	0.80	2.31	0.55	2.41		Pooled OLS
Foreign highly skilled personnel (Talent)	10.68	0.26	−8.69	−5.18	5.51	0.33	1.44	0.34	2.30		Pooled OLS
Skilled labor (Talent)	−9.62	−1.28	12.10 **	3.68	15.00	1.07	2.06	0.49	2.40		Pooled OLS
Gross domestic product (GDP) (WCY)	9.63	19.66 ***	0.73	−17.35 ***	21.06 *	1.71*	7.04	1.82	2.05		Pooled OLS
GDP (PPP) per capita (WCY)	13.11	21.86 ***	−3.04	−19.48 ***	19.77	1.56	8.19*	2.16 *	2.46		Pooled OLS
Exports of goods—growth (WCY)	10.47	26.53 ***	1.66	−20.48 ***	17.56	1.32	4.15	1.02	1.77		Pooled OLS
Government budget surplus/deficit (%) (WCY)	11.74	13.00 **	−5.22	−13.92 **	16.96	1.26	5.99	1.52	2.61		Pooled OLS
Disposable income (WCY)	6.70	9.04 **	−4.92	−7.68	18.47	1.42	9.35 *	2.52 *	2.27		Pooled OLS
For data on competitiveness available up to 2022											
Overall (WCY)	9.57 *	2.88	−3.55	−8.36	8.30	0.54	2.81	0.68	2.24		Pooled OLS
Tax evasion (WCY)	3.70	2.86	−0.39	−3.73	11.96	0.82	2.29	0.55	2.68		Pooled OLS
Pension funding (WCY)	0.19	4.43	4.59	−4.39	12.32	0.85	0.87	0.21	2.37		Pooled OLS
Protectionism (WCY)	−0.80	−1.65	0.08	1.88	9.75	0.65	1.43	0.34	2.35		Pooled OLS
Equal opportunity (WCY)	1.84	−1.86	−1.57	−0.48	8.51	0.56	1.11	0.27	2.53		Pooled OLS
Use of big data and analytics (WCY)	−3.63	3.47	−0.66	0.68	19.52	1.48	4.55	1.13	2.31		Pooled OLS
Image abroad or branding (WCY)	3.74	−2.45	−4.73	−0.39	13.57	0.95	0.92	0.22	2.67		Pooled OLS
Digital transformation in companies (WCY)	−5.26	5.11	5.86	−1.35	8.02	0.52	3.23	0.79	2.41		Pooled OLS
Scientific research legislation (WCY)	5.62	−3.08	−5.40	−0.63	5.18	0.33	0.97	0.23	2.52		Pooled OLS
Health infrastructure (WCY)	−1.59	−6.13	0.06	4.08	16.47	1.20	2.44	0.59	2.56		Pooled OLS

* stands for significance at a *p*-value lower than 10%, ** signals significance with a *p*-value lower than 5%, and *** flags situations where the *p*-value is lower than 1%.

5. Discussion and Conclusions

This study highlights the role played by the digital development of European countries from the perspective of competitiveness, as, nowadays, digitalization has a visible influence on people and businesses. Our empirical investigation is based on panel data analysis for European Union countries, separated into two groups, Central and Eastern European and Western European groups, as previous studies draw attention to the fact that the digital advance is influenced by socio-economic development [5]. The investigation is based on the DESI and IMD world competitiveness indexes and their subcomponents or sub-factors. The analyzed period was 2017–2022, which is dependent on the availability of statistical data for the latest updates of the DESI indicator and its components, which represents a limitation of the study.

Our study supports the results obtained by other researchers that provide evidence for the influence of digitization on competitiveness [18,19]. The separation into two groups of countries proved to be inspiring, as most results show the different influences of various dimensions of digitalization on competitiveness. When analyzing the primary DESI indicator, the export of goods and skilled labor are significantly influenced, both in Central and Eastern European countries and in Western European countries. In the first group of countries, it was also found that the overall talent indicator (world talent), tax evasion, and scientific research legislation are significantly and positively influenced by DESI, while in the second group, gross domestic product and digital transformation in companies are in the same position. As regards the four components of DESI, the export of goods remains the factor most significantly influenced in both groups. The connectivity sub-factor is one of the main drivers for analyzed competitiveness indicators in Central and European countries, with eight significant positive influences (skilled labor, the export of goods, pension funding, equal opportunity, image abroad, digital transformation in companies, scientific research legislation, and health infrastructure), while Western countries have only six influences, and these are mainly different ones (overall talent, gross domestic product, gross domestic product per capita, export of goods, the Government budget surplus/deficit, disposable income) but they remain in the first position as an influencer. However, the case of skilled labor stands out due to the frequency of significant results showing digitalization's influence on it. This fact demonstrates the link between various dimensions of digitalization and the need for changes in human capital development strategies, as it emerges from the specialized literature [9]. Moreover, as it emerges from the literature, digital development, reflected in the increase of the DESI indicator, contributes to the improvement of labor market-related indicators [25].

This study is helpful for political decision-makers because, on its basis, the synergies between digitalization and competitiveness can be identified, and several complex development strategies can be built. Furthermore, building optimal combinations of such synergies could constitute future research directions.

Notes

[1] The new member states are the Central and East European countries that joined the European Union lately. Particularly in this study, Romania and Bulgaria are considered candidate countries, as the study was conducted for data up to 2004, while they entered the Union in 2007.

[2] Besides this indicator, DESI was also used to assess digitalisation.

[3] Some data are available only until 2021.

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