Chapter

An Overview of Digital Entrepreneurship in Central and Eastern European Countries

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Abstract

The aim of the study is to explore and present an overview of digital entrepreneurship in Central and Eastern European countries and to examine how certain components of the DESI index affect GDP per capita in CEE countries and in what way modern information technologies affect their economies. The paper uses secondary data sources, mostly scientific and professional journals from the studied area, DESI reports, Eurostat data, and other Internet sources. The first part of the paper presents a short introduction on digitization digital entrepreneurship and digital technologies. The second part provides a descriptive analysis of digital entrepreneurship indicators and explores business demography in the ICT sector while the third part refers to the analysis of the DESI index. The panel method on data from 2015 to 2019 was used to show the influence of the different DESI index components on the observed countries' GDP per capita. The hypothesis that the components of the DESI index have a positive impact on GDP per capita has been partially confirmed. DESI rank, Connectivity and Human capital did not prove to be significant, while Use of internet services, Integration of digital technology, and Digital public services proved their significant positive effect.

Keywords: digital entrepreneurship, digital economy, digital society, ICT, CEE countries

1. Introduction

Digitization does not only change certain segments of business and individual industries – it fully affects all spheres of society and the economy, both technologically and organizationally. Digital technologies based on new platforms can transform the way economies function and impact all sectors of the economy, including traditional ones. Digital technologies "have the potential to create new or expand existing goods and services with digital features – yet possibilities in this regard depend on the characteristics of specific sectors' end products" [1, 2]. Full efficiency and profitability are impossible without digital transformation in which the private sector can and must be a leader. Although the crisis caused by COVID 19 severely affected a number of industries, the economic impact on the technology, media, and telecommunications sectors was largely neutral or even positive for some industry segments. For Europeans to take advantage of the opportunities offered by digital technologies, the European Commission adopted its digital strategy on 19

February 2020. During the coronavirus crisis, this strategy is even more important in creating favorable environment for digital entrepreneurship.

The aim of the study is to explore and present an overview of digital entrepreneurship in Central and Eastern European countries and to examine how certain components of the DESI index affect GDP per capita in CEE countries and in what way modern information technologies affect their economies. Central and Eastern European countries are European Union member states which were once part of the former Eastern bloc. The following countries are Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

The study is further structured as follows. The second part provides an overview of digital entrepreneurship. The third part explains research methodology followed by the descriptive analysis of information and communication technology sector of CEE countries and provides an insight into ICT share in GDP, the share of ICT employment in total employment and the share of R&D in the ICT industry in total R&D. Furthermore, it analyses business demography of the ICT sector and provides an overview of enterprises' birth, death, and churn rates. The fourth part of the study provides Digital Economy and Society Index analysis and relates observed DESI components to countries' GDP per capita while final remarks are presented in conclusion.

2. Overview of digital entrepreneurship

Entrepreneurship, in its simplest form, can be described as self-employment [3]. Digital entrepreneurship, on the other hand, diverges from this definition seeing as it involves entrepreneurial pursuits which occur on a digital platform ([4], as in [5], p. 1). Digital entrepreneurship is "an essential driver within the innovation system. It changes the structure, aims, and networking mechanisms of the overall business system and, ultimately, affects the various levels and dimensions of the innovation system "[2], p. 1. Bringing inevitable changes to the innovation system, digital technologies may not only provide new business opportunities but also be disruptive and cause new vulnerabilities"[2], p. 1. „The term 'Digital Entrepreneurship' most commonly refers to the process of creating a new - or novel - Internet enabled/delivered business, product or service. This definition includes both start-ups - bringing a new digital product or service to market - but also the digital transformation of an existing business activity inside a firm or the public sector "[6], p. 1,

Digital entrepreneurship is the practice of pursuing "new venture opportunities presented by new media and internet technologies" [7], p. 8. Digital entrepreneurship is "a subcategory of entrepreneurship in which some or all of what would be physical in a traditional organization has been digitized" [8], p. 4. "Digital entrepreneurship embraces all new ventures and the transformation of existing businesses that drive economic and/or social value by creating and using novel digital technologies. Digital enterprises are characterized by a high intensity of utilization of novel digital technologies (particularly social, big data, mobile, and cloud solutions) to improve business operations, invent new business models, sharpen business intelligence, and engage with customers and stakeholders. They create the jobs and growth opportunities of the future" [9], p. 1. Digital enterprises are different from traditional entrepreneurial ventures because they have different business models and can pursue their products, marketing and distribution activities using digital platforms [10].

Global diffusion of "digital technologies as general use tools has also spurred arguments that it may increase knowledge diffusion through improved communication efficiency, improve consumer engagement, and allow countries to leapfrog

traditional methods of increasing productivity" [11], p. 1. Online business does not just mean having a good communication strategy which is then marketed through various digital channels. Online business also means connecting business entities in an efficient way, enabling digital transformation that facilitates business in a simpler, more accessible, and often cheaper way. Jobs related to digital technologies or digital economy are the most sought after and most stable occupations. Without the new technologies, digital entrepreneurs "would be unable to deliver their products or services, and in some cases, the business model itself could not exist without information technology. The sector of information and communication technology remains a key driver of innovation and a sector with huge growth potential" [12], p. 180.

3. Research methodology

The first part of the analysis refers to the descriptive analysis of ICT sector and its business demography. Percentage of the ICT sector in GDP, total employment, and R&D in CEE countries are analyzed. Moreover, business demography in ICT sector in CEE countries is explained through enterprises' birth rate, death rate and churn rate. The next chapter analyses DESI index in CEE countries. DESI is a composite index that summarizes relevant indicators on Europe's digital performance. The main components of the DESI index are a) Connectivity (CON), b) Human capital (HC), c) Use of internet services (IS), d) Integration of digital technology (IDT) and e) Digital public services (DPS). In accordance with the stated aim, the following research hypothesis was formulated: *H1. The components of the DESI index have a positive impact on GDP per capita.* In hypothesis testing, GDP per capita is used as a dependent variable in the model, while the components of the DESI index: Connectivity (CON), Human capital (HC), Use of internet services (IS), Integration of digital technology (IDT) and Digital public services (DPS) – represent independent variables in the model. The analysis uses panel method and begins with estimating the equation using OLS, Random, Between, First difference and Fixed models. The next step is to determine which of the above models best specified the equation. For this purpose, the Breusch-Pagan Lagrange multiplier test and the Hausman test are performed. The Breusch-Pagan Lagrange multiplier test tests whether the "OLS" or "Random" model is suitable. The null hypothesis assumes that the variance between entities or industrial activities is zero, i.e. that there are no panel effects, which indicates the use of the least squares method or the OLS method. Furthermore, the Hausman test helps in choosing a "Fixed" or "Random" model. It tests whether the errors are correlated with the regressors. The null hypothesis assumes that the errors are not correlated with the regressors, which would indicate the use of the "Random" model. The null hypothesis of the Breusch-Pagan / Cook-Weisberg test indicates homoskedasticity in the model. Given that in this case the null hypothesis cannot be rejected at all standard levels of significance, it is concluded that there is no heteroskedasticity in the model.

4. Descriptive analysis of ICT sector and its business demography

Prior to the introduction of the DESI index (Digital Economy and Society Index), some of the indicators of the intensity of digital entrepreneurship in the total economy were the share of the ICT industry in GDP, the share of the ICT industry in total employment and the share of R&D in the ICT industry in total R&D. One of the prior indicators of digital development was citizens' Internet

penetration. Specific studies presented in **Table 1** showed positive correlation of internet penetration on GDP growth.

Koutroumpis [15] and Czernich et al. [16] conducted studies of the impact of the internet on economic growth focused mainly on the EU and US OECD countries. These studies found that a 10 per cent increase in internet penetration correlates with a 0.9–1.5 and a 0.3–0.9 percentage point (pp) in gross domestic product (GDP) growth respectively (Hernandez et al., 2016). Other indicators are analyzed below.

The average share of the ICT industry in CEE countries in GDP is 4.39%, with Hungary having the largest share (6.04%) and Lithuania having the smallest share (3.02%). The Republic of Croatia is in the middle with the share of the ICT industry in GDP of 4.40%. The average share of employment in the ICT industry in CEE countries in total employment is 3.00%, with Estonia having the largest share (5.14%) and Romania having the smallest share (2.36%). The Republic of Croatia is just ahead of Romania with the share of employment in the ICT industry in total employment of 2.45%. The average share of R&D in the ICT industry in CEE countries in total R&D is 0.83%, with Lithuania having the largest share (2.49%)

Study	Country/Region	Years	Correlation with GDP growth
Koutrompis (2009) [15]	22 OECD countries	2002–2007	0.9–1.5 pp
Czernich et al. (2009) [16]	25 OECD countries	1996–2007	0.3–0.9 pp
Garcia Zaballos and Lopez-Rivas (2012) [17]	26 Latin American and Caribbean countries	2003–2009	3.2 pp
Qiang et al. (2009) [18]	120 countries Developed countries Developing countries	1980–2006 1980–2006	1.21 pp. 1.38 pp
Scott (2012) [19]	120 countries Developed countries Developing countries	1980–2011 1980–2011	1.19 pp. 1.35 pp

Table 1.
Correlations with GDP growth for every 10-percentage point (pp) increase in internet penetration [13], p. 7, based on [14].

Country	ICTGDP (%)	ICTEMP (%)	%ICTR&D
Bulgaria	5,72	2,71	0,79
Croatia	4,40	2,45	0,00*
Czech Republic	4,42	3,07	0,33
Estonia	5,14	4,09	2,30
Hungary	6,04	3,56	0,43
Latvia	4,73	3,84	1,15
Lithuania	3,02	2,57	2,49
Poland	3,33	2,47	0,41
Romania	3,53	2,36	0,36
Slovakia	4,30	3,18	0,32
Slovenia	3,68	2,66	0,53

Table 2.
Percentage of the ICT sector in GDP, total employment, and R&D in CEE countries, 2017 [20].

Country	BR (%)	DR (%)	CR (%)
Bulgaria	14,20	11,70	25,90
Croatia	10,54	6,27	16,81
Czech Republic	11,40	6,56	17,96
Estonia	18,39	10,90	29,29
Hungary	13,74	0,21	13,95
Latvia	13,66	5,72	19,38
Lithuania	21,95	26,60	48,55
Poland	16,57	9,37	25,94
Romania	15,39	10,27	25,66
Slovakia	17,41	9,59	27,00
Slovenia	12,63	5,01	17,64

Table 3.
Business demography in ICT sector in CEE countries in 2017 [20].

and Slovakia having the smallest share (0.32%). Eurostat data is presented in **Table 2**.

The birth rate of a given reference period (usually one calendar year) is the number of births as a percentage of the population of active enterprises. The death rate of a given reference period (usually one calendar year) is the number of deaths as a percentage of the population of active enterprises. The churn rate is equal to the sum of the birth and the death rate. Eurostat data is presented in **Table 3**.

The average company birth rate in the ICT industry in CEE countries is 15.08%. Lithuania (21.95%) has the highest company birth rate, followed by Estonia (18.39%) and Slovakia (17.41%), while Croatia (10.54%), Czech Republic (11,40%) and Slovenia (12.63%) have the lowest company birth rate (11.40%). The average company death rate in the ICT industry in CEE countries is 9.29%. Lithuania (26.60%) has the highest company death rate, followed by Bulgaria (11.70%) and Estonia (10.90%), while Hungary (0.21%), Slovenia (5.01%) and Latvia (5.72%) have the lowest company closure rate. The average churn rate of companies in the ICT industry in CEE countries is 24.37%. Lithuania has the highest churn rate (48.55%), followed by Estonia (29.29%) and Slovakia (27.00%), while Hungary (13.95%), Croatia (16.81%), and Slovenia (17.64%) have the lowest turnover rate.

5. DESI index analysis

The European Commission has been monitoring the intensity of the digital economy since 2014 by publishing DESI reports for individual member states. DESI is a composite index that summarizes relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness [21]. The main components of the DESI index are a) Connectivity (CON), b) Human capital (HC), c) Use of internet services (IS), d) Integration of digital technology (IDT) and e) Digital public services (DPS).

Connectivity indicators in the DESI index look at both the demand and the supply side of fixed and mobile broadband and consist of: a) Overall fixed broadband take-up (% households), b) At least 100 Mbps fixed broadband take-up (% households), c) Fast broadband (NGA) coverage (% households), d) Fixed Very

High Capacity Network (VHCN) coverage (% households), e) 4G coverage (% households – average of operators), f) Mobile broadband take-up (Subscriptions per 100 people), g) 5G readiness (Assigned spectrum as a % of total harmonized 5G spectrum), and h) Broadband price index (Score 0 to 100). In connectivity, Latvia had the highest score, followed by Hungary and Romania. Bulgaria, Croatia, and Czech Republic had the weakest performance for this dimension of the DESI.

Human capital in DESI index consists of: a) At least basic digital skills (% individuals), b) Above basic digital skills (% individuals), c) At least basic software skills (% individuals), d) ICT specialists (% total employment), e) Female ICT specialists (% female employment), and f) ICT graduates (% graduates). According to the latest data, Estonia is leading in human capital, followed by Croatia and Czech Republic. Romania, Bulgaria, and Latvia rank the lowest.

Use of internet services in DESI index consist of: a) People who have never used the internet (% individuals), b) Internet users (% individuals), c) News (% internet users), d) Music, videos and games (% internet users), e) Video on demand (% internet users), f) Video calls (% internet users), g) Social networks (% internet users), h) Doing an online course (% internet users), i) Banking (% internet users), j) Shopping (% internet users), and k) Selling online (% internet users). Estonia Lithuania and Hungary have the most active internet users. Conversely, Romania, Bulgaria and Poland are the least active.

Integration of digital technology in DESI index consist of: a) Electronic information sharing (% enterprises), b) Social media (% enterprises), c) Big data (% enterprises), d) Cloud (% enterprises), e) SMEs selling online (% SMEs), f) e-Commerce turnover (% SME turnover) and g) Selling online cross-border (% SMEs). The top performers are Czech Republic, Lithuania, and Croatia. At the other end of the scale are Bulgaria, Romania, and Hungary.

Digital public services in DESI index consist of: a) e-Government users (% internet users needing to submit forms), b) Pre-filled forms (Score 0 to 100), c) Online service completion (Score 0 to 100), d) Digital public services for businesses (Score 0 to 100 – including domestic and cross-border), and e) Open data (% of maximum score). The top performers are Estonia, Latvia, and Lithuania. On the other hand, Romania, Slovakia, and Croatia score the lowest.

5.1 Hypothesis

The aim of the study is to explore and present an overview of digital entrepreneurship in Central and Eastern European countries and to examine how certain components of the DESI index affect GDP per capita in CEE countries and in what way modern information technologies affect their economies. In accordance with the stated aim, the following research hypothesis was formulated.

H1. The components of the DESI index have a positive impact on GDP per capita.

In hypothesis testing, GDP per capita is used as a dependent variable in the model, while the components of the DESI index: Connectivity (CON), Human capital (HC), Use of internet services (IS), Integration of digital technology (IDT) and Digital public services (DPS) – represent independent variables in the model.

The results of the conducted econometric analysis of the hypothesis test are presented below. The analysis begins with estimating the equation using OLS, Random, Between, First difference and Fixed models.

$$GDPpc_{i,t} = \beta_0 + \beta_1 DESIrank_{i,t} + \beta_2 CON_{i,t} + \beta_3 HC_{i,t} + \beta_4 IS_{i,t} + \beta_5 IDT_{i,t} + \beta_6 DPS_{i,t} + u_{i,t}$$

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Fixed-effects (within) regression               Number of obs      =        55
Group variable: id                              Number of groups   =        11

R-sq:  within  = 0.8976                         Obs per group: min =         5
       between = 0.3018                                        avg =       5.0
       overall = 0.3162                                        max =         5

                                                F(6,38)           =     55.50
corr(u_i, Xb)  = 0.2042                         Prob > F          =    0.0000
```

GDPpc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DESIrank	14.07801	43.50148	0.32	0.748	-73.98614	102.1422
CON	-10.14379	7.22938	-1.40	0.169	-24.7789	4.491324
HC	20.33353	15.98207	1.27	0.211	-12.02047	52.68753
IS	64.74837	15.35768	4.22	0.000	33.65837	95.83837
IDT	34.42375	16.42282	2.10	0.043	1.177485	67.67001
DPS	45.60849	5.531885	8.24	0.000	34.40977	56.80721
_cons	5399.138	1574.009	3.43	0.001	2212.724	8585.553
sigma_u	3166.4107					
sigma_e	271.80314					
rho	.99268547	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(10, 38) =   358.53              Prob > F = 0.0000
```

Table 4.
Stata panel model output.

The results of the panel model (fixed effects) are presented in **Table 4** above.

The hypothesis has been partially confirmed. Three components of the DESI index did not prove to be significant – DESI rank (positive sign), Connectivity (negative sign) and Human capital (positive sign), while three proved to be significant – Use of internet services (IS), Integration of digital technology (IDT) and Digital public services (DPS) (all three with the positive sign).

5.2 Data analysis

In order to prove the model's reliability and validity five different models were analyzed. The analysis begins with estimating the equation using OLS, Random, Between, First difference and Fixed models. Integration of digital technology (IDT) proved to be significant in three out of five models (OLS, Random and Fixed), while Internet services (IS) and Digital public services (DPS) proved to be significant in two out of five models (Random and Fixed).

The next step is to determine which of the above models best specified the equation. For this purpose, the Breusch-Pagan Lagrange multiplier test and the Hausman test are performed. The Breusch-Pagan Lagrange multiplier test tests whether the "OLS" or "Random" model is suitable. The null hypothesis assumes that the variance between entities or industrial activities is zero, i.e. that there are no panel effects, which indicates the use of the least squares method or the OLS method. In this case, the test result indicates that the null hypothesis can be rejected at all standard levels of significance, which means that in this case it is more appropriate to use the "Random" model.

```
Breusch and Pagan Lagrangian multiplier test for random effects

        GDPpc[id,t] = Xb + u[id] + e[id,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                   GDPpc |    1.31e+07        3617.471
                       e |    73876.95        271.8031
                       u |     3551193        1884.461

        Test:   Var(u) = 0
                                  chibar2(01) =     62.26
                              Prob > chibar2 =    0.0000
```

Furthermore, the Hausman test helps in choosing a "Fixed" or "Random" model. It tests whether the errors are correlated with the regressors. The null hypothesis assumes that the errors are not correlated with the regressors, which would indicate the use of the "Random" model. As in the specific case the result of the Hausman test could not obtain positive test values, the test proved to be inappropriate, but the Fixed model was chosen, given the greater significance of the same.

The null hypothesis of the Breusch-Pagan / Cook-Weisberg test indicates homoskedasticity in the model. Given that in this case the null hypothesis cannot be rejected at all standard levels of significance, it is concluded that there is no heteroskedasticity in the model.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of GDPpc

         chi2(1)      =     2.62
         Prob > chi2  =   0.1059
```

Descriptive data analysis is presented below.

The intensity of the individual components of the DESI index is shown in **Figure 1** below.

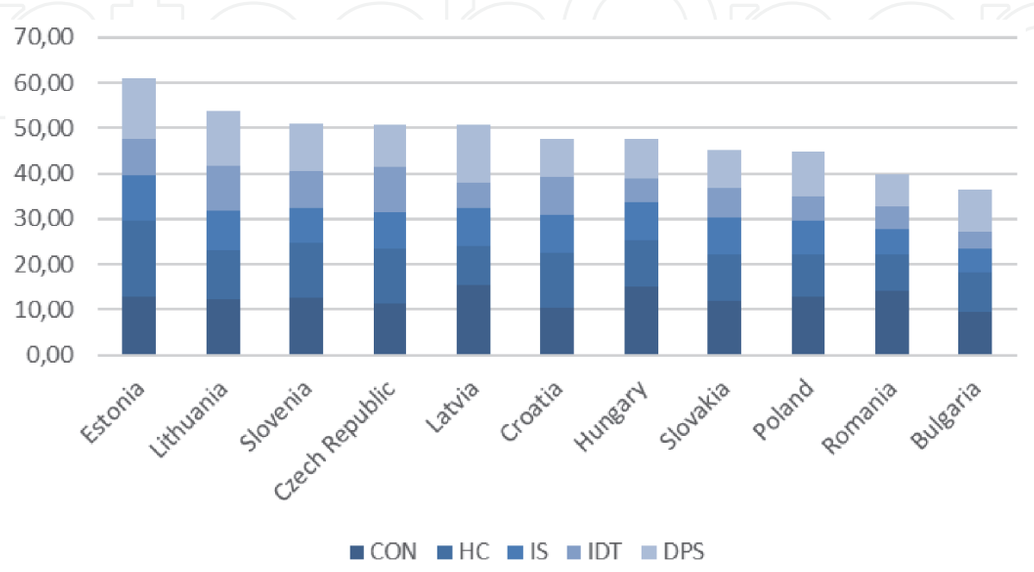

Figure 1.
DESI index components in CEE countries in 2019 [21–25].

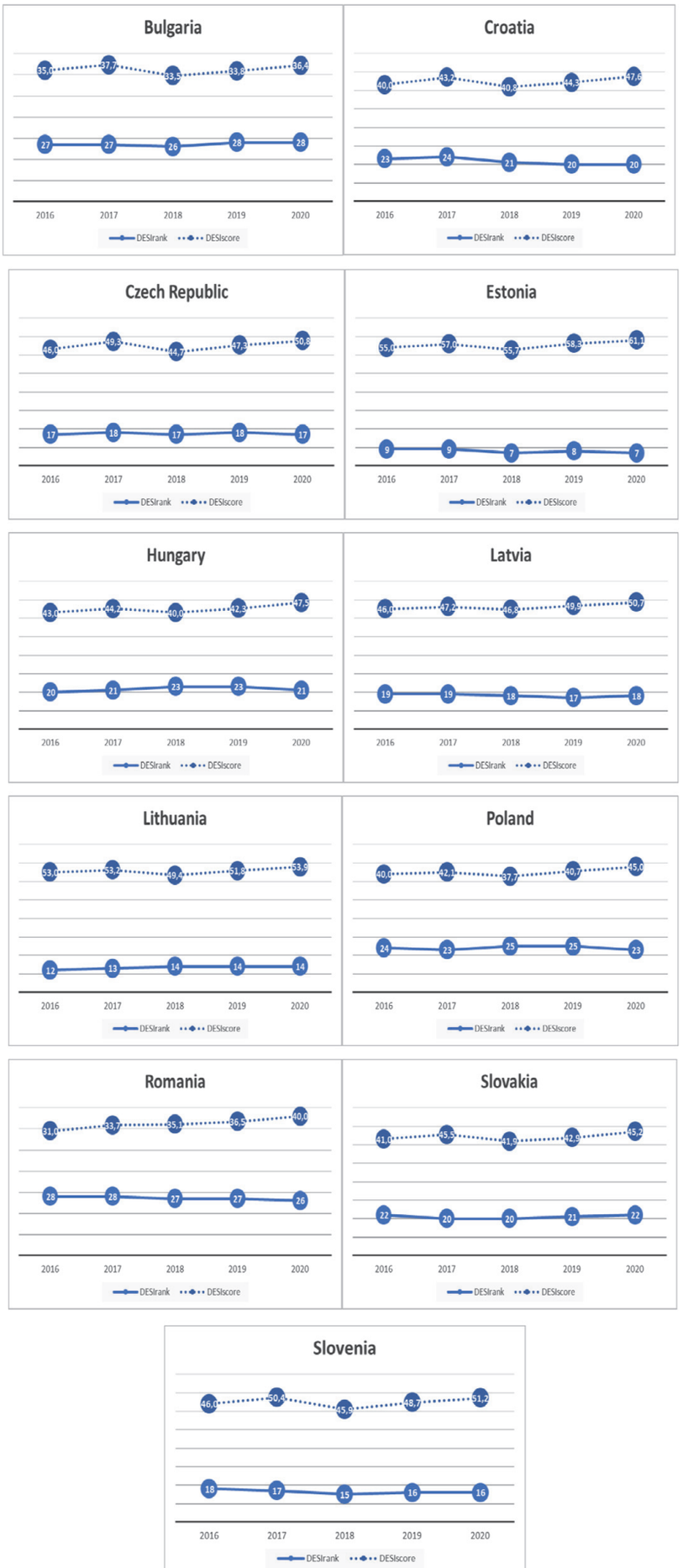

Figure 2.
DESI rank and DESI score in CEE countries, 2016–2020 [21–25].

Country	GDPpc (EUR)	Rank	CON	HC	IS	IDT	DPS
Bulgaria	6.800	28	38,5	33,9	36,6	17,9	61,8
Croatia	12.480	20	41,2	49,2	55,5	41,5	55,8
Czech Republic	18.000	17	44,9	48,6	54,1	49,6	62,4
Estonia	15.670	7	51,9	66,7	65,4	41,1	89,3
Hungary	13.180	21	59,8	41,8	55,9	25,3	57,8
Latvia	12.490	18	61,8	35,0	54,0	28,3	85,1
Lithuania	13.880	14	48,9	43,8	57,3	49,5	81,4
Poland	12.980	23	51,3	37,3	49,6	26,2	67,4
Romania	9.130	26	56,2	33,2	35,9	24,9	48,4
Slovakia	15.890	22	47,5	41,8	53,4	32,6	55,6
Slovenia	20.490	16	50,2	48,3	51,7	40,9	70,8

Table 5.
DESI index components for 2020 [21–25].

DESI ranks and DESI scores for CEE countries from 2016 to 2020 individual countries' reports are shown on **Figure 2** above. Data from 2020 reports refer to the year 2019. Each country has an increase in DESI score in 2020 (2019) compared to 2016 (2015). Croatia has made the most progress, jumping from 23rd to 20th place within the European Union, while Bulgaria, Hungary and Lithuania have fallen behind in the rankings. The biggest negative shift was made by Lithuania, moving from 12th to 14th place within the European Union. The Czech Republic and Slovakia are countries that have not had a shift in the DESI scale.

DESI index components for 2020, DESI 2020 rank and countries' GDP per capita are presented in **Table 5** above. Data from 2020 individual countries' reports refer to the year 2019.

6. Conclusions

Digital technologies provide tremendous growth opportunities. The corona crisis has changed the business of almost every entrepreneur. This crisis has shown how important it is to switch from analogue to digital business. The way of doing business had to change literally overnight. All business processes had to be organized differently in uncertain moments where instructions and notifications were received almost hour by hour. A quick adjustment and constant communication with all stakeholders are more important than ever.

Panel method used on 2015–2019 data for 11 CEE countries showed that use of Internet services (people who have never used the Internet; Internet users; news; music, videos and games; video on demand; video calls; social networks; doing an online course; banking; shopping; and selling online), Integration of digital technologies (electronic information sharing; social media; big data; cloud; SMEs selling online; e-Commerce turnover; and selling online cross-border) and Digital public services (e-Government users; pre-filled forms; online service completion; digital public services for businesses; and open data) have positive significant effect on GDP per capita. Other three components of the DESI index did not prove to be significant – DESI rank (positive sign), Connectivity (negative sign) and Human capital (positive sign). Among the significant variables, in the Use of internet

services Estonia Lithuania and Hungary have the most active internet users, while Romania, Bulgaria and Poland are the least active. The top performers in Integration of digital technology are Czech Republic, Lithuania, and Croatia. At the other end of the scale are Bulgaria, Romania, and Hungary. Estonia, Latvia, and Lithuania are top performers in Digital public services while on the other hand, Romania, Slovakia, and Croatia score the lowest.

It is extremely important to continuously implement the digital transformation of the economy. The digital transformation starts with the intention to introduce digital technologies in all parts of society, among the population, in companies, in government institutions, infrastructure and more. The introduction of digital transformation implies not only hardware and software adaptations, but also education of the population, business owners and employees in order to make the best use of the opportunities provided by new technologies such as Internet of Things, Big Data, blockchain, machine learning or artificial intelligence (AI).

Digitization is currently the most important economic reform. It remains for the Member States as well as the European Commission to adopt and implement digitization programs and to provide the financial capacity to support the digital transformation and building of the digital society.

Conflict of interest

The author declares no conflict of interest.

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