THE GLOBAL COMPETITIVENESS OF NATIONAL ECONOMIES

[a]LIUDMYLA NOVOSKOLTSEVA, [b]ANGELA IGNATYUK, CHALYNA FYLIUK, [d]LESIA CHUBUK, [e]NATALIIA KRYSHTOF, [f]ANNA HEVCHUK

[a]Research Institute of History, International Relations and Socio-Political Sciences, Lugansk National Taras Shevchenko University, Starobilsk, Ukraine
[b]Department of Economic Theory, Macro- and Microeconomics, Taras Shevchenko National University of Kyiv, Ukraine
[c]Department of Business Economics, Taras Shevchenko National University of Kyiv, Ukraine
[d]Department of Business Economics, Taras Shevchenko National University of Kyiv, Ukraine
[e]Department of Management Economic Policy and Governance, National Academy of Public Administration Under President of Ukraine, Kyiv, Ukraine
[f]Department of Accounting and Taxation, Vinnytsia University of Economy and Finance, Vinnytsia, Ukraine
email: [a]lnovoskolceva@gmail.com, [d]L_Chubuk@ukr.net, [e]kns2008@ukr.net, [f]annagevchuk69@gmail.com

Abstract: The spread of the pandemic and the resulting economic recession forced countries to reconsider the factors of growth and productivity, economic systems that require the integration of the sustainability principles. The World Economic Forum revised the directions of economic growth: the transformation of the enabling environment, human capital, markets, and the innovation ecosystem is new growth factors. The aim of the article is to assess the global competitiveness of national economies, in particular in the direction of human capital, based on the digitalization indicators of 25 European Union (EU) countries. The research methodology included methods of correlation and cluster analysis of Growth development product (GDP) per capita, labor productivity, and indicators of digitalization of the economy as new key factors of competitiveness.

Keywords: Global Competitiveness, National Economy, Productivity, Competitiveness, Digital Economy

1 Introduction

The spread of the pandemic and the resulting economic recession have forced countries to reconsider the factors of growth and productivity, economic systems that require the integration of the principle of sustainability. The World Economic Forum's report The Global Competitiveness Report (GCR) 2020 provides recommendations for ensuring economic sustainability in the following key areas: transformation of the enabling environment; 2) transformation of human capital; 3) transformation of markets, 4) transformation of the innovation ecosystem (World Economic Forum, 2021).

The favorable environment for economic growth involves eliminating the erosion of institutions and ensuring transparency in their functioning with an emphasis on the digitalization of public services and the development of information communication technologies (ICT), reducing the level of public debt and inequality. The transformation of human capital involves eliminating the imbalance of the competence of the workforce to the needs of the labor market, which has been accumulating over the past ten years. The problem of imbalance is intensified by the dynamism of ICT development, which requires workers to develop digital skills that will ensure future productivity growth and can be the basis of growth. In this context, labor laws need to be revised to accommodate the new technological, digital economy.

Transformation of markets involves addressing the liquidity and corporate debt risks of the financial system, ensuring the sustainability and inclusiveness of investments, reducing the concentration of markets through high productivity and profits of the largest companies in various industries, reducing the openness of trade and international migration. Transforming the innovation ecosystem involves fostering an entrepreneurial culture, especially in developing countries, through second-hand regional transportation district (RTD) investments, encouraging venture capital, and promoting technology diffusion and creativity. The Global Competitiveness Report (GCR) 2020 assesses the level of preparedness of countries in these areas of economic sustainability, inclusiveness and productivity.

Taking into account the new directions of ensuring the competitiveness of national economies, it is advisable to assess the indicators of sustainability of countries in the direction of human capital transformation. Despite the focus of the World Economic Forum on the importance of digital skills (skills in the use and design of technology) through their scarcity, this study examines the competitiveness of national economies on the level of development of digital skills on the example of EU countries. The aim of the article is to assess the global competitiveness of national economies.

2 Literature review

The scientific literature evaluates the global competitiveness of national economies based on the Global Competitiveness Index of the World Economic Forum, which evaluates the development factors of countries: infrastructure, institutions, macroeconomics, health, education, technological readiness, domestic markets, etc. (Kordalska & Olczyk, 2015; Palei, 2015). The World Economic Forum report presents the factors of sustainable economic growth of countries: institutions, policies and productivity factors (Cammack, 2006; Sala-i-Martin et al, 2007; Porter et al, 2008). Auzina-Emsina A. (2014) found weak links between productivity growth and economic growth in the pre-crisis period; however, productivity growth during the crisis ensures economic growth after a certain period of time (Auzina-Emsina, 2014). Lall (2001) argues the fallacy of the World Economic Forum methodology bias and overly broad definitions of competitiveness factors, and the weakness of the theoretical and practical basis for calculating the Index. Schwab (2018) presents a new Global Competitiveness Index 4.0 methodology, the development of which arose in the wake of the fourth industrial revolution and the 2008 crisis. The new methodology puts forward new requirements for economic growth: resilient countries, agile or fast adaptability, an innovation ecosystem, a human-centric approach to economic development. Palei (2015) explores the infrastructure factor of competitiveness through an assessment of the quality of roads, rail infrastructure, air transport and electricity supply. Yunis et al. (2012) investigate the impact of ICT maturity on national economies through cluster analysis and structural equation modeling. Paraušić et al. (2014) conducted a correlation analysis of cluster development and competitiveness of economies, finding high levels of innovation and productivity within clusters. Krstić, Krstić & Antonović (2019) investigated innovation and innovation development indicators (particularly science) in competitiveness (Krstić, Krstić & Antonović, 2019). Dima et al. (2018) the impact of knowledge economy indicators (innovation, education and lifelong learning, R&D) on EU competitiveness. Mihaela, Claudia & Lucian (2011) identify the influence and relationship between cultural dimensions (power distance, individualism, masculinity, avoidance of uncertainty) and national competitiveness of countries, in particular a significant influence of cultural dimensions on national competitiveness is found. Şener & Sarıdoğan (2011) proved that countries focused on science, technology and innovation strategies of global competitiveness have sustainable competitiveness and long-term growth.

Thus, scientific literature based on mathematical methods of research studies the influence of various factors of competitiveness of national economies. However, taking into account the updated methodology of the Global Competitiveness Index of the World Economic Forum due to new developments, strengthened by pandemics and the formation of new areas of competitiveness (favorable environment, human capital, markets and innovative ecosystem) there is a need for research on the impact of these tensions on competitiveness. This research proposes an assessment of the competitiveness of national economies in 25 EU countries based on GDP indicators, productivity (dependent changes) and digitalization factors, which mainly reflect the quality of human capital and its compliance with the needs of the digital economy.

3 Materials and research methods

This study uses correlation analysis to identify the linear relationship and directions of the relationship between labor productivity, the growth rate of GDP per capita and indicators of development of the ICT sector of countries and digital skills. For the correlation analysis, the average values of the indicators for 2012-2020 from the Eurostat database, broken down by 25 countries, were used.

The significance of the correlation coefficients was assessed using a p-value of 5%. Not all EU member states are included in the analysis due to the lack of data for certain periods for certain countries. In the second stage, the construction of a tree diagram and cluster analysis was carried out to identify groups of countries according to the level of productivity and sustainability of economic growth. The tree diagram served as the basis for visualization of the potential number of country clusters and their subsequent clustering. Cluster analysis was carried out based on k-means method. The global k-means algorithm is the next.

The k-means algorithm 2nds locally optimal solutions with respect to the clustering error. A fast iterative algorithm has been used in many clustering applications. A point-based clustering method starts with the cluster centers initially placed at arbitrary positions and proceeds by moving at each step the cluster centers in order to minimize the clustering error. The main disadvantage of the method lies in its sensitivity to initial positions of the cluster centers. Therefore, in order to obtain near optimal solutions using the k-means algorithm several runs must be scheduled in the initial positions of the cluster centers (Likas, Vlassis & Verbeek, 2003).

Suppose we are given a data set $X = \{x_1, \ldots.., x_N\}, x_N \in R^D$. The M-clustering problem aims at partitioning this data set into M disjoint subsets (clusters) $C_1, \ldots\ldots, C_M$, such that a clustering criterion is optimized. The most widely used clustering criterion is the sum of the squared Euclidean distances between each data point x_i and the centroid m_k (cluster center) of the subset C_k which contains x_i. This criterion is called clustering error and depends on the cluster centers $m_1, \ldots.., m_M$:

$$E(m_1, \ldots, m_M) = \sum_{i=1}^{N} \sum_{k=1}^{M} I(x_i \in C_k) \| x_i - m_k \|^2,$$

where I(X) = 1 if X is true and 0 otherwise.

4 Results

Beginning with the 2008 crisis, economic growth in the EU countries has accelerated, and the policy is focused on stimulating innovation, human capital development, mainly through lifelong learning and popularization of the importance of digital competencies to meet the needs of the digital economy.

The average value of GDP per capita as a share of GDP per capita EU-27 in the 25 EU countries was 96.5% for 2012-2020 (see Table 1) with a significant deviation at the rate of 66.86%. This means that the GDP per capita in some countries was higher than in the EU countries as a whole, while in others it was lower, as a result reflecting the level of the quality of life. The real labor productivity level averaged 100.24 for 2012-2020 with a deviation of 2.01, which means the absence of changes in the real labor productivity of the EU-27 countries (Table 1).

Table 1: Descriptive statistics

#	Indicator	Mean	Minimum	Maximum	Variance	Std.Dev.
1	GDP, % of EU27 total per capita, current prices	96,5038	24,52000	329,4300	4470,738	66,86358
2	Real labor productivity per person, Index, 2015=100	100,2412	95,47000	103,9100	4,067	2,01663
3	Employed ICT specialists – total % of total employment	3,6550	1,92000	6,5200	1,227	1,10755
4	Enterprises that provided training to develop/upgrade ICT skills of their personnel, % of enterprises	21,0199	5,12500	37,5000	63,040	7,93976
5	Large enterprises (250 persons employed or more) provided training to their personnel to develop their ICT skills, without financial sector, % of enterprises	65,3929	27,50000	87,5000	182,129	13,49551
6	Enterprises that employ ICT specialists, % of enterprises	21,4952	10,87500	31,5000	24,568	4,95662
7	Large enterprises (250 persons employed or more) that employ ICT specialists, without financial sector, % of enterprises	76,0721	40,25000	86,3750	94,378	9,71482
8	Enterprise recruited/tried to recruit personnel for jobs requiring ICT specialist skills (reduced comparability with 2007), %	8,4856	3,62500	12,7500	6,543	2,55791
9	Enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007), %	4,2147	1,50000	7,7500	3,356	1,83184
10	Individuals who have low overall digital skills, % of all individuals	25,4647	16,00000	35,2500	27,642	5,25760
11	Individuals who have basic overall digital skills, % of all individuals	24,9647	17,50000	34,7500	21,221	4,60659
12	Individuals who have above basic overall digital skills, % of all individuals	29,8654	9,50000	50,2500	109,176	10,44874
13	Individuals who have basic or above basic overall digital skills, % of all individuals	54,9038	28,50000	80,5000	170,685	13,06466
14	Percentage of the ICT personnel in total employment, %	2,7014	1,39750	4,3690	0,438	0,66159
15	Percentage of the ICT sector in GDP, %	4,0766	2,11625	7,3730	1,098	1,04776

Source: Eurostat (2021)

The share of those employed in the ICT sector was 3.65% in 2012-2020, with a decrease of 1.11%. The share of enterprises that provided their employees with ICT skills training or development programs was 21.02% with a decrease of 7.94% by country in 2012-2020. At the same time, large enterprises had a greater share of those who conducted ICT skills development trainings – 65.39% with a 13.49% difference. The number of enterprises employing ICT specialists was 21.49% with a 4.95% reduction in 2012-2020. Among large companies, the indicator was 76.07%. 8.48% of companies tried to hire ICT specialists, and 4.21% of companies had difficulties hiring specialists with ICT skills. Within 25 countries, 25.46% of people have low levels of digital skills with a deviation of 5.26%; 24.96% have basic digital skills with a deviation of 4.61%; 29.86% have more than basic skills with a tolerance of 10.44% per country; 54.9% have basic or more than basic digital skills with a tolerance of 13.06%. The share of ICT personnel was 2.7% of all employees in 25 EU countries. The share of ICT sector in GDP was 4.07% with a deviation of 1.05%.

Table 2 presents a correlation matrix of indicators. GDP per capita is directly linearly related to the following indicators: employed ICT specialists, enterprises that provided training to develop/upgrade ICT skills of their personnel, large enterprises provided training to their personnel to develop their ICT skills, enterprises that employ ICT specialists, enterprise recruited/tried to recruit personnel for jobs requiring ICT specialist skills (reduced comparability with 2007), enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007), individuals who have basic overall digital skills, above basic overall digital skills, basic or above basic overall digital skills. The GDP per capita share in the GDP of the EU-27 per capita is correlated with the index of real work productivity, individuals who have low overall digital skills. The index of real work productivity is linearly related to such factors: GDP per capita, enterprises that provided training to develop/upgrade ICT skills of their personnel, enterprises that employ ICT specialists, enterprise recruited/tried to recruit personnel for jobs requiring ICT specialist skills (reduced comparability with 2007), enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007).

The correlation analysis reveals the impact of the ICT sector development, the development of ICT skills of the companies' employees and the digital skills of the EU population on the economic growth and labor productivity. It is also worth noting the link between the factors. For example, a portion of enterprises that conduct ICT skills development training, including large ones, is negatively related to the low level of digital skills of individuals, but positively related to basic or more basic digital skills of the population.

The share of ICT employees in the total employment is positively correlated with the basic or higher level of digital skills of the population. The share of the ICT sector in GDP is positively correlated with employed ICT specialists, enterprise recruited/tried to recruit personnel for jobs requiring ICT specialist skills (reduced comparability with 2007), enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007), percentage of the ICT personnel in total employment.

Table 2: Correlations, Marked correlations are significant at p < ,05000, N=26 (Casewise deletion of missing data)

	1 – GDP	2 – RLPI	3 – EICTS	4 – ETICTS	5 – LETICTS	6 – EEICT	7 – LEEICT	8 – ERPFJ	9 – EHTFVICT	10 – ILODS	11 – IBODS	12 – IABODS	13 – IBABODS	14 – ICTPE	15 – ICTSGDP
1 – GDP	1,00	-0,48	0,70	0,57	0,48	0,52	0,26	0,59	0,68	-0,43	0,41	0,71	0,71	0,24	-0,02
2 – RLPI	-0,48	1,00	-0,27	-0,50	-0,38	-0,67	-0,36	-0,52	-0,46	0,14	-0,01	-0,30	-0,24	-0,19	-0,28
3 – EICTS	0,70	-0,27	1,00	0,71	0,67	0,57	0,39	0,65	0,76	-0,45	0,43	0,79	0,78	0,66	0,41
4 – ETICTS	0,57	-0,50	0,71	1,00	0,90	0,71	0,69	0,61	0,65	-0,43	0,41	0,64	0,66	0,39	0,22
5 – LETICTS	0,48	-0,38	0,67	0,90	1,00	0,62	0,85	0,46	0,57	-0,47	0,60	0,62	0,71	0,37	0,14
6 – EEICT	0,52	-0,67	0,57	0,71	0,62	1,00	0,62	0,74	0,67	-0,25	0,21	0,50	0,47	0,37	0,36
7 – LEEICT	0,26	-0,36	0,39	0,69	0,85	0,62	1,00	0,34	0,39	-0,42	0,45	0,49	0,55	0,27	0,06
8 – ERPFJ	0,59	-0,52	0,65	0,61	0,46	0,74	0,34	1,00	0,83	-0,33	0,17	0,66	0,59	0,53	0,47
9 – EHTFVICT	0,68	-0,46	0,76	0,65	0,57	0,67	0,39	0,83	1,00	-0,48	0,41	0,74	0,74	0,66	0,53
10 – ILODS	-0,43	0,14	-0,45	-0,43	-0,47	-0,25	-0,42	-0,33	-0,48	1,00	-0,53	-0,73	-0,77	-0,16	0,09
11 – IBODS	0,41	-0,01	0,43	0,41	0,60	0,21	0,45	0,17	0,41	-0,53	1,00	0,43	0,70	0,19	-0,13
12 – IABODS	0,71	-0,30	0,79	0,64	0,62	0,50	0,49	0,66	0,74	-0,73	0,43	1,00	0,95	0,55	0,22
13 – IBABODS	0,71	-0,24	0,78	0,66	0,71	0,47	0,55	0,59	0,74	-0,77	0,70	0,95	1,00	0,51	0,13
14 – ICTPE	0,24	-0,19	0,66	0,39	0,37	0,37	0,27	0,53	0,66	-0,16	0,19	0,55	0,51	1,00	0,82
15 – ICTSGDP	-0,02	-0,28	0,41	0,22	0,14	0,36	0,06	0,47	0,53	0,09	-0,13	0,22	0,13	0,82	1,00

Source: author calculation in Statistica based on Eurostat (2021).

The correlation analysis enabled us to see a significant linear relationship between the indicators of development of the digital economy and the GDP per capita, the real productivity of labor. This means that countries can be clustered into groups depending on the rate of economic growth and real productivity of labor, indicators of digitalization. The tree diagram makes it possible to nominally distinguish three groups of countries with different distances depending on the values of the analyzed indicators of competitiveness (Figure 1).

The first group of countries with the distance between them for the level of competitive capacity is within 10-20; the second group of countries with the distance between them for the level of competitive capacity is within 20-30; the group of countries with the distance between them for the level of competitive capacity is over 30.

Table 3 shows the average values of indicators of competitiveness of countries in each cluster.

The third cluster of countries is characterized by the highest average values of economic development indicators: the highest share of GDP per capita; the highest share of ICT professionals employed (4.64%); the highest share of companies conducting ICT skills development trainings (28.29%); the highest share of companies with ICT professionals (24.96%), etc. The first cluster of countries in terms of competitiveness is characterized by medium development values, the second – by the lowest ones. However, the index of real productivity does not vary significantly within the clusters.

Table 4 shows Euclidean Distances between Clusters, which indicate the distance of each group of countries depending on the level of development. Thus, the first group is 9.99 away from the second group and 20.89 away from the third. The second group is 99.96 away from the first group and 30.52 away from the third group. The third group is distant from the first – by 436.73, from the second – by 931.58.

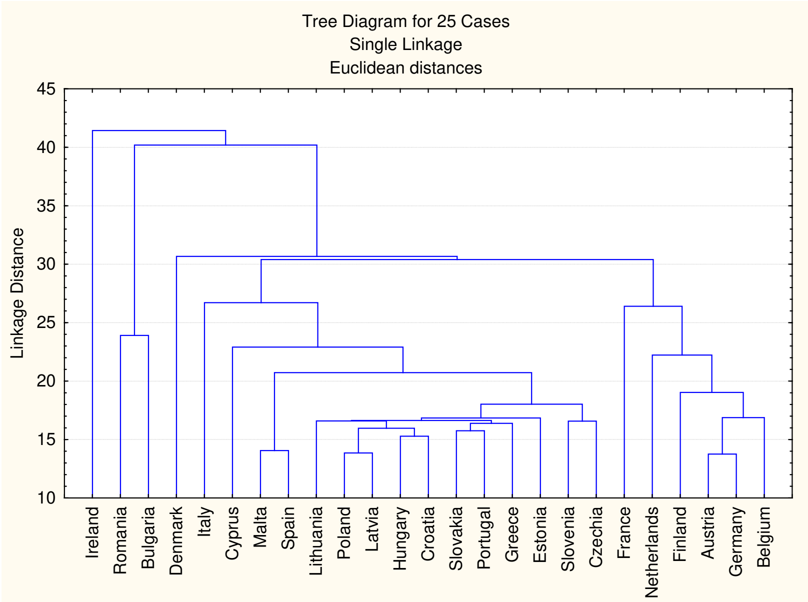

Figure 1. – Tree Cluster Diagram of Countries
Source: author calculation in Statistica based on Eurostat (2021).

Table 3: Cluster Means

Indicators	Cluster 1	Cluster 2	Cluster 3
GDP, % of EU27 total per capita, current prices	71,37600	39,2486	148,8963
Real labor productivity per person, Index, 2015=100	99,66400	102,1729	99,5362
Employed ICT specialists – total % of total employment	3,35300	2,7243	4,6450
Enterprises that provided training to develop/upgrade ICT skills of their personnel, % of enterprises	20,43750	12,9643	28,2991
Large enterprises (250 persons employed or more) provided training to their personnel to develop their ICT skills, without financial sector, % of enterprises	65,68750	51,3393	77,1987
Enterprises that employ ICT specialists, % of enterprises	20,77500	18,1250	24,9688
Large enterprises (250 persons employed or more) that employ ICT specialists, without financial sector, % of enterprises	76,73750	69,4286	81,7344
Enterprise recruited/tried to recruit personnel for jobs requiring ICT specialist skills (reduced comparability with 2007), %	7,77500	7,0179	10,1719
Enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007), %	3,50000	3,0714	5,6667
Individuals who have low overall digital skills, % of all individuals	25,40833	28,7143	23,8750
Individuals who have basic overall digital skills, % of all individuals	24,58333	21,5714	27,7500
Individuals who have above basic overall digital skills, % of all individuals	27,45000	21,5000	37,6563
Individuals who have basic or above basic overall digital skills, % of all individuals	52,17500	43,1071	65,4375
Percentage of the ICT personnel in total employment, %	2,67763	2,4355	2,9415
Percentage of the ICT sector in GDP, %	4,02309	4,0288	4,2805

Source: author calculation in Statistica based on Eurostat (2021).

Table 4: Euclidean Distances between Clusters Distances below diagonal Squared distances above diagonal

	No. 1	No. 2	No. 3
No. 1	0,00000	99,96461	436,7306
No. 2	9,99823	0,00000	931,5770
No. 3	20,89810	30,52175	0,0000

Source: author calculation in Statistica based on Eurostat (2021).

Table 5 provides an analysis of variations in the indicators of competitiveness of the countries and the significance of each factor in the development of the country. Thus, with the level of significance of 5% we can conclude that all factors are significant with the exception of such indicators as individuals who have low overall digital skills, % of all individuals; percentage of the ICT personnel in total employment, %; percentage of the ICT sector in GDP, %.

Table 5: Analysis of variances

Indicators	Between	df	Within	df	F	signif.
GDP, % of EU27 total per capita, current prices	49050,78	2	6292,884	22	85,74107	0,000000
Real labor productivity per person, Index, 2015=100	33,25	2	63,787	22	5,73366	0,009904
Employed ICT specialists – total % of total employment	14,71	2	13,242	22	12,22141	0,000269
Enterprises that provided training to develop/upgrade ICT skills of their personnel, % of enterprises	880,90	2	678,616	22	14,27897	0,000106
Large enterprises (250 persons employed or more) provided training to their personnel to develop their ICT skills, without financial sector, % of enterprises	2498,37	2	2053,852	22	13,38072	0,000158
Enterprises that employ ICT specialists, % of enterprises	180,86	2	423,955	22	4,69257	0,020076
Large enterprises (250 persons employed or more) that employ ICT specialists, without financial sector, % of enterprises	568,69	2	1759,898	22	3,55450	0,045957
Enterprise recruited/tried to recruit personnel for jobs requiring ICT	42,27	2	105,568	22	4,40471	0,024611

specialist skills (reduced comparability with 2007), %						
Enterprise had hard-to-fill vacancies for jobs requiring ICT specialist skills (reduced comparability with 2007), %	30,62	2	40,270	22	8,36503	0,001987
Individuals who have low overall digital skills, % of all individuals	90,58	2	507,310	22	1,96412	0,164114
Individuals who have basic overall digital skills, % of all individuals	143,00	2	358,464	22	4,38819	0,024903
Individuals who have above basic overall digital skills, % of all individuals	1017,16	2	1280,092	22	8,74057	0,001608
Individuals who have basic or above basic overall digital skills, % of all individuals	1910,06	2	1675,707	22	12,53837	0,000232
Percentage of the ICT personnel in total employment, %	0,96	2	9,949	22	1,06165	0,362949
Percentage of the ICT sector in GDP, %	0,35	2	26,488	22	0,14699	0,864139

Source: author calculation in Statistica based on Eurostat (2021).

Table 6 provides a list of the countries of each cluster with distances. The third cluster of countries with the highest indicators of competitiveness includes Belgium, Denmark, Germany, Ireland, France, Netherlands, Austria, and Finland. The second cluster with the lowest indicators of development includes Bulgaria, Croatia, Latvia, Lithuania, Hungary, Poland, and Romania. The first cluster with medium development indicators includes Czech Republic, Estonia, Greece, Spain, Italy, Cyprus, Malta, Portugal, Slovenia, and Slovakia.

Table 6: Members of Clusters and Distances from Respective Cluster Center

Cluster 1		Cluster 2		Cluster 3	
Countries	Distance	Countries	Distance	Countries	Distance
Czech Republic	5,112251	Bulgaria	7,76315	Belgium	5,12456
Estonia	5,629626	Croatia	6,27929	Denmark	7,92008
Greece	4,784779	Latvia	3,65223	Germany	4,32638
Spain	4,286819	Lithuania	5,02048	Ireland	13,09593
Italy	8,937014	Hungary	5,48605	France	9,51808
Cyprus	4,789231	Poland	3,71375	Netherlands	5,11806
Malta	4,446863	Romania	11,60857	Austria	2,21719
Portugal	2,750758			Finland	5,35399
Slovenia	4,494978				
Slovakia	4,839439				

Source: author calculation in Statistica based on Eurostat (2021).

5 Discussion

This study reveals the dependence of the competitiveness of countries on the factors of digitalization and the quality of human capital. Yunis et al. (2012) clearly differentiated differences between countries with high network readiness and countries with low ICT readiness based on cluster analysis. Countries with high average network readiness (digital skills of the population) also had higher average values for global competitiveness, ICT competence, ICT security, and RTD spending. The opposite was true for those countries with low average values of business and population network readiness. It was quite interesting to find that the group with low ICT readiness had higher mismatch values on global competitiveness. This could be explained by the possibility of greater compliance with certain common standards for technology use and deployment among countries with high levels of technology readiness than among countries with low levels of readiness. Another reason is that some countries, especially developing countries, will have higher levels of options for using ICTs and other ICT-related resources to achieve global competitiveness than among developed countries. An example would be the United Arab Emirates (UAE), a developing country that the World Economic Forum reported to have a high index of network readiness through 2008, accompanied by a high index of global competitiveness. Yunis et al. (2012) found that other developing countries similar in economic and social characteristics to those in the UAE ranked significantly lower on all variables than the UAE. This is consistent with a dynamic view of capabilities, highlighting the way resources are managed and allocated by policies and organizations across countries (Yunis et al., 2012).

Wade and Hulland's (2004) and Batra's (2006) models of the relationship between indicators of ICT development and competitiveness show a positive and significant relationship between digital readiness, that is, ICT maturity and global competitiveness. This means that countries with higher levels of network readiness are more able to achieve better performance in global development. Of course, ICT maturity gives countries ways to achieve domestic and global market goals, including market sensitivity, efficiency between organizations, and enhanced supply chain and customer relationship management systems. This is consistent with previous research on the impact of modern ICT systems on the competitiveness of global firms in international markets (Wade and Hulland, 2004; Batra, 2006).

Atkinson's (2007) model reflects significant and positive relationships between each of the ICT competencies, ICT security, and RTD costs with ICT maturity. The higher these factors, the higher a country's ICT maturity becomes. So, the government of a country that seeks to achieve global competitiveness must instill in the country's private and public organizations a set of standards for ICT competence, ICT security, and RTD spending levels. High standards of these factors would increase the maturity of the country's ICT and network readiness, allowing it to meet or exceed the performance of other countries and therefore achieve global competitiveness. Regarding RTD, the results showed that network readiness has a partial mediating effect on the relationship between RTD and global competitiveness. This is consistent with previous research that has shown a link between RTD and the appropriate diffusion and use of ICT, as well as a link between RTD and global competitiveness (Atkinson, 2007).

6 Conclusion

The study systematizes the main competitiveness trends of the 25 EU countries in 2012-2020. The average GDP per capita as a share of GDP per capita of the EU-27 in the 25 EU countries was 96.5% through 2012-2020 with a significant deviation of 66.86%. Real labor productivity averaged 100.24 for 2012-2020 with a deviation of 2.01, which means there is no change in real labor productivity in the EU-27 countries. The share of GDP per capita is directly linearly related to the digital economy's performance. However, the index of real productivity is linearly inversely related to the factors of digitalization. It was found that individuals who have low overall digital skills, percentage of the ICT personnel in total employment; percentage of the ICT sector in GDP do not determine the country's belonging to a certain cluster, and therefore cannot be used as indicators of competitiveness.

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Primary Paper Section: A

Secondary Paper Section: AH