Eastern Journal of European Studies
DOI: 10.47743/ejes-2023-0211 • December 2023 • VOLUME 14 ISSUE 2

The nexus between digital skills' dynamics and employment in the pandemic context

Dumitru Filipeanu[a], Florin Alexandru Luca[a], Liviu-George Maha[b], Viorel Țarcă[c], Claudiu Gabriel Țigănaș[b*]

[a]Gheorghe Asachi Technical University, Iași, Romania; [b]Alexandru Ioan Cuza University, Iași, Romania; [c]Grigore T. Popa University of Medicine and Pharmacy, Iași, Romania

Abstract
This paper aims to analyse the relation between the digitalization process and the performance of the labour market in the context of the pandemic. Thus, some relevant indicators were used to measure digital proficiency (individuals using the online tools for interaction with public authorities, for sending/receiving e-mails, for finding information about goods and services, for seeking health-related information, and for doing an online course), while the performance of the labour market was evaluated through the employment rate. The main findings are related to the confirmation of the intensification of digital skills during the pandemic, compared to the period before, the increase in digitalization based mainly on online education, as well as the demonstration of the fact that countries with a high level of digital proficiency have high employment rates, especially during the pandemic.

Keywords: digitalization; labour market; employment; pandemic crisis

Introduction

The current pandemic crisis, one with an unprecedented magnitude, has led to significant changes in the economy, with important implications for the labour market. Automation, robotization and digitalization carried out rapidly in this global context have revealed a new perspective of the economic development process, characterized by a very high degree of adaptability of the workforce that has digital skills in the new social and economic context. Along with automation, the widespread utilization of the Internet and the digital skills of individuals have become increasingly important, and the close correlation between high wage levels and digital efficiency has become a central element of the development of labour market-specific economic relations (Piroșcă et al., 2021).

[*]✉ Claudiu Gabriel Țigănaș, Assistant Professor, Alexandru Ioan Cuza University, Iași, Romania; email: clau_tiganas@yahoo.com.

The industrial revolution, which started long before the pandemic period, focused on the automation of production processes and generated the emergence of a new concept, the robotic workforce (Madakam et al., 2019). Widespread use of the Internet, robotics and the utilization of virtual autonomous systems and artificial intelligence (Da Silva et al., 2020; Frey & Osborne, 2013) has produced and will continue to produce major changes in the structure of supply and demand in the labour market. Looking ahead, the McKinsey Global Institute estimates that by 2030, in most areas of activity (approximately 60%), a third of jobs would require digitization-specific skills (Piroșcă et al., 2021).

The COVID pandemic and its socioeconomic implications have led to an undesirable acceleration of this process (Chen et al., 2020). Analysing the effects of COVID-19 on the labour market, The Future of Jobs Report 2020, published by the World Economic Forum, highlights that the outlook does not seem at all optimistic: the job destruction pace (6.4%) will be higher than the pace of the creation of new jobs (5.7%) until 2025, and the existence of a "double disruption", enforced by the historical trend of automation against traditional work, along with the COVID-19 recession, will be accompanied by the rising fear of accelerating social and material inequalities (The Future of Jobs Report, 2020).

The lives of millions of employees in almost all countries have been negatively affected by the waves of permanent and temporary redundancies made by many companies. Among the first measures taken by most employers were the decrease in the number of jobs and the reduction of the working hours. In this context, governments have taken measures to stimulate employment, giving companies several subsidies and other types of facilities. In this way, the premises for the widespread use of telework have been created, and an increase in the flexibility of distance activities is expected in the future, which will permanently change the way people will be employed in the global labour market (Zamfir & Aldea, 2020).

However, the amplification of digitalization in the pandemic period as a result of online teaching, homework or the orientation of many companies towards online activities to meet the basic needs of consumers and to avoid bankruptcy opens new opportunities, both in terms of entrepreneurship and the personal development of employees (Surico & Galeotti, 2020). Even if the pandemic period ends, the digital skills and experience gained will be the basis for a new digital culture for future generations (using the internet for interaction with public authorities, for being informed when buying goods and services, for doing an online course or generalization of digital payments) with positive effects on increasing flexibility in the labour market.

Our research is based on a critical view of the implications of the pandemic crisis on the consequences of the expansion of the digitalization process on the efficiency of the labour market in the member and candidate countries of the European Union. We attempt to provide an analysis of the relation between the

digital technologies and the digital skills of individuals and the labour market performance in terms of employment rate, especially for EU member states. Thus, the research hypotheses that are verified are as follows:

H1. There is an intensification of digital skills during the pandemic compared to the period before;

H2. The increase in digitalization is seen mainly in communicating with the public authorities and in accessing information about health;

H3. Countries with a high level of digital proficiency have high employment rates, especially during the pandemic.

1. Literature review

The growing trend to use new technologies such as digitization, artificial intelligence or robotics in most sectors of the economy has inevitably led to the production of a greater amount of goods and services with less labour and much improved labour productivity. Digitization has led to an unprecedented expansion of information flow and reduced its cost. This phenomenon has encouraged the search for information online, obtaining and distributing it in the electronic environment, inevitably contributing to better organization and collaboration between economic agents, putting their mark on the way companies operate, citizens look for different opportunities and finally interact with their own governments (World Development Report, 2016).

Artificial intelligence is a fascinating field and has been a concern for scientists since the last century. The first research was done by John McCarthy in 1955 and continued by Allen Newell and Nobel Prize winner in Economics, Herbert Simon (Newell & Simon, 1956). Since 1974, it has been demonstrated that many people believe that their work will be replaced by a robot or an intelligent algorithm within the next 50 years (Braverman, 1974). For most business executives and managers, artificial intelligence (AI) is seen as a strategic priority for their businesses, allowing them to move into new conditions in businesses (Columbus, 2017). That is why we must consider the positive but also the potential negative aspects that accompany the process of replacing human labour with AI. If this robotization can have economic advantages in terms of communication, education and even health, things can be questionable from a moral and ethical point of view. Therefore, in most developed countries, such as the US, Germany, Sweden, Spain and others, several international organizations – the European Union, the OECD, and the OSCE – have started to set up appropriate regulatory institutions and guidelines. The focus must be on the need for scientific research and increased funding in these specific areas (Abuselidze & Mamaladze, 2021).

Technological development may have an impact on the labour market in many ways, by displacing workers from tasks in their jobs (displacement effect) and by increasing the demand on the labour market in the domains that develop due to

technological progress (productivity effect) (IBA). Thus, rapid technological innovation can threaten and radically change the structure of employment (Abuselidze & Mamaladze, 2021).

Everybody knows about John Maynard Keynes' "technological unemployment theory", postulating that technological change causes loss of jobs (Keynes, 1963). In fact, it is just a transfer of labour from some fields to others because technology can replace human labour in routine manual or cognitive tasks, but this is not possible for the nonroutine or creative tasks (musicians, actors, authors, other artists). For developed countries, where the number of highly qualified jobs is increasing, this may be an advantage, but there is a concern that for developing countries, where the number of low- and medium-skilled workers is high, replacing the work of these workers with digital technology can lead to an increase in the unemployment rate. Nevertheless, some researchers believe that AI may become a "general purpose technology", with a wide range of applications in various professions (Méda, 2016).

In the last decade there were estimations that AI would contribute a lot to the job offer on the labour market. For instance, a report from the World Economic Forum anticipated that AI would create a net total of 58 million new jobs by 2022 (WEF, 2016). There are studies suggesting that higher labour productivity growth induces lower unemployment rates (Miyamoto & Takahashi, 2011). Thus, jobs with low or medium qualifications will be eliminated because changing human manual labour with robots makes economic sense, and the big problem for developing countries will be to integrate the large numbers of unskilled producers into the digital technology industry and to benefit from this technological change by creating new types of jobs and the need for qualified personnel. According to the research done by the IBA Global Employment Institute, the need for scientists and information technology specialists will increase with the development of the digital economy (IBA).

The crisis caused by COVID-19 highlighted some of the above-mentioned aspects. There has been a marked increase in the role of digital technologies in all types of communication, healthcare and pharmaceuticals, food, clothing or cosmetics and thus an increased flow of users and online referrals (Abuselidze & Mamaladze, 2021). The labour markets have experienced great uncertainty during the current coronavirus pandemic crisis in the last three years. There is a real need for policy interventions to promote capital investment in digital technologies, research, development, competitiveness, and innovation; this must be included in the EU Recovery and Resilience Plan to enhance labour productivity in EU regions (Giannakis & Mamuneas, 2022).

Digitalization and new technologies certainly have a positive effect on business and economics, but there are issues regarding growing inequalities, exacerbating job insecurity and threatening the availability of adequate employment opportunities (Holtgrewe, 2014).

The structure of the labour market is susceptible to change in the coming years under the impact of digitalization and the growing need to implement information technology. An interesting result is presented in the study by Kuznetsova et al., highlighting that there is a positive correlation between the level of computer and Internet use by employees in organizations and the percentage of people employed part time in the European Union (Kuznetsova et al., 2021).

In the COVID-19 pandemic, digital proficiency has put pressure on both companies and employees. Companies have had to develop digital applications and platforms, create specialized websites, expand their server storage capacity, or move to cloud storage services. On the other hand, their employees have implicitly engaged in a conscious effort to improve their previous digital skills. Wang at all suggests that company managers can boost the productivity and well-being of their employees by efficiently implementing remote work (Wang et al., 2021). At the same time, employers have the opportunity to find and use new forms of employment and take advantage of the benefits they bring to rational business (Digilina et al., 2020).

The effect of the COVID-19 crisis on the labour market for different EU countries has varied according to differences in their economic structure, with some sectors being more affected than others. At the same time, the negative impact of the pandemic will be higher for those with a lower level of education and lower incomes, mainly due to their concentration in the most affected sectors as well as the fact that they do not have the required digital skills (Zamfir & Aldea, 2020).

It has been shown that the levels of salaries and wages are strongly correlated with digital proficiency and Internet usage (Piroșcă et al., 2021). In addition, it is important to develop the research regarding the relation between the digital behaviour and other components of the labour market, such as employment. Various socioeconomic factors have led in recent decades to important changes both in the labour market (reducing the employment rate in many European countries) and at the population level (declining birth rates) (Țarcă et al., 2022). All these changes were accentuated in the context of the COVID-19 pandemic. Finally, the labour market in the current context is facing the process of demographic aging, a very complex phenomenon, having direct implications on the reduction of the active and the employed population (Țarcă et al., 2021).

2. Data and methodology

The main objective of our research is to determine the relation between the digital skills of individuals and the labour market performance, especially in terms of employment level. To this end, we used the information from the EUROSTAT database, the chapter "Science, technology, digital society", and the subchapter "Digital economy and society" (https://ec.europa.eu/eurostat/data/database), which measures the digital performance of EU member / candidate countries.

In the analysis, we used 5 indicators that adequately describe people's digital skills (as a percentage of total individuals):

- Individuals using the internet for interaction with public authorities;
- Individuals using the internet for sending/receiving e-mails;
- Individuals using the internet to find information about goods and services;
- Individuals using the internet to seek health-related information;
- Individuals using the internet for doing an online course.

The indicators considered in the analysis were selected based on the assumption that they are more sensitive to structural changes induced by a global crisis such as the COVID-19 pandemic. To quantify labour market performance, we selected the employment rate, obtained by reporting the employed persons between the ages of 20-64 years to the total population corresponding to the same age group.

To reach the objective of the paper and to verify the research hypotheses, several methodological steps are employed:

- Count country averages were computed for each of the two periods, 2015-2019 and 2020-2021, for all the variables considered in the analysis.
- Assessing the significance of the differences between the two periods for all indicators using the Wilcoxon matched-pairs signed-rank test. The choice for this test was made considering that the distribution of the differences between the two periods is not normal.
- Determining a synthesized measure that will evaluate the level of digital skills of the population by using Principal Components Analysis. The scores of the main component, which will have to capture over 70% of the total variation from the data, will be used as a proxy for measuring digital proficiency in the population of each country.
- Computing, for each country, the slopes of the trend lines for each of the two periods. The comparison made between the slope series before and during the pandemic for each of the five indicators of digital performance will provide insight into which of those indicators are more sensitive to shocks.
- Correlating the digital proficiency with the employment rate of the countries in the sample in each of the two periods. The results will show whether countries with high employment rates have similar levels of digital performance and how the relationship between the two variables changes from one period to the other. Correlation coefficients are computed, and a visual representation of the data is presented.

Descriptive statistics are presented in Table 1. All calculations were made using a standard statistical package (JASP Team (2022). JASP (Version 0.16.3), University of Amsterdam, The Netherlands, https://jasp-stats.org/).

Table 1. Descriptive statistics

	Mean	Std. Deviation	Variance	Minimum	Maximum
Authorities2015_2019	51.059	22.290	496.835	10.000	89.800
Authorities2020_2021	59.595	22.732	516.762	14.000	94.000
Course2015_2019	7.016	4.184	17.505	2.000	20.000
Course2020_2021	17.459	7.768	60.339	4.000	35.000
Email2015_2019	66.827	19.218	369.348	29.300	94.300
Email2020_2021	71.743	19.027	362.023	29.000	96.000
Information2015_2019	64.238	16.371	268.015	33.200	91.000
Information2020_2021	71.500	13.694	187.514	45.000	93.500
Health2015_2019	50.900	10.829	117.271	28.200	69.000
Health2020_2021	57.527	11.665	136.069	32.500	78.500
Employment2015_2019	71.206	8.064	65.024	54.400	86.500
Employment2020_2021	72.400	7.877	62.047	51.300	82.000

Source: authors' representation

The descriptive indicators show a consistent increase in digital skills for all five indicators, the most notable being registered for using the internet for online courses. There is also an increase in the employment rate average, with slight decreases in the minimum and maximum values but with a higher homogeneity among countries.

To evaluate if the differences in digital proficiency are significant before and during the pandemic periods, the nonparametric Wilcoxon matched-pairs signed-rank test is applied (table 2), since the differences for interest variables are not normally distributed.

Table 2. Wilcoxon signed-rank test

Measure 1	Measure 2	z	p	Rank-Biserial Correlation
Authorities2015_2019	- Authorities2020_2021	-5.303	< .001	-1.000
Course2015_2019	- Course2020_2021	-5.303	< .001	-1.000
Email2015_2019	- Email2020_2021	-4.866	< .001	-0.917
Information2015_2019	- Information2020_2021	-4.504	< .001	-0.846
Health2015_2019	- Health2020_2021	-4.707	< .001	-0.888

Source: authors' representation

The rank-biserial correlation highlights an important increase between the levels of the 5 indicators in the period 2020-2021 compared to 2015-2019, with values above 0.5 and probabilities below 0.05 confirming, according to Cohen's criteria, a significant effect (Cohen, 1988).

A factorial analysis using Principal Component Analysis (PCA) was performed to synthesize and then capture the main components that could characterize the level of digital skills of different people to finally check the

existence of a statistical correlation between digital proficiency and the employment rate for the two periods considered (pre- and post-pandemic COVID-19).

The Kaiser-Meyer-Olkin test (Table 3) verifies whether our sample is suitable for analysis. The KMO values of 0.869 for 2019 and 0.837 for 2021 that we obtained after data processing are considered very good (Kaiser, 1974).

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**2015-2019**	**2020-2021**
		0.869	0.837
Bartlett's Test of Sphericity	Approx. Chi-Square	197695	193710
	df	10	10
	Sig.	,000	,000

Source: authors' representation

The Bartlett sphericity test $\chi 2 = 197695$ for the period before the pandemic and $\chi 2 = 193710$ for the period 2020-2021 ($p<0.001$ in both cases) indicates that the correlations between the variables were large enough to apply the Principal Component Analysis method (Table 3).

Table 4. Total Variance Explained 2015-2019

Component	**InitialEigenvalues**			**ExtractionSums of SquaredLoadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.203	84.069	84.069	4.203	84.069	84.069
2	.366	7.327	91.397			
3	.252	5.043	96.439			
4	.119	2.373	98.812			
5	.059	1.188	100.000			

Extraction Method: Principal Component Analysis

Source: authors' representation

Table 5. Total Variance Explained 2020-2021

Component	**InitialEigenvalues**			**ExtractionSums of SquaredLoadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.238	84.756	84.756	4.238	84.756	84.756
2	.295	5.909	90.665			
3	.264	5.288	95.953			
4	.132	2.633	98.586			
5	.071	1.414	100.000			

Extraction Method: Principal Component Analysis.

Source: authors' representation

As presented in Tables 4 and 5, after the analysis we have for each year considered we have only one component with eigenvalue value greater than 1, which explains 84,069% of the total variance of the data from 2015-2019 and 84,756 % in

the case of the period 2020-2021. Given that the scores of the component extracted for the two analysed periods represent an aggregate variable that gives us the possibility to obtain information about the units' positioning within the data set, the scores were saved using the regression method as separate variables for each period (DiStefano et al., 2009). Consequently, for both periods, only the first component was retained, and its scores were further used as a proxy for measuring the digital proficiency of a population.

3. Results and discussion

H1. There is an intensification of digital skills during the pandemic compared to the period before:

For each of the 5 indicators, there is an increase in averages in the period 2020-2021 compared to the period 2015-2019 and an increase in their values in general, with higher minimum and maximum values in the period of the pandemic (Table 1)

The most important increase is observed in the percentage of people who used the Internet for online courses, from 7.016% in the period 2015-2019 to approximately 17.459% in the period 2020-2021, the COVID-19 pandemic causing the translation of most education and training programs into e-learning (Meulenbroeks, 2020).

The outbreak of the COVID-19 pandemic was a factor in accelerating the natural process of adapting societies to new socioeconomic realities. The survey carried out by Eurostat shows us that in less than six months from the beginning of the pandemic, the average number of people connected to digital networks increased by 3% (Schöbel et al., 2021), and for the OECD countries, the fixed broadband subscriptions increased by 14% in 2020 relative to the previous year (OECD, 2021).

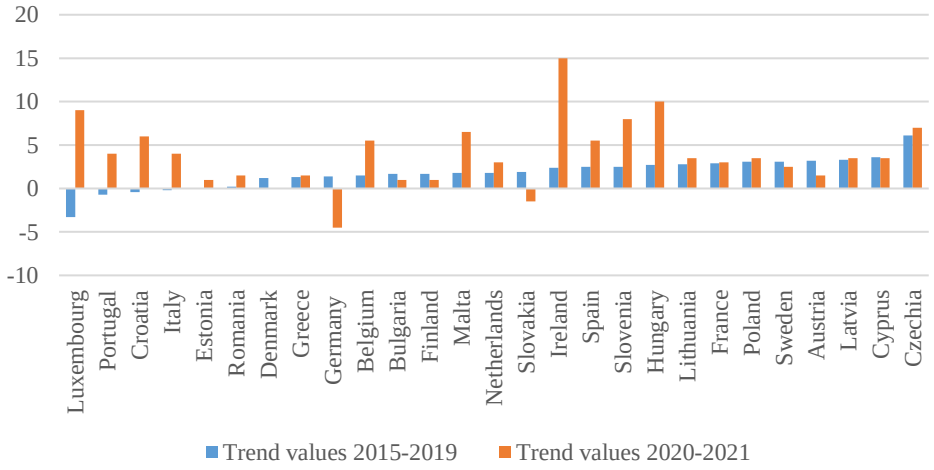
It can be stated that the amplification of the digitization process in the member/candidate countries in Europe is due to the inertia generated by the policies adopted before the pandemic, but especially to the awareness by all parties involved (authorities and population; employees and employers) of the positive effects that the call to the new technologies and the acquisition/improvement of digital skills have on the salary level and labour productivity (Piroșcă et al., 2021), the reduction of transaction costs and the identification of new opportunities (Lungu et al., 2021) or decisional transparency.

Thus, research hypothesis H1. is validated, and the pandemic, introduced in the analysis by separating the data into the two specific periods, could weigh in trying to explain the before-and-after differences in digital performance.

H2. The increase in digitalization is seen mainly in communicating with public authorities and in accessing information about health:

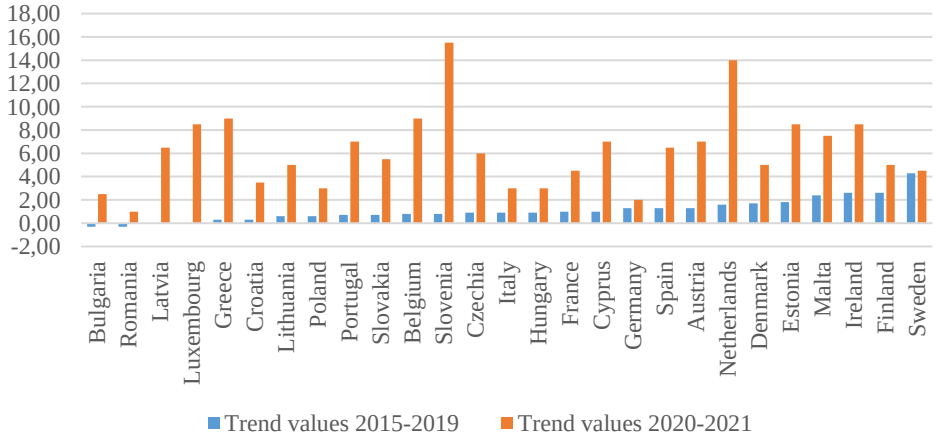
To better highlight, comparatively for the two periods, the variation of the five indicators of digital performance, as well as the different country dynamics, for each country in the sample, two trend values (i.e., slopes of the trend lines) were computed – one for the period before the pandemic and one for the period during the pandemic. The visual representation of these trend values for the countries in the sample and for the two periods are displayed in Figures 1 to 5.

Figure 1. Individuals using the internet for interaction with the public authorities – comparative trend values before and during the pandemic



Source: authors' representation based on Eurostat data

Figure 2. Individuals using the internet for doing an online course – comparative trend values before and during the pandemic

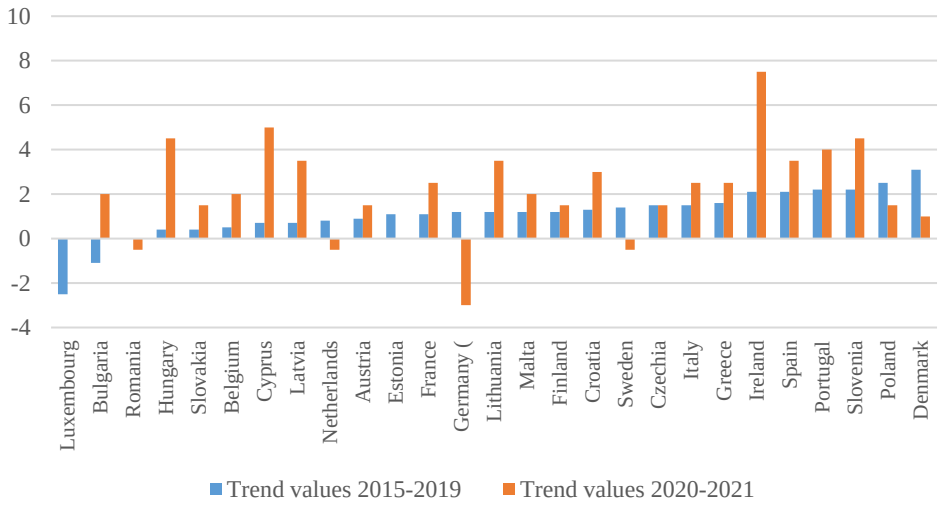


Source: authors' representation based on Eurostat data

The analysis of the trend slopes for this indicator shows a relative homogeneity for all the countries in the selected sample (Figure 1). Ireland, Luxembourg and Hungary present the highest emphasis on the importance attributed to online communication with the authorities during the pandemic. In the case of Germany and Slovakia, there was a decrease in the use of this digital skill in the pandemic period, while for Austria, Denmark and Sweden, there was a slower pace in the pandemic vs. before the pandemic, but still a positive trend.

For the indicator measuring the digital skill of doing online courses (Figure 2), there are consistently higher trend values in the period during the pandemic compared to the pre-pandemic period in all countries. The most notable difference between the two periods is observed for the Netherlands and Slovenia, with a more than 10% increase in trend values during the pandemic.

Figure 3. Individuals using the internet for sending/receiving e-mails – comparative trend values before and during the pandemic



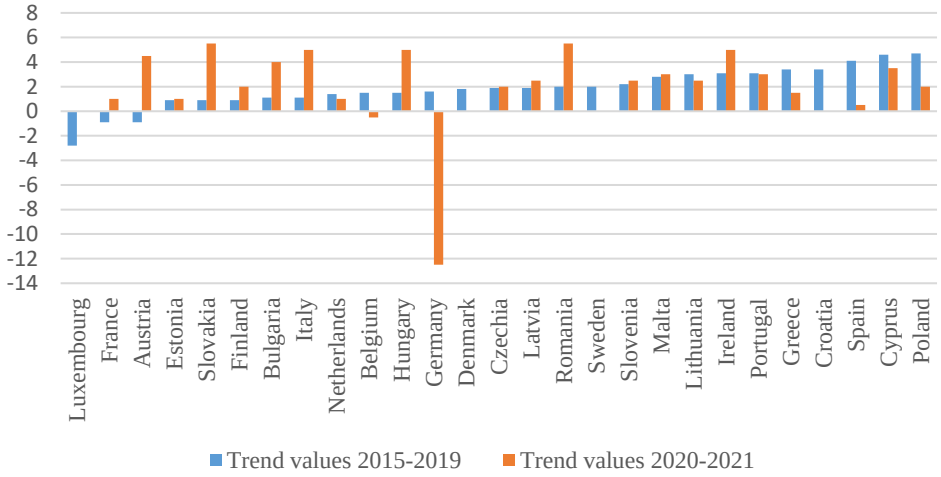
Source: authors' representation based on Eurostat data

Most countries have intensified the digital skill used for sending/receiving e-mails during the pandemic, with Ireland having the highest increase and Germany the highest decrease in trend values in the period during the pandemic (Figure 3).

When analysing the trends for the use of the Internet to find information about goods and services (Figure 4), there is an important decrease for Germany, and a modest one for Belgium in the pandemic period comparing to the pre-pandemic behaviour. For the rest of the sample, the trend continues to be positive during the pandemic with significant higher rates (Austria, Slovakia, Bulgaria, Italy, Hungary, Romania, Ireland) or similar or smaller rates comparing to the pre-pandemic period.

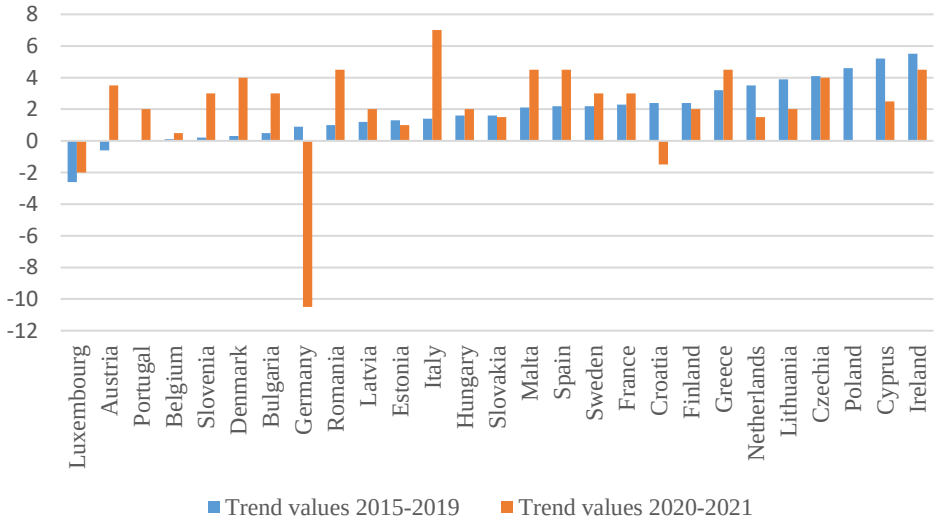
The case of Austria and France is interesting, both having a negative trend before the pandemic and a positive one during the sanitary crisis.

Figure 4. Individuals using the internet to find information about goods and services – comparative trend values before and during the pandemic



Source: authors' representation based on Eurostat data

Figure 5. Individuals using the internet to seek health-related information - comparative trend values before and during the pandemic



Source: authors' representation based on Eurostat data

The online tools are not limited to e-commerce, portals, official websites etc. We should not neglect the increasing importance of electronic word-of-mouth, customers having the opportunity to spread their experiences and to formulate personal opinions regarding the products they bought, using different platforms such as social media, review websites and brand websites, and thus influencing other customers' behaviour (Ilieva and Boteva, 2023).

Similar trends are visible for individuals using the internet to seek health-related information (Figure 5). While the trend become negative during the pandemic for Germany and Croatia, it remains negative for Luxembourg, being positive for all the other countries. For most of the sample the rates are significantly higher during the pandemic comparing to the pre-pandemic situation, the exceptions being represented by Estonia, Slovakia, Finland, Lithuania, Czechia, Cyprus, and Ireland.

Except for the digital skills used for doing online courses, the results do not highlight a faster growth of digital skills of individuals in the EU in the pandemic period compared to the pre-pandemic period. The effect of the COVID-19 pandemic cannot be considered a coherent accelerator in terms of acquiring significantly improved digital skills in a population, even if, due to the respective context, a large part of the economic activities was carried out mainly online.

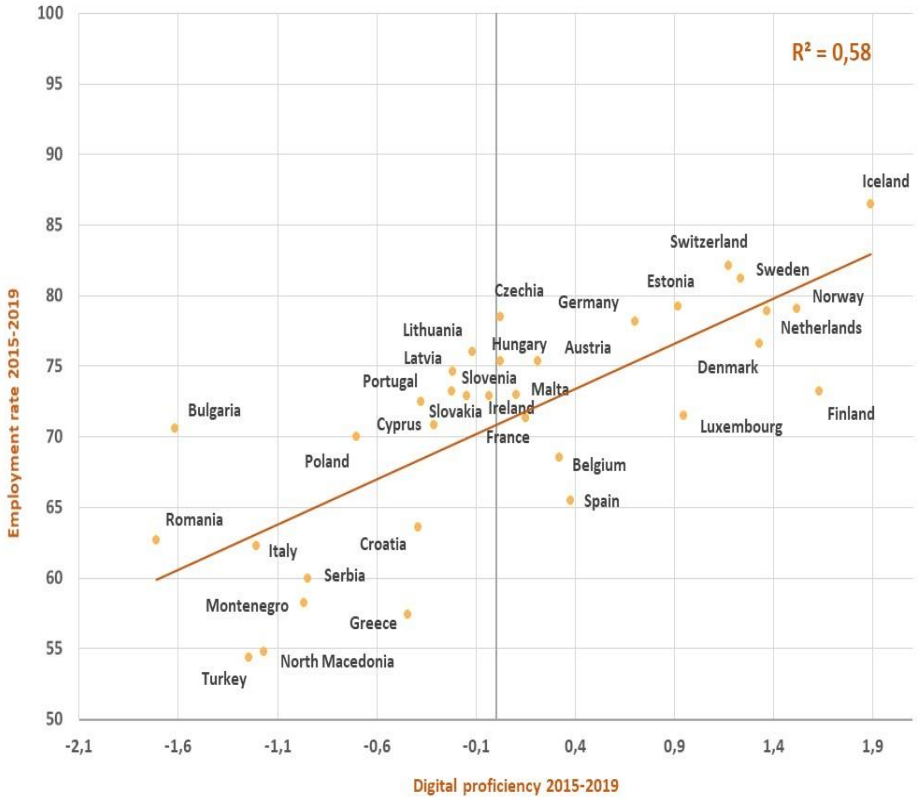
Research hypothesis H2. cannot be validated by these results, the increases in using digital skills for accessing information about health and for communicating with the authorities not being the most notable ones.

H3. Countries with a high level of digital proficiency have high employment rates, especially during the pandemic:

For both pre- and during pandemic periods, the relationship between digital proficiency and employment is examined graphically by plotting the coordinates for the two variables for all countries in the sample and numerically by computing correlation coefficients, as presented in Figures 6 and 7.

The results show, for the pre-pandemic period, that digital proficiency is strongly correlated with employment (Figure 6). Moreover, it could easily be seen that there is still an important gap between EU member and candidate countries when assessing the digital competences of the population. Countries with higher digital proficiency scores have a higher employment rate, while countries with a lower position in the digitalization process face lower employment rates. In the group of countries with high values for both digital proficiency and employment, there are Sweden, Norway, Denmark, Switzerland, the Netherlands and Luxembourg. The common feature of these economies is the high share in GDP of the service sector and the production of high-performance technologies. In these economies, digitization and the accumulation of digital skills emerged as a natural process of assimilation of new technologies, equally by employees and employers, authorities, and the population.

Figure 6. Digital proficiency and the employment rate in the pre-pandemic period

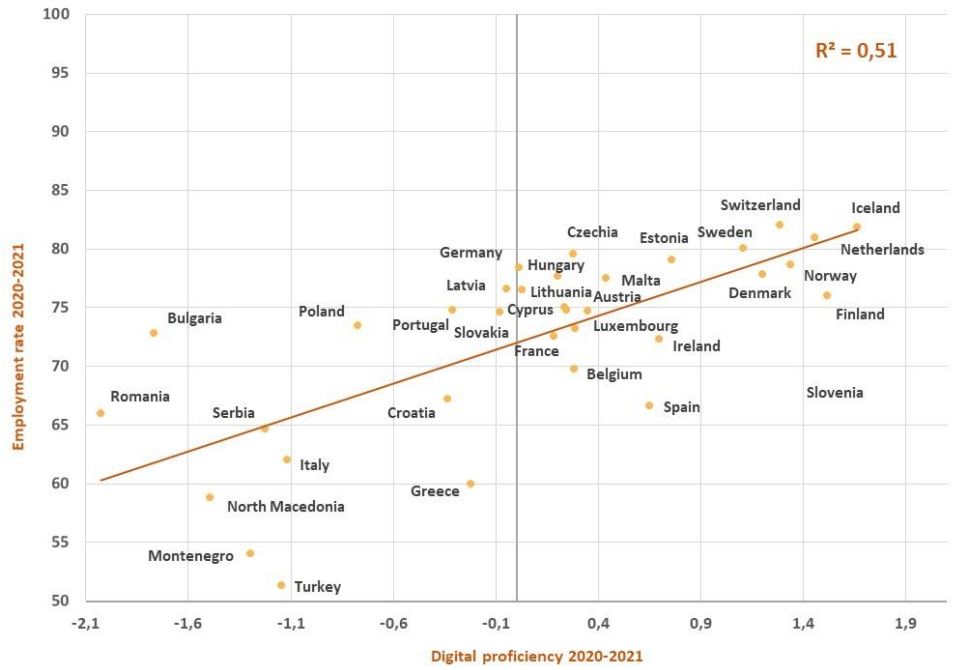


Source: authors' representation

The opposite group of countries, with low digital proficiency and/or low employment rates, includes newer EU member states such as Romania and Bulgaria and the candidate countries.

For the period during the pandemic, there is also a strong correlation observed between digital proficiency and employment (Figure 7), with a notable difference between the Western and Eastern countries. The Nordic countries stand out, with high values for both variables. Except for Italy and Greece, which make a discordant note, all Western European states form a relatively compact group from the perspective of associating high employment with high digital proficiency.

Figure 7. Digital proficiency and the employment rate in the period during the pandemic



Source: authors' representation

There is an observable difference in the countries' display when comparing the results from the two analysed periods. In the pre-pandemic period, there are three clusters of countries that can be observed in the scatterplot: the group with high employment and high digital proficiency, formed by the Nordic countries, Switzerland, Estonia, Luxembourg and Netherlands; the group with low levels of employment and digital skills, with Romania, Bulgaria, Italy, Greece, Poland, Croatia and the candidate countries; and the middle group, with the rest of the countries in the sample. When examining the period during the pandemic, the countries are visually grouped into two clusters. The middle cluster forms the pre-pandemic period, migrating in the quadrant with high employment and digital proficiency. Additionally, during the pandemic, a stronger correlation between employment and digital skills can be observed for the countries with high values for the two, as they are more grouped around the regression line, proving that the relationship between the two variables is more stable for this cluster of countries than for the group with low employment and digital proficiency.

In addition, the diversity of types and groups of Internet users widens the gap between incomes and implicitly the employment rates of different socioeconomic categories, as people with a high qualification and implicitly with a high level of

digital skills can adapt faster with new technologies. The study conducted by the Whitacre demonstrates this fact, highlighting the impact of the efficient use of the Internet on income in the sense that individuals belonging to the middle class have significantly higher earnings than those who perform low-skilled activities and belong to lower classes. (Whitacre et al., 2014)

The resilience of the labour market brought by digitization is also amplified by a series of factors, such as education, entrepreneurial dynamics or income level. Education, on both its levels, formal and informal, plays a fundamental role in ensuring the flexibility of the labour market. The orientation of the educational system towards the development of digital capabilities is very important (Pană & Fanea-Ivanovici, 2019). There is a direct relationship between the level of education and income and that of digital proficiency. Thus, in the EU28, in 2019, only one quarter of low educated and almost 90% of highly educated individuals had basic or above basic digital skills (Zamfir & Aldea, 2020). From the perspective of the level of income, the statistics are conclusive for our study. The categories of people with a low level of income and with low formal education are the most vulnerable. There is also a remarkable difference regarding digital skills between the EU28 states, varying from 29% in Bulgaria to over 70% in Nordic countries and Germany (Zamfir & Aldea, 2020).

The results of our research are confirming the conclusions of some previous studies, such as those showing that the use of Internet is strongly correlated with the level of the individual salaries (DiMaggio & Bonikowski, 2008). Additionally, given that wage income levels are closely correlated with digital competence and the use of the Internet, a sustained effort to increase the digital skills of individuals can have multiple beneficial values in terms of flexibility and efficiency of the labour market (Piroșcă et al., 2021), inevitably leading to a higher occupancy rate.

All these results contribute to stating that the research hypothesis H3. is validated by the empirical findings and is consistent with previous studies.

5. Conclusions

Markets are unstable by their nature and their internal functioning mechanism. At the same time, during an economic crisis or under the pressure of exogenous shocks, the degree of instability is accentuated. Compared to the other components of the economic system, the labour market presents a particular specificity generated by the high degree of volatility caused by the inherence of adaptation and adjustment to the changing conditions of the entrepreneurial environment. The dramatic situation induced by the spread of the COVID virus and the settlement of the pandemic situation by the World Health Organization in March 2020 accentuated instability and uncertainty already existing in the economy and implicitly in the labour market at the global level.

The results of the analysis regarding the relationship between the performance of labour market performance and the digitalization process confirm, first, that contemporary human society is much more prone to accepting and using new technologies than in the case of previous technological revolutions. Thus, the pessimistic view on the future of the labour market is refuted. The assumption that new technologies are generators of unemployment and poverty for the population turns out to be false in the context of the trade fair in the medium or long term. The dynamics of labour demand and supply during this period provide us with a relevant image of the sustainability-performance binomial.

Second, the results are consistent with other findings that underline the fact that, in the context of a similar trend, with an increasing rate of assimilating information technologies, there are still significant differences in pace and impact between EU member states and candidate countries. The structure of each national economy, the general available infrastructure (communication, transportation, utilities, etc.), standards of living and personal incomes can explain these differences. The comparative analysis carried out for the two periods indicates the maintenance of these differences.

The correlation between employment rate and digital proficiency is statistically significant for both periods, leading us to the idea that the assimilation of new technologies and the improvement of digital skills can represent important sources but not singular determinants of the resilience of the labour market.

Finally, the amplification of the digitalization process during the pandemic as a result of online education, work at home or an increased preference of many companies towards online activities to meet the basic needs of consumers and to avoid bankruptcy creates new opportunities, both in terms of the entrepreneurship and the personal development of employees. Even if the pandemic will completely end, the acquired digital skills and the experience in using information technologies will be the basis of a new digital culture for the next generations.

Thus, it is obvious that decision-makers at both the national and regional levels should be aware of the importance of implementing effective policies in education to achieve a real improvement of the population's digital skills and finally to offer better integration into the labour market for everyone. At the same time, as our study shows, it is important to reduce the existing regional disparities between the member states, as well as between them and the candidate countries, from this perspective. Additionally, because the present study is limited to only one variable regarding the performance of the labour market and only a few indicators that characterize the digital performance of an individual, it is necessary to continue research in this field.

Acknowledgement: This paper was supported by the Erasmus+ programme of the European Union, under the Jean Monnet Chair *Doing Resilient Business on the*

European Market - DO RE BIZ (project number ERASMUS-JMO-2022-HEI-TCH-RSCH-101085838).

References

Abuselidze, G., & Mamaladze, L. (2021). The impact of artificial intelligence on employment before and during pandemic: A comparative analysis. *Journal of Physics: Conference Series*, Volume 1840, XII International Conference on Mathematics, Science and Technology Education (ICon-MaSTEd 2020) 15-17 October 2020, Kryvyi Rih, Ukraine. https://doi.org/10.1088/1742-6596/1840/1/012040

Braverman, H. (1974). Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century. *Monthly Review*, *26*(3). https://doi.org/10.14452/MR-026-03-1974-07_1

Chen, B., Marvin, S., & While, A. (2020). Containing COVID-19 in China: AI and the Robotic Restructuring of Future Cities. *Dialogues in Human Geography*, *10*(2), 238-241. https://doi.org/10.1177/2043820620934267

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203771587

Columbus, L. (2017). How Artificial Intelligence Is Revolutionizing Business in 2017. *Forbes*. https://www.forbes.com/sites/louiscolumbus/2017/09/10/how-artificial-intelligence-is-revolutionizing-business-in-2017/

Da Silva, V. L., Kovaleski, J. L., Pagani, R. N., Silva, J. D. M., & Corsi, A. (2020). Implementation of Industry 4.0 Concept in Companies: Empirical Evidence. *International Journal of Computer Integrated Manufacturing*, *33*(4), 325-342. https://doi.org/10.1080/0951192X.2019.1699258

Digilina, O. B., Teslenko, I. B., & Abdullaev, N. V. (2020). New Developments in the Labor Market Amid the COVID-19 Pandemic. *Advances in Social Science, Education and Humanities Research*, *486*, 12-16. https://doi.org/10.2991/assehr.k.201105.003

DiMaggio, P., & Bonikowski, B. (2008). Make Money Surfing the Web? The Impact of Internet Use on the Earnings of U.S. Workers. *American Sociological Review*, *73*(2), 227-250. https://doi.org/10.1177/000312240807300203

DiStefano, C., Zhu., M., & Mîndrilă, D. (2009). Understanding and Using Factor Scores: Considerations for the Applied Researcher. *Practical Assessment, Research, and Evaluation, 14*(20). https://doi.org/10.7275/da8t-4g52

Frey, C. B., & Osborne, M. (2013). *The Future of Employment: How Susceptible Are Jobs to Computerisation?*. Oxford: Oxford Martin Programme on Technology and Employment, Oxford Martin School, University of Oxford. https://doi.org/10.1016/j.techfore.2016.08.019

Giannakis, E., & Mamuneas, T. P. (2022). Labour productivity and regional labour markets resilience in Europe. *The Annals of Regional Science*, *68*, 691-712. https://doi.org/10.1007/s00168-021-01100-y

Holtgrewe, U. (2014). New technologies: the future and the present of work in information and communication technology. *New Technology Work and Employment*, *29*(1), 9-24. https://doi.org/10.1111/ntwe.12025

Ilieva, G., & Boteva, D. (2023). Effects of electronic word-of-mouth (eWOM) drivers on customers' behaviour. *Eastern Journal of European Studies*, *14*(SI), 58-78. https://doi.org/10.47743/ejes-2023-SI04

Keynes, J. M. (1931). *Essays in Persuasion.* London: Macmillan.

Kuznetsova, A., Selezneva, A., Askarov, A., Askarova, A., & Gusmanov, R. (2021). Trends of Labor Market Change in the Countries of the European Union and Russia under Conditions of Digitalization of the Economy. *Montenegrin Journal of Economics* *17*(1), 175-183. https://doi.org/10.14254/1800-5845/2021.17-1.13

Lungu, A. E., Bogoslov, I. A., Stoica, E. A., & Georgescu, M. R. (2021). From Decision to Survival - Shifting the Paradigm in Entrepreneurship during the COVID-19 Pandemic. *Sustainability*, *13*(14), 7674. https://doi.org/10.3390/su13147674

Madakam, S., Holmukhe, R. M., & Jaiswal, D. K. (2019). The Future Digital Work Force: Robotic Process Automation (RPA). *JISTEM - Journal of Information Systems and Technology Management*, *16*. https://doi.org/10.4301/S1807-1775201916001

Méda, D. (2016). The future of work: The meaning and value of work in Europe. *International Labour Office Research Paper*, 18. https://hal.science/hal-01616579v1

Meulenbroeks, R. (2020). Suddenly fully online: A case study of a blended university course moving online during the Covid-19 pandemic. *Heliyon*, *6*(12). https://doi.org/10.1016/j.heliyon.2020.e05728

Miyamoto, H., & Takahashi, Y. (2011). Productivity growth, on-the-job search, and unemployment. *Journal of Monetary Economics*, *58*(6-8), 666-680. https://doi.org/10.1016/j.jmoneco.2011.11.007

Newell, A., & Simon, H. (1956). The logic theory machine – A complex information processing system. *IRE Transactions on Information Theory*, *2*(3), 61-79. https://doi.org/10.1109/TIT.1956.1056797

Pană, M. C., & Fanea-Ivanovici, M. (2019). Institutional Arrangements and Overeducation: Challenges for Sustainable Growth. Evidence from the Romanian Labour Market. *Sustainability*, *11*(22), 6459. https://doi.org/10.3390/su11226459

Pirosçă, G. I., Șerban-Oprescu, G. L., Badea, L., Stanef-Puică, M. R., & Valdebenito, C. R. (2021). Digitalization and Labor Market—A Perspective within the Framework of Pandemic Crisis. *Journal of Theoretical and Applied Electronic Commerce Research*, *16*(7), 2843-2857. https://doi.org/10.3390/jtaer16070156

Schöbel, S., Saqr, M., & Janson, A. (2021). Two Decades of Game Concepts in Digital Learning Environments - A Bibliometric Study and Research Agenda. *Computers & Education*, *173*, 104296. https://doi.org/10.1016/j.compedu.2021.104296

Surico, P., & Galeotti, A. (2020). *The economics of a pandemic: the case of Covid-19*. London: Wheeler Institute for Business and Development, London Business School. https://www.london.edu/think/the-economics-of-a-pandemic

Ţarcă, E., Roşu, T. S., Luca, A., Ciomagă, I. M., Murgu, A., & Ţarcă, V. (2021). Decrease in birth rate as an important factor of demographic aging in Romania. *Pediatru.ro*, *61*(1), 34-37. https://doi.org/10.26416/Pedi.61.1.2021

Țarcă, V., Țarcă, E., & Luca, F. A. (2022). The Impact of the Main Negative Socio-Economic Factors on Female Fertility. *Healthcare*, *10*(4), 734. https://doi.org/10.3390/healthcare10040734

Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving Effective Remote Working during the COVID-19 Pandemic: A Work Design Perspective. *Applied Psychology*, *70*(1), 16-59. https://doi.org/10.1111/apps.12290

Whitacre, B., Gallardo, R., & Strover, S. (2014). Broadband's Contribution to Economic Growth in Rural Areas. *Telecommunications Policy*, *38*(11), 1011-1023. https://doi.org/10.1016/j.telpol.2014.05.005

Zamfir, A. M., & Aldea, A. B. (2020). Digital Skills and Labour Market Resilience. *Postmodern Openings*, *11*(1Sup2), 188-195. https://doi.org/10.18662/po/11.1sup2/151