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Measuring the effect of health on cross-country income variability

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Abstract

We construct a human capital series adjusted for measures of health based on a new dataset from World Bank for a large sample of countries. We show that the health-adjusted series of human capital increases the explanatory power of factor inputs by seven percentage points in explaining cross-country income variability, which represents 35% of the variation generated by human capital. This result shows the importance of measures of health in human capital. It is robust to changes in the sample of countries and to how we measure the schooling component of human capital.

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1. Introduction

The development of technology is changing the world at an unprecedented rate, and the technological revolution is influencing the organization of governance and decision-making in both the public and private sectors. Public authorities must have a digital infrastructure that provides leadership in the field of digital transformation and contributes to added value, allowing such organizations to respond quickly to present threats and the challenges of the future (Hai et al. 2021).

In the run-up to the COVID-19 pandemic, public service authorities and governments in many countries developed and implemented a digital transformation strategy. After the pandemic spread to most of the world, approaches and working models for further digitization were revised to provide effective services to businesses and citizens (Ting et al. 2020).

An important goal of the digital strategy of the EU countries is the development of an open, democratic and sustainable society, which includes the digital transformation of public administration. This issue is particularly acute at the EU level, taking into account the conditions of the pandemic. Research is currently underway into the need for a European space for digital services and reliable data protection (European Commission, Directorate-General for Communications Networks, Content and Technology 2020c). For 21st century Europe, concrete measures and goals are becoming more important than ever to achieve the digital transformation of public administration in a pandemic (Cavallini and Soldi 2021).

This article aims to explore the homogeneity and pace of digital transformation of public administration through the impact of the COVID-19 pandemic and to identify problems and forecasts of research processes at the EU level. The following hypotheses were put forward to analyze the problems and prospects of the COVID-19 pandemic's impact on the digital transformation of public administration:

EU countries have uneven results from public administration digital transformation.

The overall pace of the digital transformation of public administration in the EU has accelerated due to the impact of the COVID-19 pandemic.

1.2 Literature Review

The use of new technologies in public administration is usually understood as a component of improving the efficiency of public administration, a way of digitizing documents, disseminating information, and communicating with citizens. Examining current publications related to digitization, Kraus et al. (2021) note that the concept of digital transformation in the literature is interpreted differently, but covers virtually all aspects of the economy from the private sector to government organizations.

Digital transformation can be defined as an organizational shift to big data, analytics, the cloud, mobile communication technologies, and social media platforms to provide goods and services (Bresciani et al. 2021). The digital transformation of public administration involves the use of digital technologies to provide services or administrative management in the context of replacing non-digital or manual processes with the latest processes or technologies. At the same time, digital solutions not only improve traditional methods but also affect the efficiency of services and promote innovation and creativity (Boban and Klaric 2021). As noted by Ting et al. (2020) it is time for organizations and governments to realize the importance of digital transformation, which is gradually changing approaches to public administration. Digitization-based public administration will have a positive impact on the economy and will be able to increase citizen involvement in civil society and e-government (Alvarenga et al. 2020). Therefore, digital transformation is not only a means of improving the current model of public administration. Repa (2021) notes that for public administration, the idea of digital transformation is gradually being implemented as e-government, Belo (2021) emphasizes the importance of moving to the National Network for Open Administration in the EU.

Kingdom of Denmark	14.88	15.30	12.08	18.51	11.79	14.48	19.17	21.77	57.92	70.06
Republic of Finland	16.50	17.78	9.93	12.82	12.69	14.87	19.01	21.68	58.13	67.15
Kingdom of Sweden	15.93	16.14	12.42	14.89	11.50	14.08	18.54	20.99	58.39	66.10
Kingdom of the Netherlands	14.87	15.39	10.83	17.11	11.39	12.67	17.37	19.98	54.46	65.15
Ireland	12.17	13.52	8.38	14.10	10.68	12.01	17.91	20.65	49.13	60.28
Republic of Malta	13.35	12.27	9.86	13.53	10.10	12.71	18.65	21.05	51.96	59.56
Republic of Estonia	13.63	14.48	10.19	11.64	8.11	10.37	20.20	22.94	52.12	59.43
Grand Duchy of Luxembourg	13.32	14.05	12.02	15.24	8.61	9.86	17.60	19.84	51.54	58.98
Kingdom of Spain	11.39	12.08	11.77	15.51	8.89	9.69	17.50	20.17	49.55	57.45
Republic of Austria	13.49	13.34	8.56	13.25	8.41	10.33	17.26	19.96	47.72	56.87
Federal Republic of Germany	13.44	13.81	9.79	14.50	7.63	8.89	14.22	16.87	45.08	54.07
Kingdom of Belgium	12.67	12.70	8.45	12.10	10.70	12.44	14.28	16.46	46.09	53.70
Republic of Slovenia	11.57	11.95	10.55	13.30	9.44	10.58	14.37	17.00	45.93	52.83
Republic of Lithuania	10.93	11.54	9.71	10.43	9.24	10.30	16.82	19.51	46.70	51.78
French Republic	11.49	11.84	9.57	11.85	7.31	8.69	15.58	18.25	43.95	50.71
Portuguese Republic	10.30	11.39	10.37	12.13	8.54	9.14	15.09	17.24	44.31	50.63
Republic of Latvia	9.98	10.28	12.09	12.59	5.20	6.70	17.25	19.91	44.51	49.90
Czech Republic	11.28	11.79	9.02	11.16	8.34	9.77	12.50	14.65	41.13	49.48
Republic of Croatia	11.90	11.68	7.93	11.35	7.76	9.99	10.78	12.99	38.37	47.36
Italian Republic	8.78	8.78	8.91	10.59	7.55	10.36	13.29	15.80	38.52	46.02
Republic of Cyprus	10.30	9.92	7.11	10.45	6.73	7.63	12.84	15.46	36.98	45.53
Slovak Republic	11.06	10.94	8.49	11.56	6.71	7.27	11.42	13.43	37.68	43.46
Hungary	9.79	10.12	9.73	13.00	5.12	5.82	10.65	12.29	35.29	43.21
Republic of Poland	9.13	9.42	8.07	11.33	5.32	6.47	11.42	13.78	33.94	41.23

Hellenic Republic	8.98	10.26	5.93	9.43	6.54	7.13	8.60	10.49	30.06	41.00
Republic of Bulgaria	8.31	8.18	8.14	9.52	4.53	5.12	11.74	14.01	32.72	37.31
Romania	7.56	8.26	10.85	13.29	4.98	5.94	3.68	5.37	27.08	36.83

Sources: Compiled by the authors on the data from Directorate-General for Communications Networks, Content and Technology, Data Visualization Tool (2021)

The method of cluster analysis was used to form clusters and establish the degree of similarity of DESI data in different EU countries. An Agglomerative Hierarchical Clustering (AGNES, Agglomerative Nesting) was applied to construct clusters. Our choice of the AGNES is partially substantiated by previous research. The studies, like Bach et al. (2019) and Bluszcz, Manowska (2021) have already shown that a comparison of the EU countries' different characteristics can be conducted by Agglomerative Hierarchical Clustering and indicated that AGNES is one of the appropriate statistical methods to do that. Also, this statistical method is generally well-accepted for analyzing the digital development of different countries (Cruz-Jesus 2017). We used connectivity-based clustering, which is based on the distance between objects, where objects are more related to nearby objects than to objects farther away. To analyze the uniformity of the digital transformation of public administration by cluster analysis, we group the EU countries based on the DESI. We placed the obtained data in the distance matrix and step by step selected the countries whose DESI values are closest to each other and combined them into one cluster. The distance between objects was determined based on the Euclidean distance. In the matrix, the value in the cell formed by row i , column j , represents the distance between object i and object j in the original data set. For instance, element 1,1 represents the distance between object 1 and itself (which is zero). Element 1,2 represents the distance between object 1 and object 2, and so on. (Datanovia 2019). The calculations were made on the base of Excel using the XLSTAT statistical software. The results of cluster analysis are presented in a dendrogram.

To study the changing pace of digital transformation of public administration in the EU under the influence of the COVID-19 pandemic, trend analysis is based on the indicator “Individuals using the Internet to interact with public authorities”. This indicator is calculated as a rate of all individuals aged 16-74 years and measured relations range from simply obtaining information from the EU members' government websites. In this case, public authorities refer to public services and public administration activities at the local, regional or national level. To predict the number of people who use the Internet to interact with public authorities without taking into account the impact of the pandemic, a trend analysis was conducted for the next 5 years (2020-2024) based on actual data for 2009-2019. To determine the impact of the pandemic, the forecast data for 2020-2021 were compared with the actual for the same period. Data were obtained for the period from 2009 to 2021 from Eurostat (2022).

The study used data on the digitization of public administration in EU member states, which are officially published on the websites of the European Commission, in particular:

- Directorate-General for Communications Networks, Content and Technology;
- Directorate-General for Informatics;
- EU Open Data Portal;
- eGovernment Benchmark 2020 and 2021.

3. Results

According to the EU report, most EU members had already begun to digitalize their public sectors and public administration, but the COVID-19 pandemic has accelerated the spread of digital transformation, rendering digital technologies and services imperative for all (Crahay et

al. 2021). EU countries before the COVID-19 crisis invested €875 billion in 2019 in Information and Communication Technologies (ICT), Digital Equipment (DE), intellectual property (IP), software, digital licenses, patents, etc. After 2019 digital investment already grew by 5 percent per year, and the main reason was the rapidly increasing importance of digital technology and innovation because of the COVID-19 pandemic (European Commission, Directorate-General of Communications Networks, Content and Technology 2020c). However, investment, regulation, measures, and steps on the provision of public administration and services were not homogenous across EU countries.

The results obtained for 2019 (before the COVID-19 pandemic) are shown in Table II, the results for 2021 are shown in Table III.

Table II. Results of the cluster analysis of the DESI in the EU countries for 2019

Clusters	First cluster	Second cluster	Third cluster	Fourth cluster	Fifth cluster
The first cluster (Kingdom of Sweden ¹ , Republic of Finland ² , Kingdom of Denmark ³)	0	3.911	18.068	29.798	34.519
The second cluster (Kingdom of the Netherlands ⁴ , Republic of Estonia ⁵ , Republic of Malta ⁶ , Grand Duchy of Luxembourg ⁷ , Kingdom of Spain ⁸ , Ireland ⁹ , Republic of Austria ¹⁰ , Republic of Lithuania ¹¹ , Kingdom of Belgium ¹² , Republic of Slovenia ¹³ , Federal Republic of Germany ¹⁴ , Republic of Latvia ¹⁵ , Portuguese Republic ¹⁶ , French Republic ¹⁷)	3.911	0	4.099	15.546	20.652
The third cluster (Czech Republic ¹⁸ , Italian Republic ¹⁹ , Republic of Croatia ²⁰ , Slovak Republic ²¹ , Republic of Cyprus ²² , Hungary ²³ , Republic of Poland ²⁴ , Republic of Bulgaria ²⁵)	18.068	4.099	0	4.114	9.841
Fourth cluster (Hellenic Republic ²⁶)	29.798	15.546	4.114	0	5.756
Fifth cluster (Romania ⁰)	34.519	20.652	9.841	5.756	0

Sources: Compiled by the authors on the data from European Commission (2021)

Each cluster includes EU countries according to the degree of similarity of public administration based on the Digital Economy and Society Index (DESI) in different EU member-states. As a result, the first cluster in 2019 included 3 countries with the highest level of DESI and the strongest degree of similarity (Kingdom of Sweden¹, Republic of Finland², and Kingdom of Denmark³); the second cluster – 14 countries (Kingdom of the Netherlands⁴, Republic of Estonia⁵, Republic of Malta⁶, Grand Duchy of Luxembourg⁷, Kingdom of Spain⁸, Ireland⁹, Republic of Austria¹⁰, Republic of Lithuania¹¹, Kingdom of Belgium¹², Republic of Slovenia¹³, Federal Republic of Germany¹⁴, Republic of Latvia¹⁵, Portuguese Republic¹⁶, French Republic¹⁷); the third cluster – eight countries (Czech Republic¹⁸, Italian Republic¹⁹, Republic of Croatia²⁰, Slovak Republic²¹, Republic of Cyprus²², Hungary²³, Republic of Poland²⁴, Republic of Bulgaria²⁵); fourth and fifth cluster consist just from one country (Hellenic Republic²⁶ and Romania⁰ respectively).

Table III. Results of the cluster analysis of the DESI in the EU countries for 2021

Clusters	First cluster	Second cluster	Third cluster	Fourth cluster	Fifth cluster
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The first cluster (Kingdom of Denmark ¹ , Republic of Finland ² , Kingdom of Sweden ³ , Kingdom of the Netherlands ⁴)	0	4.917	11.511	28.937	35.43
The second cluster (Ireland ⁵ , Republic of Malta ⁶ , Republic of Estonia ⁷ , Grand Duchy of Luxembourg ⁸ , Kingdom of Spain ⁹ , Republic of Austria ¹⁰)	4.917	0	4.173	20.901	28.086
Third cluster (Federal Republic of Germany ¹¹ , Kingdom of Belgium ¹² , Republic of Slovenia ¹³ , Republic of Lithuania ¹⁴ , French Republic ¹⁵ , Portuguese Republic ¹⁶ , Republic of Latvia ¹⁷ , Czech Republic ¹⁸ , Republic of Croatia ¹⁹ , Italian Republic ²⁰ , Cyprus ²¹ , Slovak Republic ²² , Hungary ²³ , Republic of Poland ²⁴)	11.511	4.173	0	4.172	10.856
Fourth cluster (Hellenic Republic ²⁵ , Republic of Bulgaria ²⁶)	28.937	20.901	4.172	0	6.773
Fifth cluster (Romania ⁰)	35.43	28.086	10.856	6.773	0

Sources: Compiled by the authors on the data from Directorate-General for Communications Networks, Content and Technology, Data Visualization Tool (2021)

The results of cluster analysis indicate the uneven digitization of public administration in the EU, as the gaps between countries are quite significant. In the time since the beginning of the COVID-19 pandemic, there has been some regrouping in the level of digitalization of public administration. The Kingdom of the Netherlands added to the first cluster of countries with the highest level of digitization in 2021, countries in the second and third clusters regrouped, Republic of Bulgaria moved to the fourth cluster with Hellenic Republic, the fifth cluster remained unchanged and consisted of only one country, Romania, which differs significantly from EU countries for all components of the DESI indicator.

According to experts' opinions, EU institutions and governments may need to contribute about €75 billion per year for digital investment in the coming future to close the digital gap between the EU members compared to the most digitally advanced countries. Additionally, education, upskilling, and reskilling of the public administration workers and users of public service may require total investments of €42 billion per year (European Commission, Directorate-General of Communications Networks, Content and Technology 2020c).

After the clustering to visualize the data obtained in 2021, we will build a dendrogram, which provides an opportunity to get an idea of the overall configuration of EU countries in terms of digitalization of public administration. The pairs of objects in the construction of the dendrogram are linked according to the level of connection, which is plotted on the y-axis, taking into account the number of clusters and the relationship between them (see Figure 1).

Thus, five clusters were obtained, which allow the grouping of the EU countries according to the level of digital transformation in 2021. According to the EU Commission report, most countries with a high level of digitalization (all from the first cluster and some from the second, see Table I and Fig. 1) reported no disruption to their public services during the first COVID-19 wave. The EU eGovernment Benchmark 2020 demonstrated that these countries are considered to be highly digitalized when it comes to the provision of public services, scoring well above the European average. The favorable level of public administration in these countries helped to ensure the continuity of public services delivery throughout the COVID-19

crisis (European Commission, Directorate-General for Communications Networks, Content and Technology 2020b).

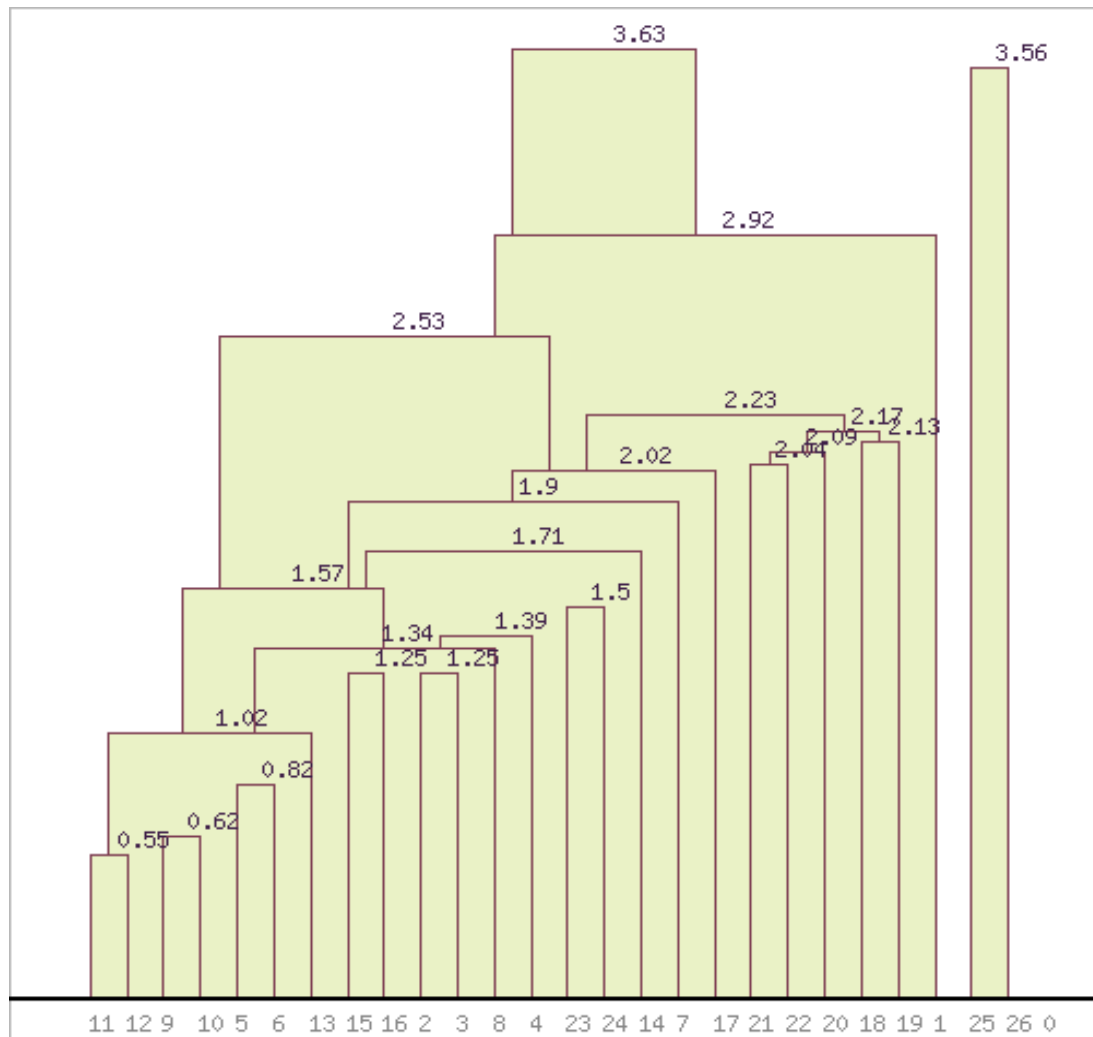


Figure 1. Cluster analysis of the DESI indicator of the EU countries for 2021

Sources: Compiled by the authors

*The numbering of the country corresponds to their numbers, given in Tables I and II

According to the latest eGovernment report (European Commission, Directorate-General for Communications Networks, Content and Technology, 2021), the EU now faced the Non-Consolidated eGov scenario, a scenario where some countries are not fully exploiting ICT opportunities.

By comparing the performances of countries from clusters four and five with similar relative indicators' scores, their scores underperformed in most of the digitalization indicators. The digitalization penetration level in Romania is the worst in Europe and is lower than of any other European country with similar relative performances. The digitalization level is still relatively low, also compared with similar countries like Republic of Bulgaria and Hellenic Republic. Hellenic Republic and Republic of Bulgaria are more On-Track in both Penetration and Digitalization. It means these countries' performances are in line with the EU eGov scenario and can improve the Penetration level by increasing the number of people that submit official forms online to administrative authorities or by automating processes and requesting fewer forms from citizens. Regarding Digitalization, Republic of Bulgaria and Hellenic Republic can further improve their level of back-office and front-office digitalization.

The key source of data to measure the digitalization of public administration is the eGovernment benchmark statement which however only analyses the availability and features of digital public services at the country level. At the same time, a proxy of the availability of eGovernment services is considered to be the number of individuals who use the internet for interaction with public authorities (Cavallini and Soldi 2021). Variability of this indicator is evident across different countries and can be changed as a result of different unexpected impacts.

To analyze and predict the number of individuals using the Internet to interact with public authorities, the actual data for 2009-2019 (without pandemic impact) were used and on this basis, a trend line was built for the next 5 years (2020-2024). The results of the trend analysis since 2019 are shown in Figure 2.

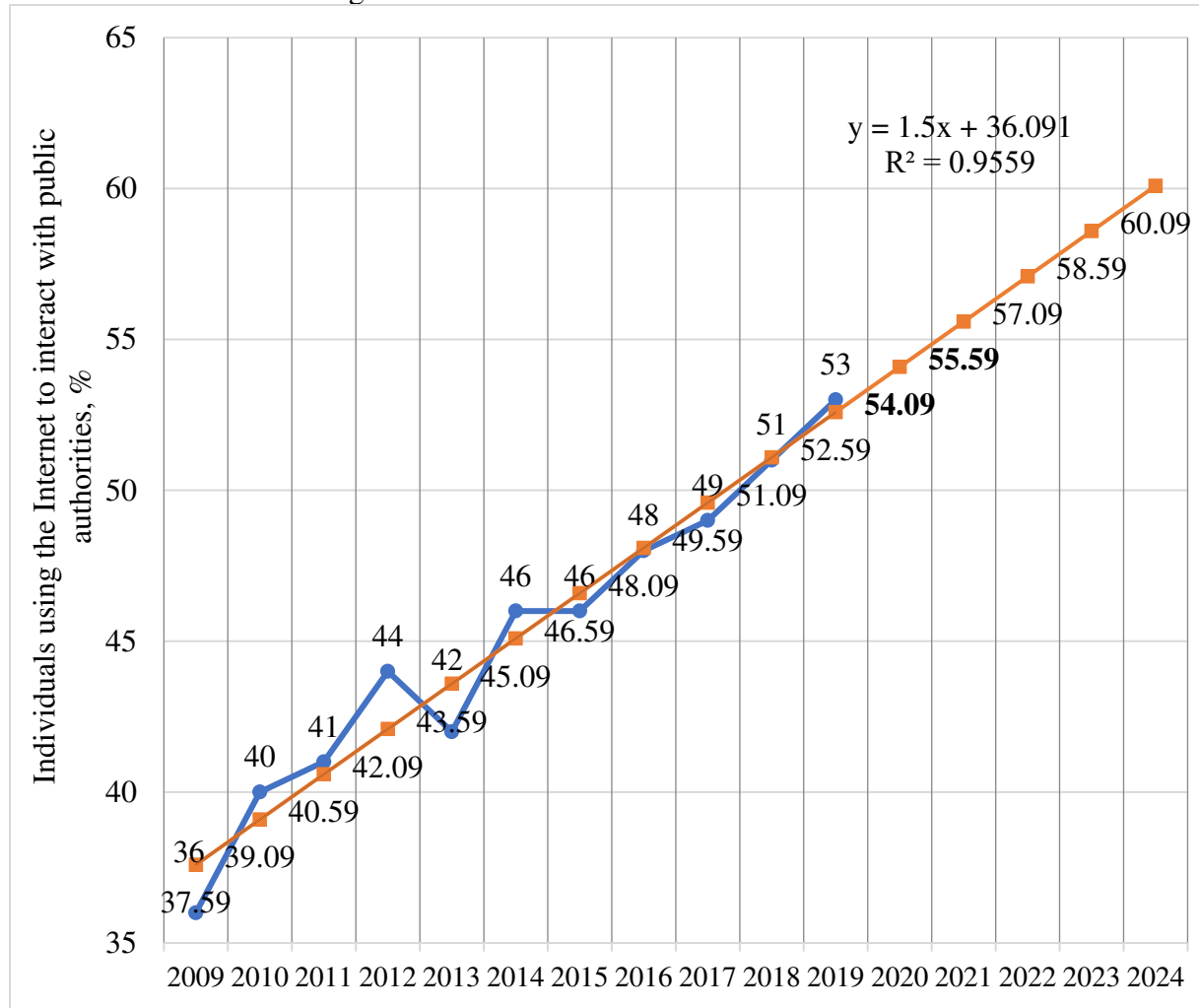


Figure 2. Trend analysis of individuals using the Internet to interact with public authorities in the EU countries without COVID-19 pandemic impact

Sources: Compiled by the authors on the data from Eurostat (2022)

The processes of digital transformation of public administration that have taken place in the EU countries are expected to gradually lead to an increase in the number of people applying for digital administrative services (except for 2013, see Figure 2). Over the ten years analyzed, the share of such users in the EU population increased from 36 percent to 53 percent. The projected figure for 2024 excluding actual data for 2020 and 2021 is 60,09 percent, i.e., 2/3 of the EU population will apply for administrative services by electronic means – via the Internet (see Figure 2).

As the pandemic has affected the ability of citizens to receive administrative services the forecast until 2024 based on the actual data for 2009-2019 plus 2020 and 2021 is shown in Figure 3.

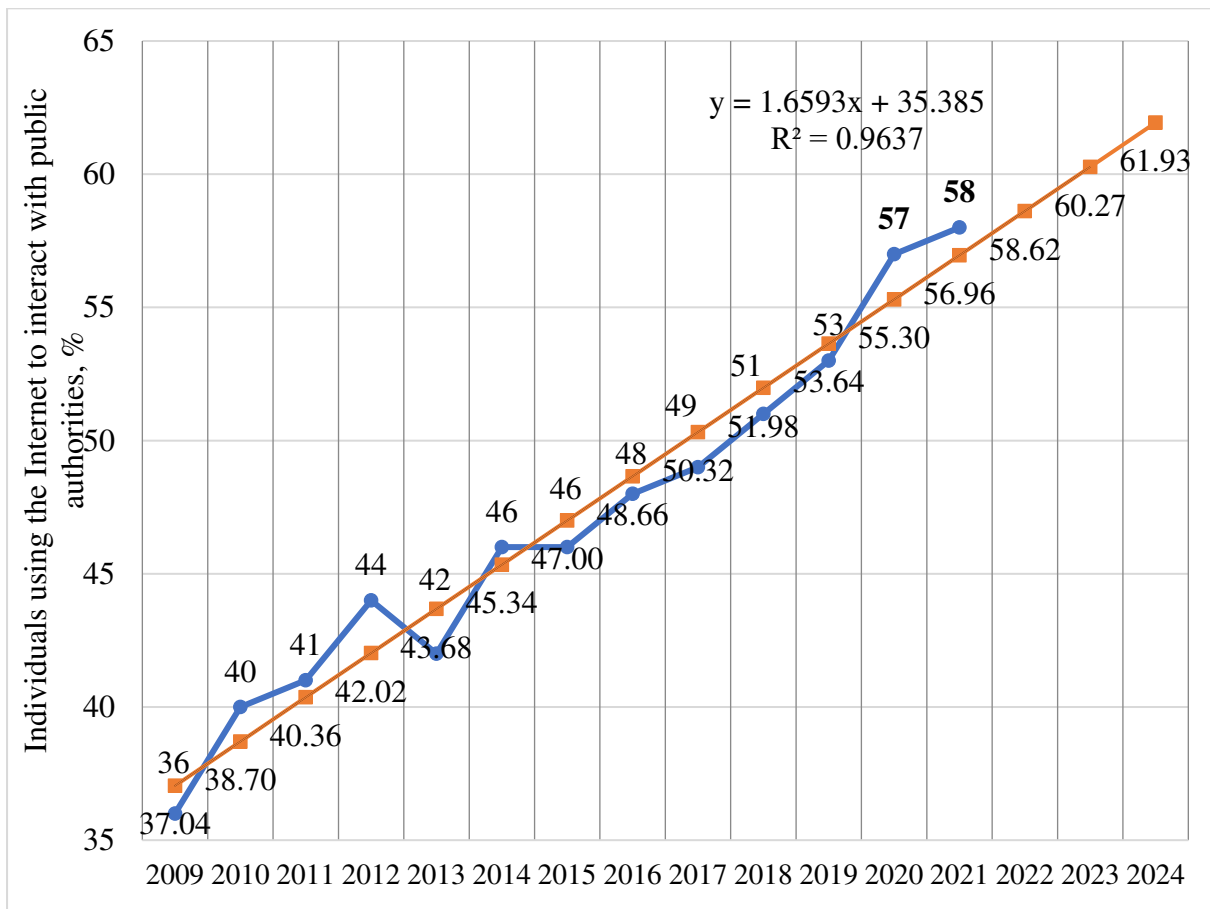


Figure 3. Trend analysis of individuals using the Internet to interact with public authorities in the EU with COVID-19 pandemic impact

Sources: Compiled by the authors on the data from Eurostat (2022)

The obtained data confirm the hypothesis that the pace of digital transformation of public administration in the EU has accelerated due to the impact of the COVID-19 pandemic, as the forecast data shown in Figure 2 differ from the actual and forecast data in Figure 3. The actual number of users in 2020 and 2021 was 57 and 58 percent, respectively (see Figure 3), while without the impact of the pandemic, these figures were forecasted at 54,05 and 55,59 (see Figure 2). That is, if earlier the annual growth of users of digital administrative services was 1-2 percent per year, the first wave of the pandemic increased their number by 4%. Accordingly, the forecast of the analyzed indicator for 2024 has also increased and is almost 62% compared to the previous forecast of 60%.

According to the EU eGovernment benchmarking report, the public services made available online by regional and local public authorities within EU member-states are lower but comparable, on average, to those made available by national authorities. The ‘online availability’ indicator scores 89% for national services, 84% for regional services, and 77% for local services. At the same time, these EU averages hide wide disparities across EU member-states.

4. Discussion

Digital transformation should be the basis for the further development of public administration and state activity. Despite the results achieved by EU countries, the problems associated with the lack of digitalization, openness, and customer focus, remain relevant. A high level of digitalization of public administration creates conditions for the development of proactive multi-channel service, integration of modern fragmented information systems and communication channels, creation of a single “front office” aimed at ensuring the availability of information and services anytime, anywhere, and on any device (Ziyadin, Shaikh and Ismail 2019). According to Nienaber and Woodcock (2020), both business and government do not provide the right pace of digitization, although digital transformation has been a must for the European economy and society for many years in almost all spheres of life and business. EU authorities are forced to respond to the constraints caused by the coronavirus, but before the pandemic, many countries were reluctant to introduce e-services for citizens and separate offices for civil servants, resulting in significant differences in the levels of digitalization of public administration.

As shown in the cluster analysis result (Tables II and II), variability of DESI is evident across EU countries, in particular, the use of digital public administration and services are lag behind in Hellenic Republic, Republic of Bulgaria, and Romania. According to the European Commission report, it may be because digital public services are not available in these countries, or are not easily accessible (Cavallini and Soldi 2021). At the same time, the highest access characterizes countries such as Republic of Finland, Kingdom of Sweden, Kingdom of Denmark, and the Kingdom of the Netherlands. Our results are in line with the conclusions of the latest eGovernment benchmarking statement which emphasizes underperformance in penetration for Italian Republic, Hellenic Republic, and, to a lesser extent, Republic of Bulgaria and Republic of Poland. Instead, in Romania, the most evident underperformance area relates to digitization (European Commission, Directorate-General for Communications Networks, Content and Technology 2020a). Bachev (2020) has found that in recent years there is an improvement in the access of individuals using the internet in Republic of Bulgaria for relations with public institutions, trading goods, and services. Nevertheless, Republic of Bulgaria is quite behind other EU members in regards to the introduction of digital technologies in the economy and society taking one of the last places in the EU for digital public administration and services (DESI).

The present study complements the results obtained by Malkowska, Urbaniec, and Kosala (2021), who studied the impact of digital transformation on EU members but did not take into account the impact of the COVID-19 pandemic. The results of cluster analysis (Tables II and III, Figure 1) indicate the uneven digitization of public administration in the EU, as the gaps between countries are quite significant. In the time since the beginning of the COVID-19 pandemic, there has been some regrouping in the level of digitalization of public administration. Our data correlate with the results of Datta, Walker, and Amarilli (2020), which studied the digital transformation in Italian Republic based on the Index of Digital Economy and Society (DESI). Their research shows that the digital divide between countries complicates the digital transformation, and the availability of advanced technological infrastructure is exacerbated by the low quality of digital literacy. The success of the digital transformation of public administration should be based on ensuring not “broad” but “full” adoption and use of digital transformation decisions by citizens (McDonnell, Verdin and O`Reilly 2022).

The use of blockchain technology is a promising area of public administration, as it not only improves the efficiency of the main functions of public authorities but is also considered a security system for protecting public data and digital transactions (Rot et al. 2020). The use of blockchain technology in the public sector and public administration depends on the synthesis of technological, political, social, managerial, and legal decisions. Therefore, it is extremely

timely to investigate how and to what extent blockchain technology can transform the public sector (Tan et al. 2022).

Automation of processes in public administration can provide greater security, speed, practicality, and efficiency for public authorities (Martins, Pinheiro and Martini 2020). The increase in the number of people using the Internet to interact with public authorities since the beginning of the COVID-19 pandemic (Figures 2 and 3) indicates an increase in the number and acceleration of the provision of digital administrative services to users due to the impact of the pandemic. Zait and Horodnic (2022) prove the relationship between the level of development of e-government services and the level of informal economy in the EU, with special emphasis on the impact of the COVID-19 pandemic. Boban and Klaric (2021) on the example of the EU in general and Republic of Croatia in particular consider the best practices of digital transformation as a component for improving public governance. The authors believe that the existing systems and established processes should be open to the rapid implementation of innovative digital solutions, as they are the main condition for overcoming the crisis caused by COVID-19, and the use of digital technologies in the future will not only reduce the negative impact of potential crises, to create conditions for successful digitalization of power and the formation of a digital society (Boban and Klaric 2021).

5. Conclusion

The digital transformation of public administration is one of the main components of the EU's digital strategy, which has grown significantly in the context of the COVID-19 pandemics. Most governments are aware of the importance of digital transformation and are gradually changing their approaches to public administration, involving citizens in e-government processes.

Successful implementation of digital strategies in most EU countries has led to their rapid adaptation to the challenges of the COVID-19 pandemics, remote work, distant offices, and digital solutions. Countries with a high level of digitalization of public administration have easily adapted to COVID-19 quarantine restrictions, accelerating the pace of digitization and proving the need for further transformation of public authorities. The increase in the actual number of users of digital administrative services since the beginning of the COVID-19 pandemics and the Digital Economy and Society Index (DESI) shows that the pace of digital transformation of public administration in the EU has accelerated due to the COVID-19 pandemic. In addition, the introduction of new technologies can not only improve administrative processes and structures but also reduce the negative impact of possible futures and move to e-government at the EU level as a whole.

At the same time, the crisis caused by the COVID-19 pandemic has revealed the weaknesses and shortcomings of the digital transformation of public administration. At the EU level, there is uneven digitization of public administration, and digital gaps between member states, which complicates digital transformation and affects the effectiveness of measures to create a National Network for Open Administration in the EU.

The practical significance of the results is to identify the leading and outsider countries on the digital transformation of public administration to develop appropriate measures at the EU level to close the digital gaps, apply legal, economic, and incentive measures to align the Digital Economy and Society Index (DESI) and the gradual transition to universal digitization, the effectiveness and feasibility of which has increased significantly under the influence of the COVID-19 pandemic.

Prospects for further research are to develop measures to support countries with a low level of digital transformation of public administration and to ensure the interoperability of digital data, services, platforms, and communication networks between countries.

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