

Digitalization in Romania Measured with DESI

Mihai Ciobotea¹, Ecaterina-Milica Dobrotă², Marian Stan³ and Alina-Florentina Săracu⁴

¹⁾²⁾³⁾ *The Bucharest University of Economic Studies, Bucharest, Romania.*

⁴⁾ *"Dunarea de Jos" University, Galati, Romania*

E-mail: mihai.ciobotea@gmail.com; E-mail: milicadobrota@yahoo.com

E-mail: marian.stan.ro@gmail.com; E-mail: alina.saracu@ugal.ro

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Abstract

The current paper examines the current state of the digitalization in Romania and the European Union (EU), considering also the first year of pandemic. The purpose is to identify those zones with a significant performance gap between Romania and EU regarding digitalization and to highlight barriers that prevent digitalization. At EU level, one of the evaluation tools regarding the success of the digitalization strategies is the Digital Economy and Society Index (DESI). We have used this tool in this article. Our research revealed a number of relevant indicators pertaining to digital economy where Romania ranks above the EU average however, most of them have values below EU average.

Based on a comparative and a factorial analysis, we have assessed a set of elements that may influence the digitalization. We have created a statistical model that uses historical data and linear regression in order to estimate how the digitalization dimensions look like without the influence of pandemic and we have compared this estimation with the actual data from the first year of pandemic.

The originality of the article consists of the comparative analysis between the actual evolution of the digitalization during pandemic and the estimated trend of this evolution should the pandemic did not occur. For this, we have used the most recent formula for DESI, which is the 2021 edition.

As the new data from DESI 2022 becomes available, the new researches might be able to evaluate more accurately the impact that pandemic had on the digitalization of Romanian society and economy.

Keywords

Digitalization, DESI, Digital Economy and Society Index, Romania, pandemic.

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Introduction

The pandemic, in these two years of manifestation, has proven to public and private organizations that they cannot do business without immediate links. A significant part of the business could have been performed online or remotely if the companies had been implemented programs and electronic platforms that allow them to perform this work. The society, at large, is more and more interested in adopting the digital transformation of activities (Lichtenthaler, 2021). The digitalization reshapes the strategies and the working procedures in most industries (Bánhidi, Dobos and Nemeslaki, 2020). In the same time, the acceleration of this transformation process is imposed by the need to achieve the sustainable development objectives of the 2030 Agenda, sustainability and digitalization being two major trends that will influence the businesses (Aksin-Sivrikaya and Bhattacharya, 2017). In order to achieve the sustainable development objectives, the politics of the Green Pact indicates that the European Union (EU) to stimulate via investments the digital transformation (European Commission, 2019). The investments consider all type of entities either public or private, regardless of their dimension (Hossnofsky and Junge, 2019; Lichtenthaler, 2021).

With Digital Agenda Scoreboard, the European Commission (EC, 2015) has designated as a digital performance monitoring tool at EU level, the composite index - Digital Economy and Society Index (DESI).

In the current paper, the authors propose an analysis of the evolution of the digitalization process in Romania using the most recent version of DESI (the 2021 edition) with the presentation of two scenarios:

the first scenario looks at the digital changes under pandemic period and the second scenario considers an estimation of digitalization process should the pandemic wouldn't occur. The novelty of the paper is the utilization of the DESI 2021 edition for Romania and EU, in these two scenarios. The topicality of the paper resides in the purpose of this research namely, to get an overview of the existing digitalization capabilities at country level, to get insights on the underlying indicators to be improved in order for Romania to catch up the performance gaps to the EU member states.

1. Review of the scientific literature

DESI represents a tool that allows comparative analyses regarding the digitalization and it can be applied to rank the EU countries with an aim to monitor the evolution of the digital competitiveness both at country and at European Union level. This tool has been used for the first time in 2014 (EC, 2014). From 2015, DESI have five components (EC, 2015) that could be measured individually or aggregated as an overall index (EC, 2018). The tool has been mentioned in multiple researches. DESI has been used to compare the digital development trends, for example Latvia with EU (Vidrúška, 2016). Most of researches have revealed significant digital differences that prevent the creation of a common digital market. The concept of DESI has been officially launched in 2016 in the documents released by European Commission as a comparative tool at international scale (EC, 2018).

The trend toward digitalization is closely related to functioning and developing of society and with the commitment to investments in equipment and innovative technologies. All of these will lead to an increase of general wellbeing and the creation of the necessary conditions for sustainable economic growth (Borowiecki et al., 2021).

From existing researches, it can be understood that the value of the overall index is directly associated with the digitalization trends recorded in the previous years for the analyzed countries. Also, the index growth rate is slow. To the same degree, the fundamental pillars that support the development of its specific components are defined by the following: the capability of the citizens to use the information technology and the capability of the education sector to deliver specialists in this field (Stavytskyy, Kharlamova and Stoica, 2019). The digitalization will improve because the accessibility to the hardware and software investments will be extended and because the internet connectivity will be large, in keeping with the general economic development (Bánhidi, Dobos and Nemeslaki, 2020).

2. Research methodology

In our work, we have examined the effects of pandemic on the digitalization process for public institutions and private companies in Romania. Starting from DESI, we have used the comparative method in order to assess the progress in this domain. In the same time, it has been applied the factorial analysis in order to compare the value of this index for Romania with the average of EU and we have examined the main factors that have had an influence on the overall result. The statistical analysis has been applied in order to create a linear model to simulate the trends of the index dimensions and we have compared them with the actual values from the dataset DESI.csv (EC, nd- available at <https://digital-agenda-data.eu/datasets/desi>). We have used classical statistics tools (Țițan, 2003; Voineag, et al., 2007).

In this analysis, it has been applied, as a benchmark, the DESI index which is published yearly by European Commission. The index provides an indication on the progress toward digitalization for each of the European Union countries. Its three levels structure includes dimensions, sub-dimensions and indicators. Starting with 2021, the European Commission has adjusted this index to be in line with the major European initiatives related to digital transformation: the Digital Decade Compass and the Recovery and Resilience Facility (RRF). The index includes now only four dimensions instead of five. Furthermore, each dimension is now equally weighted in contrast with the previous years. A comparison of the index dimensions for 2021 versus 2020 and earlier has been illustrated below (Table no. 1).

Table no. 1. A comparison of the DESI Dimensions and their weights 2020 versus 2021 and earlier

| DESI 2020 Dimensions | Weight% | DESI 2021 Dimensions | Weight% |
|-----------------------------------------|---------|-----------------------------------------|---------|
| Human Capital (HC) | 25% | Human Capital (HC) | 25% |
| Connectivity (Conn) | 25% | Connectivity (Conn) | 25% |
| Integration of Digital Technology (IDT) | 20% | Integration of Digital Technology (IDT) | 25% |
| Digital Public Services (DPS) | 15% | Digital Public Services (DPS) | 25% |
| Use of Internet Services (UIS) | 15% | - | - |

Source: Adapted from European Commission, 2021

These four dimensions include the following sub-dimensions with its weights:

- Human Capital includes the following two sub-dimensions, equally weighted: Internet user skills (50%) and Advanced skills and development (50%);
- Connectivity includes the following four sub-dimensions: Fixed broadband take-up (25%), Fixed broadband coverage (25%), Mobile broadband (40%), Broadband prices (10%);
- Integration of digital technology includes the following three sub-dimensions: Digital intensity (15%), Digital technologies for businesses (70%) and e-Commerce (15%);
- Digital public services dimension includes one sub-dimension: e-Government (100%).

Each sub-dimension includes a number of indicators that are calculated for each of EU Member States.

The same formula applies for any EU country to calculate the overall index. The index is calculated based on Eurostat data and specialized surveys and it represents a powerful tool that can be used for comparative analysis or general performance assessment of digitalization in EU.

In the current paper, we have compared the values of the DESI indicators, sub-dimensions and dimensions that compose the overall index from Romania with the EU average. We have focused mainly on the indicators that measure the targets stated for 2030 Digital Compass. Typically, these indicators have double weights within their sub-dimensions and they are more important from an index calculation perspective (EC, 2021a):

- Human Capital (25%): (i) At least basic digital skills, (ii) Information communications technology (ICT) specialists, (iii) Female ICT specialists;
- Connectivity (25%): (i) Gigabit for everyone, (ii) 5G coverage;
- Integration of digital technology (25%): (i) Small and Medium Enterprises (SMEs) with a basic level of digital intensity, (ii) Artificial Intelligence (AI), (iii) Cloud, (iv) Big data;
- Digital public services (25%): (i) Digital public services for citizens, (ii) Digital public services for businesses.

3. Results and discussion

The digitalization in EU has progressed with different speeds subject to the analyzed countries. From an overall DESI perspective, Denmark, Netherlands, Finland, Sweden and Ireland are the front-runners on the digitalization. By contrast, Romania had a slow progress regarding digitalization comparing with the EU countries, as shown in the graph below (Figure no.1). In the same category of laggards, there is Bulgaria, Hungary and Greece.

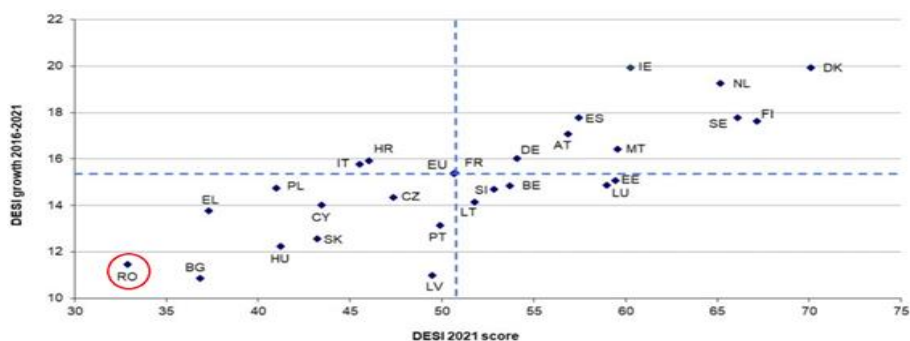


Figure no. 1. Digital Economy and Society Index – Member States' progress, between 2016-2021

Source: DESI 2021, European Commission

In the 2021 edition of the Digital Economy and Society Index (EC, 2021b), Romania ranks last among EU states with a DESI overall index of 32.9 compared with the EU average of 50.7. If we examine each dimension, Romania ranks 26th in EU for Human Capital, 10th for Connectivity, 25th for Integration of Digital Technology and 27th for Digital Public Services out of 27 EU Countries (Figure no. 2).

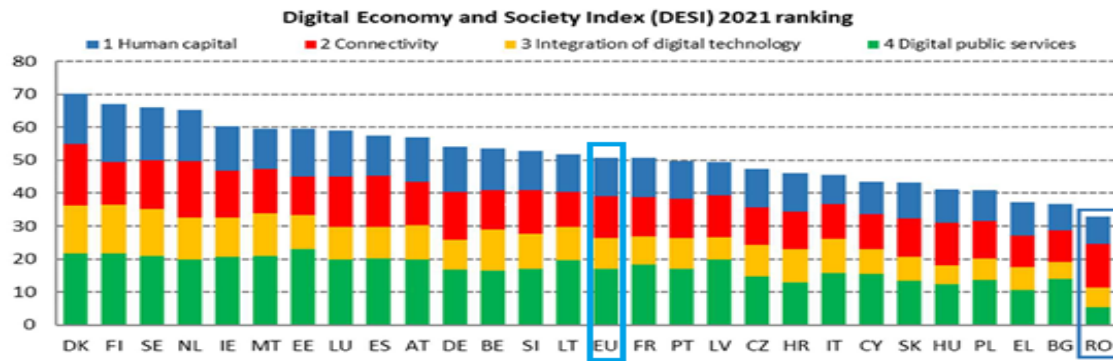


Figure no. 2. Overall DESI 2021 EU Member States rankings, including EU average

Source: European Commission, 2021b

Romania performs above of the EU average on the following indicators that are composing DESI 2021: Female ICT Specialists, ICT graduates, At least 100 Mbps fixed broadband take-up, the fixed very high capacity network (VHCN) coverage, Broadband prices index when analyzing all product baskets (fixed, mobile, converged), Artificial Intelligence, ICT for environmental sustainability. The remaining indicators rank equal to or below the EU average. Furthermore, with one exception (Female ICT Specialists), the indicators with a double weight have their values below the EU average.

The fourth dimension of the index – Digital Public Services- is ranked last among EU member states. The biggest influence in ranking low on overall DESI for Romania is explained by Digital Public Services dimension. In order to improve the overall DESI score, Romania has to make a substantial progress with improving the score on Digital Public Services dimension.

The low score for Digital Public Services has two explanations: one is the slow progress in this domain comparing with the rest of EU countries and second, the adjustment of the index structure and the change in the way the composing indicators are calculated. For example, in 2019 and 2020, the indicator related to "e-Government users" within the Digital Public Services dimension took into consideration all the users who have to submit online forms to the public authorities in Romania regardless of the year when this submission has occurred.

Starting with 2021 edition of DESI, this indicator considers only the percentage of users who have used the internet in the last year in their interaction with public authorities. This change in the way the "e-Government users" is calculated has determined a significant drop (from 82% to 16%) of the values assigned to this indicator in 2021 comparing with the previous editions. If in DESI 2019 or 2020 editions the value of this "e-Government users" indicator for Romania were above EU average, in 2021 the newly calculated value is way below this average.

Table no. 2. The indicators from Digital Public Services, comparison Romania versus EU

| Dimension | Sub-dimension | DESI 2021 Indicators | Romania% | EU Average% |
|-------------------------|---------------|--------------------------------------------|----------|-------------|
| Digital Public Services | e-Government | 4a1 e-Government users | 16% | 64% |
| | | 4a2 Pre-filled forms | 6% | 63% |
| | | 4a3 Digital public services for citizens | 44% | 75% |
| | | 4a4 Digital public services for businesses | 49% | 84% |
| | | 4a5 Open data | 69% | 78% |

Source: adapted by authors based on European Commission, DESI 2021

4. Statistical Analysis – DESI 2021

Our research presents a comparison between the DESI progress for Romania and the EU. The data used for the following figures come from the dataset DESI.csv and they are aggregated data. We have used linear regression in order to model the non-pandemic situation, and put under each graph the regression equation. The model fits very well the situation, as shown by coefficient of determination and the level of significance F. The equations represent the respective DESI indicators function of time (t).

The research team has also illustrated the difference between the two scenarios considered – pandemic scenario vs basic scenario, for 2021, shown as Delta under each graph, where applicable. In the figure no. 3, we compare the DESI components for Romania with those at EU level and we notice that they look

different (we have studied also other countries, from the upper echelon, and the graphs look similar with those of EU).

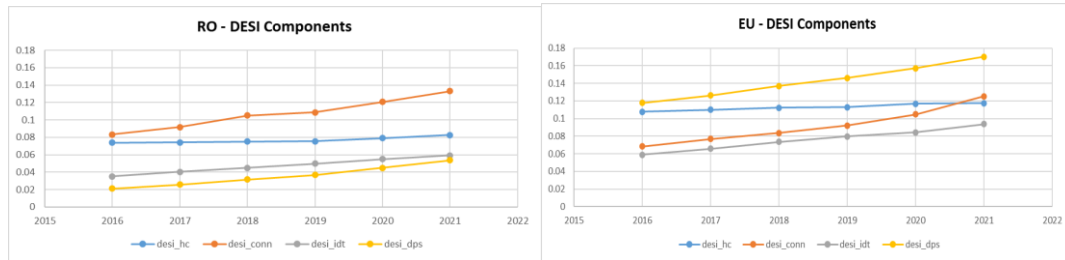


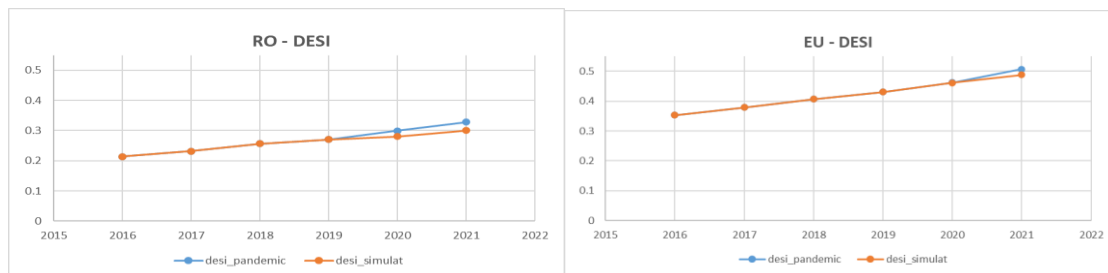
Figure no. 3. The evolution of index four dimensions for Romania and EU

Source: Dataset DESI.csv (EC,nd)

Analyzing these two charts, we can state the following:

- desi_dpt (Digital Public Services) - the least developed in Romania (vs. EU);
- desi_hc (Human Capital) - quasi-constant for Romania (vs. EU). This item to be the most important correlated with at least other 2 out of the total of 3 remaining (IDT and DPS).

Moving forward, in the figure no. 4 we can see a stronger increase for the Romanian DESI (more than double as for the EU) as compared to the simulation of the non-Pandemic case. The pandemic has accelerated the enhancement of the DESI index for Romania; however, there still are a lot to improve in order to have the values over the EU average.

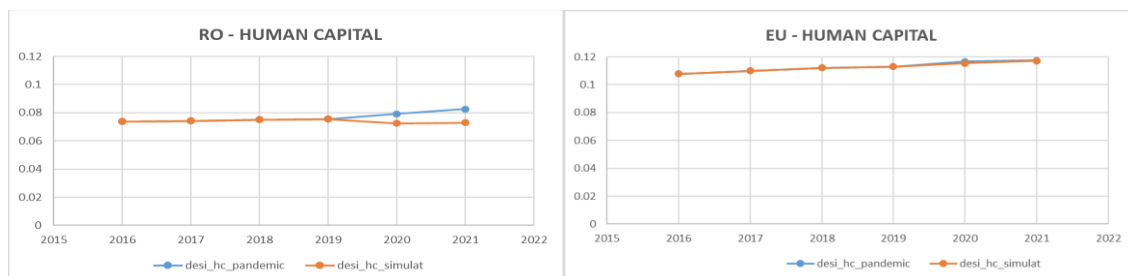


Delta: +9.51% (pandemic vs non-pandemic)
Coefficient of determination: 98.98%
Regression: $f(t) = 10^{(-3)} * 19.53 * t - 39.17$
Significance F: 0.005099

Delta: +3.94% (pandemic vs non-pandemic)
Coefficient of determination: 99.95%
Regression: $f(t) = 10^{(-3)} * 26.09 * t - 52.24$
Significance F: 0.000245

Figure no. 4. The evolution of DESI (simulated versus real, considering the first pandemic year)

Source: Dataset DESI.csv (EC,nd)



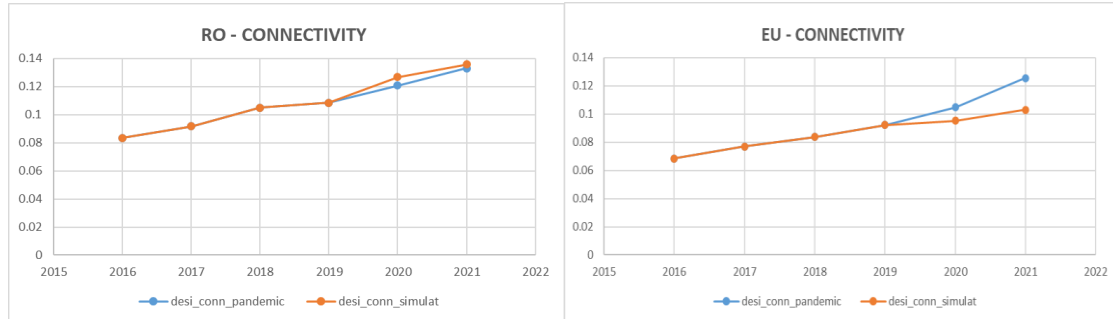
Delta: +13.16% (pandemic vs non-pandemic)
Coefficient of determination: 98.11%
Significance F: 0.009499
Regression: $f(t) = 10^{(-3)} * 0.62 * t - 1.18$

Delta: +0.41% (pandemic vs non-pandemic)
Coefficient of determination: 99.95%
Significance F: 0.019769
Regression: $f(t) = 10^{(-3)} * 1.77 * t - 3.46$

Figure no. 5. Comparison Romania versus EU average on Human Capital dimension

Source: Dataset DESI.csv (EC, nd)

Human Capital dimension of DESI (figure no. 5) for the non-pandemic scenario is quasi-constant; as it results from the figures and as illustrated in above graph, the pandemic has accelerated the development of this dimension for Romania. There are three factors determining this acceleration: (1) need generated by the pandemic; (2) additional time at hand for people and the work from home option, generating opportunities for online education and (3) the general EU trend.



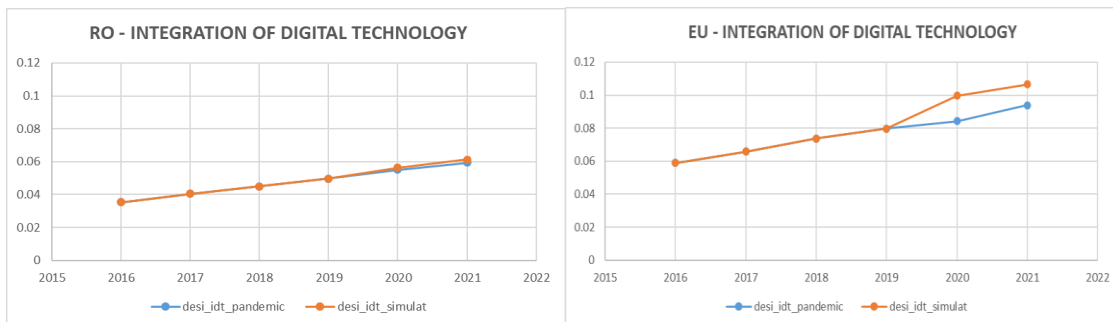
Delta: -2.00% (pandemic vs non-pandemic)
Coefficient of determination: 96.05%
Significance F: 0.019974
Regression: $f(t) = 10^{(-3)} * 8.84 * t - 17.73$

Delta: +21.80% (pandemic vs non-pandemic)
Coefficient of determination: 99.83%
Significance F: 0.000863
Regression: $f(t) = 10^{(-3)} * 7.76 * t - 15.58$

Figure no. 6. Comparison Romania versus EU average on Connectivity dimension

Source: Dataset DESI.csv (EC, nd)

Connectivity dimension for Romania is the only dimension higher than the EU (figure no. 6). As the Romanian trend is very little influenced by the pandemic, the EU trend shows acceleration.



Delta: -2.98% (pandemic vs non-pandemic)
Coefficient of determination: 96.05%
Significance F: 0.000325
Regression: $f(t) = 10^{(-3)} * 4.82 * t - 9.68$

Delta: -11.88% (pandemic vs non-pandemic)
Coefficient of determination: 99.73%
Significance F: 0.001353
Regression: $f(t) = 10^{(-3)} * 6.98 * t - 14$

Figure no. 7. Comparison Romania vs. EU average on Integration of digital technology dimension

Source: Dataset DESI.csv (EC, nd)

Analyzing the above figure and according to our model, we have noticed that the pandemic did not influence the progress for this dimension, for Romania (figure no. 7). At EU level this dimension has decelerated with ~12%, due to saturation.

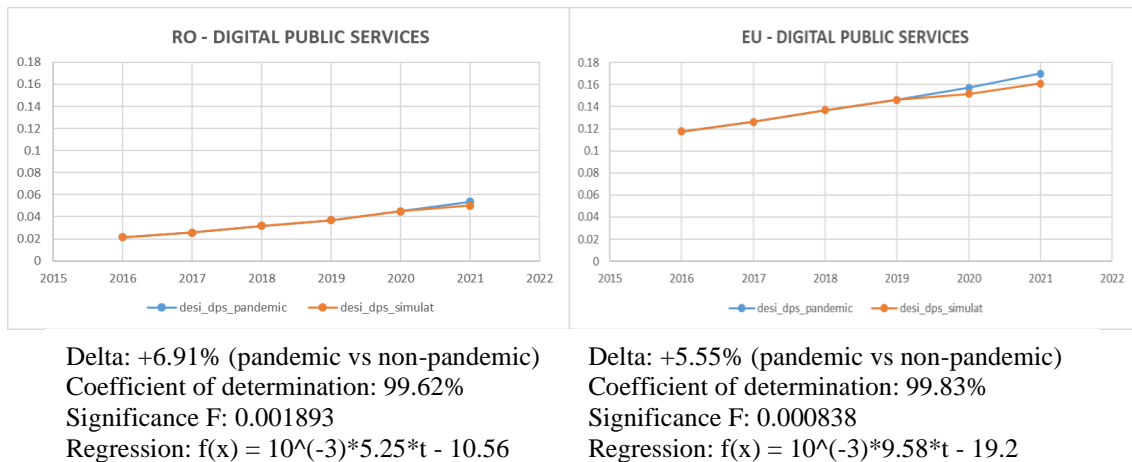


Figure no. 8. Comparison Romania versus EU average on Digital Public Services dimension

Source: Dataset DESI.csv (EC, nd)

Digital Public Services is slowly increasing for Romania, showing very little acceleration due to pandemic, as compared to EU for which this index increases with 5.5% as compared to the base scenario of no pandemic (figure no. 8). An explanation could be the fact that in Romania there already are plans for which the implementation is in progress, so the pandemic was not able to influence visibly this dimension.

5. Barriers in pursuing the path to digital for Romania

From those presented previously, it can be noticed that Romania is facing a number of difficulties in the process of digitalization. Although a number of steps have been made toward digitalization of public services such as "Virtual Private Space" (www.anaf.ro), launching and developing of ghiseul.ro platform (for tax payments), the public procurement system - e-licitatie.ro, The National Office Trade Register, it appears that these may not be sufficient.

Empowering the Authority for the Digitalization of Romania (ADR), the allocation of an important number of financial resources through NPRR on digital transformation component, adopting the European strategy "Digital Decade Compass" represents positive influence factors that may contribute to the progress of the digitalization in Romania.

In a study released in April 2021, ADR identified barriers on the path to digital for the public sector: lack of effective and efficient IT infrastructure for the management of electronic public services, lack of information systems for operationalizing the electronic public services, insufficient number of specialists in e-Government and human resources in the IT departments of public institutions, insufficient competencies required for the development and the maintenance of electronic public services, lack of a unified legal and procedural framework for supporting electronic public services.

The same study (ADR, 2021) has highlighted a number of factors that have impacted the private companies:

- human capital (low digital skills, digital skills specific to SME management is under represented and to a lesser extent the number of IT specialists working on SMEs);
- lack of financing for adopting the advanced digital technologies along with the support for expertise and consulting;
- lack of clarity and a coherent evolution of e-government tools.

Conclusions

At EU level, the pandemic has accelerated the digitalization process. The DESI index (2021 edition) has shown that Romania, despite ranking higher than EU average on the connectivity dimension, has recorded an overall slow progress on digitalization comparing with the other European countries. The existence of certain barriers toward digitalization, especially in public sector, such as the lack of ICT specialists or the lack of an appropriate IT infrastructure, makes the improvement of DESI ranking for Romania a lengthy process. In order to catch up with the digitalization gaps, the decision makers from both public and private

sectors should focus more on initiating and implementing projects in this domain. The results from the current paper highlight, via DESI analysis the weaknesses of the country (insufficient human resources, low integration of digital technology, public services not digitalized) and the barriers in the process of digitalization. This paper may serve as a starting point for next studies regarding the digitalization process, the access to online services or regarding the impact of public policies on the digital transformation strategies for Romania.

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