INVESTIGATING THE ROMANIAN DIGITAL TRANSFORMATION PROGRESS IN THE EU CONTEXT

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Abstract: *There is an increasing emphasis on the role played by digitalization in our daily life. Starting with the industrial revolution, digitalization was applied primarily in the automation of manufacturing processes or in service provider processes. As a result, the effect of digitalization in many economic sectors has grown worldwide. The enhancement of digital potential is continuously supported at the European Union level. In order to improve the lives of citizens and enterprises, the 27 EU member nations therefore develop regulations that allow digitalization to be implemented at national level. The main goal of this article is to provide an overview of Romania's digital position within the framework of the European Union. The outcomes provide important insights into this nation's strengths as well as possible growth sectors that could potentially meet the level of the European Union. In regard to this goal, the paper first proposes a brief descriptive analysis of Internet access in Romania based on certain groups related to education and occupation. This will ultimately be followed by a comparative analysis that aims to highlight the ways in which Romania and the European Union differ based on the primary dimensions of the Digital Economy and Society Index.*

Keywords: Digitalization, internet access, Digital Economy and Society Index, European Union, Romania

JEL classification: O33, J24

1. Introduction

The impact of digitalization at the global level is felt in the needs of countries in terms of stable development. The European Union (EU) published a document titled "A Digital Agenda for Europe" (“Europe’s digital decade,” n.d.) in 2021 aiming to outline the 2030 digital goals and the primary strategies for reaching it. The objective is to empower enterprises and citizens equally by taking full advantage of the benefits generated by global digitalization. In other words, at the European level, there is a need for digitally prepared individuals who have developed the skills required by the digital transformation on the labor market, as well as businesses that are capable of staying up with technological advancements. The benefits of digitalization in sustaining the economy have become substantially more visible in the period following of the COVID-19 epidemic. The pandemic problem highlighted the

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shortcomings in the digital systems in use at the time and made it possible for their advancement to significantly contribute to the welfare of the world community.

The role of digitalization has been extensively researched from a variety of perspectives in the specialised literature up to this point. (Tünde Zita Kovács et al., 2022) studied the phenomenon of digitalization in the EU through the „The Digital Economy and Society Index" (DESI), more precisely through the prism of one of the dimensions of this index. For the purpose of assessing the digital skill level of Europe, the paper primarily focused on the analysis of the human capital component. The results indicate that the segments where the convergence is not attainable, the goals set by the EU will either not be fulfilled or will be in the backlog in 2030. Consequently, in this age of innovation, the authors highlight the importance of continuously learning new skills and acquiring digital competencies. Furthermore, it is pointed out how important it is to encourage these abilities, through comparing them to fundamental reading and writing requirements in school. The necessity of strengthening these abilities is strongly connected to the need to prepare future generations for a labour market that is undergoing a digital transformation towards innovation (Picatoste et al., 2018).

An alternative viewpoint centres on the well-being of humans subsequent to the successful implementation of digital regulations. It has been established that there is a positive correlation between the Human Development Index (HDI) and the DESI index value, suggesting that a digital lifestyle contributes to high well-being among citizens (Laitsou and Xenakis, 2023). Since education prepares people with the skills to meet the demands of the market, the inverse relationship illustrates the remarkable impact that education has on the digital development of the economy.

Broadband infrastructure has also been researched in connection to digital advancements, and it has been found to positively correlate with market innovations. By ensuring that proper enhancements were made from a digital perspective, (Pinto et al., 2023) explored this phenomenon. As a result, emphasis is placed on the need to prioritise the development of digital skills, followed by the requirement of a suitable digital infrastructure to ensure a comprehensive digital empowerment.

(Fernández-Portillo et al., 2022) considers that in order to guarantee a favorable economic environment, digital policies must also be implemented at the organizational level. Thus, a topic of interest is how the digitalization of business can impact the economic and financial performance. This study ultimately reached the conclusion that investments in digitalization are directly correlated with a business's performance, and that innovations serve a critical role in acting as an intermediary between digitalization and performance. The authors emphasize how important it is to continuously invest in the human resource element by ensuring the right kind of experience and training are delivered.

The most significant impact of national digitalization occurs in the context of public services. Everyday life might alter as a result of the digitalization of routine activities since public administrations have direct contact with individuals and their businesses. It is more difficult to apply digital policies in public service activities because these measures can only be extensively used if they have been properly implemented in the areas of infrastructure, business, and human capital (Andersson et al., 2022). It has been observed that e-governance performance indicators that may be used as assessment criteria have a tendency to be (disproportionately) sensitive to the policy domain, institutional settings, systemic constellations, and administrative traditions under consideration (Umbach and Tkalec, 2022).

The labor market has been significantly impacted by digitalization, particularly for the younger generations (Crisan et al., 2023). The dynamics associated with employment are shaped by the constantly evolving skills required to fulfil market demands. Another field that has been significantly impacted by the economy's digital revolution is sustainability (Crisan et al., 2024). Given the complexities of combining these two transitions, the 27 EU members

exhibit various levels of digitalization and sustainability, which determine national economic development.
These elements highlight the complex nature of the digital transition and the importance of researching this area, considering the implications of digitalization presented by the segments involved in the economic development. A proper digital transformation requires progressive changes for each concerned section: human capital, infrastructure, business, and public services.
The current paper aims to ascertain the level of digitalization of Romania in comparison with the average of the EU member countries, through the use of relevant descriptive analyses. Consequently, the study seeks to address questions regarding Romania's level of digitalization based on the dimensions of the DESI index as a framework.

2. Methodology

The data extracted for the analysis of the level of digitalization in Romania come from the official website of the Romanian Institute of Statistics ("Institutul Național de Statistică," n.d.).The periodicity of the data is annual and the selected time interval extends between the year 2007 and the year 2023. For the digital characterization of Romania until the year 2023, a group of indicators was selected: the number of people aged 16-74 who have ever accessed the Internet, by education level and the share of households that have access to the Internet at home, on the occupational status of the head of the household, in total households from each occupational status. These indicators, based on a division by educational and occupational categories, allow a more complex analysis that will value the population's access to digital platforms in the context of a certain educational level and for certain occupations.
Subsequently, in order to make a comparison between the level of digitalization of Romania and the level of the European Union, the website dedicated to the digitalization of the European Union ("Digital Decade DESI visualisation tool," n.d.) provides all the indicators used in the aggregation of the DESI index at the level of the EU member states. The time period available from a DESI perspective is 2018-2024, the periodicity of the data being annual.
In order to create the visualizations required for the descriptive analysis, stacked line graphs were generated to be able to visualize the historical data. The two retrieved indicators serve the purpose of presenting an overview of the evolution of internet access over a 16-year period, as well as the potential of extracting information on how educational level and an occupation affect the population's access to the internet. However, in terms of the comparative analysis using the DESI index, the graphs were created in the digitalization platform according to the dimensions and indicators of interest.

3. Main findings

In this section the exploratory analysis was conducted in order to highlight the most important characteristics of Romania's level of digitalization. Firstly, the two indicators linked to the internet access of the population will be presented in order to create an overview of the country and then a comparison between EU average and Romania in term of DESI indicators.

3.1. Digitalization in Romania's context

Figure 1 shows the share of households with Internet access according to occupation. Thus, each occupational category: employee, retired, student, unemployed, other type of inactive person and total is marked by a distinctive colour. It is noteworthy that the majority of students live in households with internet access. Overall, regardless of category, the

percentage of Internet access was increasing. The light blue line, which represents the student category, shows that in 2008, 75% of students had Internet connection, with a rising trend that reached 100% in 2023. The employees' segment is the next hierarchically in terms of recorded values, with the lowest point attained in 2007 at 38.5% and the highest position at the conclusion of the reference period at 98.4%. The unemployed group has an irregular pattern, with significant fluctuations between 2007 and 2023. The most pronounced increases in internet access among the unemployed occurred between 2015 and 2016, followed by a more gradual increase until 2021, when it decreased to 84.2%. The group "other type of inactive person" exhibits a fluctuating trend as well; on an overall basis, its values were lower compared to each of the other occupational categories previously stated. Therefore, the lowest point is recorded at 12.4% at the start of the reference period in 2007, followed by four consecutive rapid declines in 2011, 2017, 2019, and 2021, until ultimately reaching the highest value in 2023 (85%). As expected, the lowest figures for internet access belong to the elderly group, which likewise had a steady development from 2007 to 2023, rising from 8.3% in 2007 to 70.5% in 2023. Without regard for occupational type, the general trend is as well ascending, reaching an all-time high of 85.7% in 2023 with an amplitude of 65.2% for the reference period.

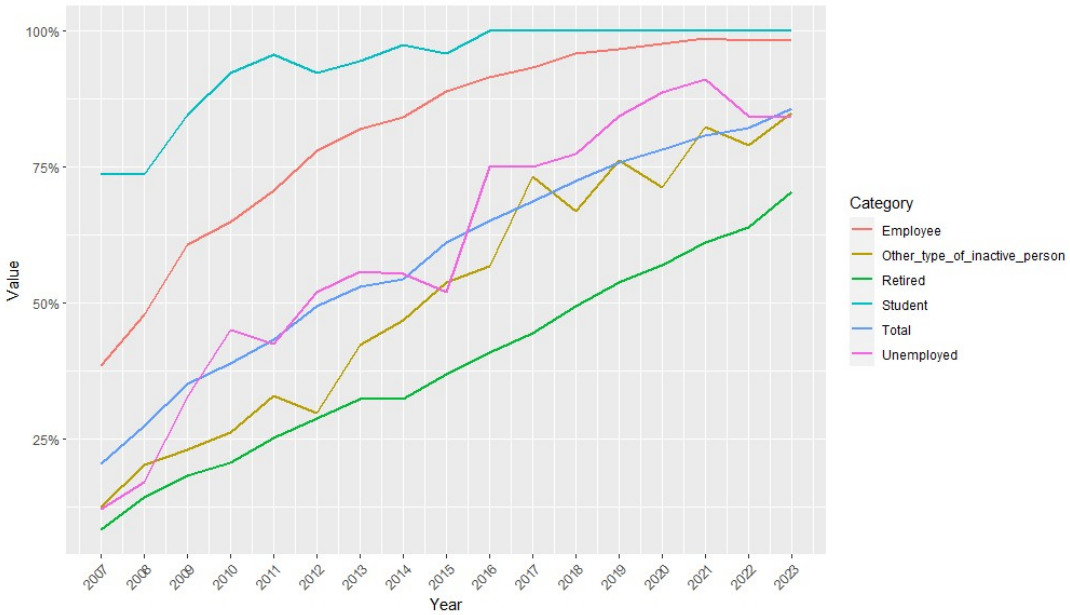

Figure 1: Share of households that have access to the Internet at home
Source: Author's analysis based on INSSE data

The number of individuals between the ages of 16 and 74 who have ever accessed the Internet is shown in Figure 2, with the indicator categorized by level of education. Accordingly, the group of persons with a high school diploma is the one that showed the largest percentage of respondents who, regardless of mode, had at least one Internet connection. This category's trend is primarily upward with a few minor variations, maintaining a nearly constant value starting in 2020. Those who have finished their university education fall into the next category, and their values are lower compared to that of the people who have only completed their high school education. Given that the value of this category increased by 916,215 persons between 2007 and 2023, the trend is therefore slightly upward. Because there are times during the period span when the two lines in the image

certainly overlap, the next two categories, "professional, complementary or apprentice" and "secondary school" record data from the same register. The two groups' amplitudes—2090645 individuals with a professional degree and 1670890 those with only a secondary school education—are comparable as well. What makes this case unpredictable is that, as of 2021, the values associated to the category of people with a university education follow the same trajectory as the categories of people with secondary school education and "professional, complementary, or apprentice" type studies. This pattern continues until 2022, at which point the category of people with a university education shows a noticeable decrease below the two categories indicated in green. Individuals with strictly primary education and those with postsecondary education were the categories with the lowest observed values. Regarding both categories, the trend is nearly continuous, with no significant fluctuations, culminating in the highest levels in 2023 (288178 individuals who had a primary education and 592260 individuals with post-secondary education).

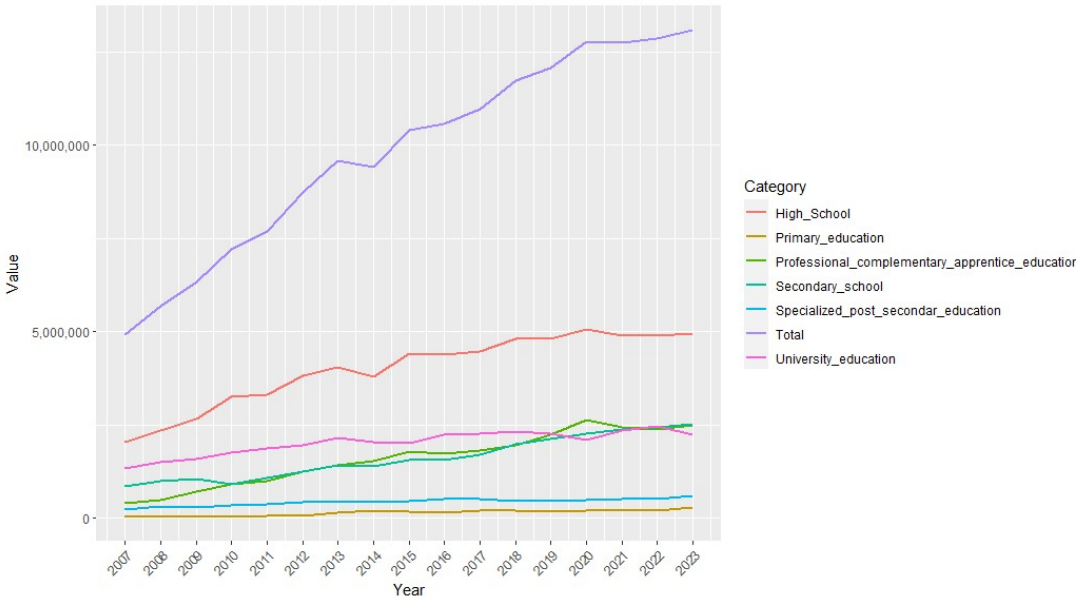

Figure 2: Number of people aged 16-74 who have ever accessed the Internet
Source: Author's analysis based on INSSE data

3.2 Comparative analysis between Romania and EU in terms of digitalization

In terms of comparative analysis, the data specific to the DESI index will be used. The DESI index is characterized by four dimensions:

- Human capital (Digital Skills)
- Connectivity (Digital infrastructure)
- Integration of Digital Technology (Digital transformation of businesses)
- Digital Public Services (Digitalization of public services)

Table 1: DESI's dimensions

DESI Dimension	Indicators related to the Path to the Digital Decade proposal
1 Human capital	At least basic digital skills
	ICT specialists
	Female ICT specialists

2 Connectivity	Gigabit for everyone (Fixed very high-capacity network coverage)
	5G coverage
3 Integration of digital technology	SMEs with a basic level of digital intensity
	AI
	Cloud
	Big data
4 Digital public services	Digital public services for citizens
	Digital public services for businesses

Source: Digital Economy and Society Index (DESI) 2022

In this subsection, a comparative analysis between EU and Romania will be conducted, based on each dimension of the DESI index.
Regarding the human capital, there are seven indicators that measure the share of people with digital skills and the ITC specialists and graduates. The first indicator displayed from this dimension is the internet use among all individuals. Both trends are ascending, and by the time the period finishes in 2024, they will have reached their maximum value. Compared to the European average of 79.17%, Romania begins to advance from this perspective with a modest 60.78% of its population having Internet connection. Compared to the European average of 90.27%, Romania managed to achieve the maximum value of 88.05% of people having Internet connection after 6 years, indicating a faster rate of growth for this statistic in Romania. Therefore, starting from a difference of 18.39%, Romania is quickly approaching the European average with a difference of only 2.22% in 2024 (Figure 3).

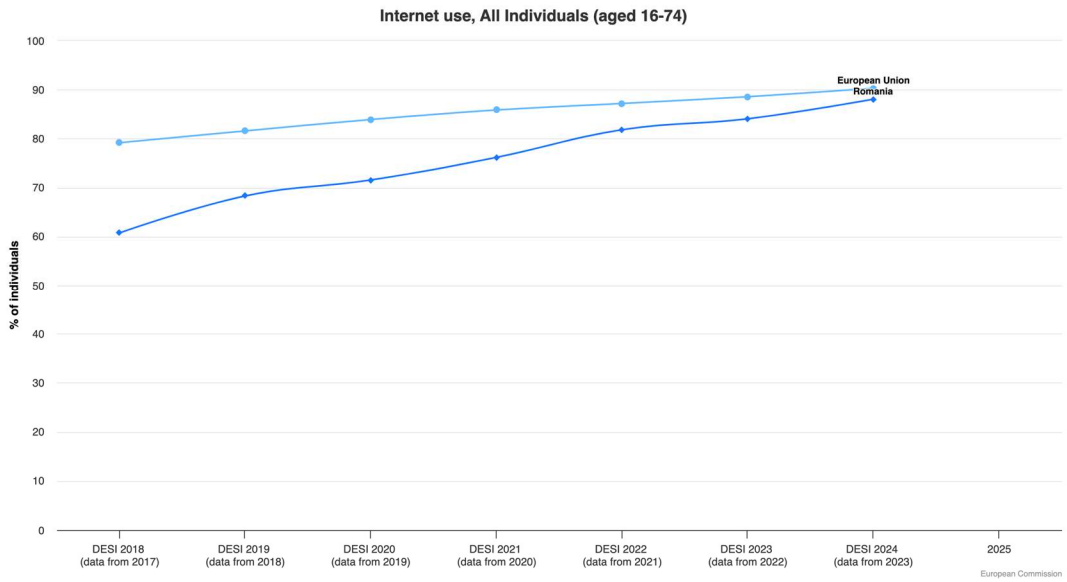

Figure 3: Internet use. EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

Figure 4 illustrates a significant disparity between the Romanian and European levels in the case of individuals with a degree in ICT. The values that Romania has documented in this chapter surpass the average values of the European Union by almost one percent. ICT graduates made up 4.9% of Romania's total in 2018, and the country is expected to graduate 6.80% of its population by 2024 due to the growing trend. In contrast, the European Union average ascended from 3.4% in 2018 to 4.5% in 2024.

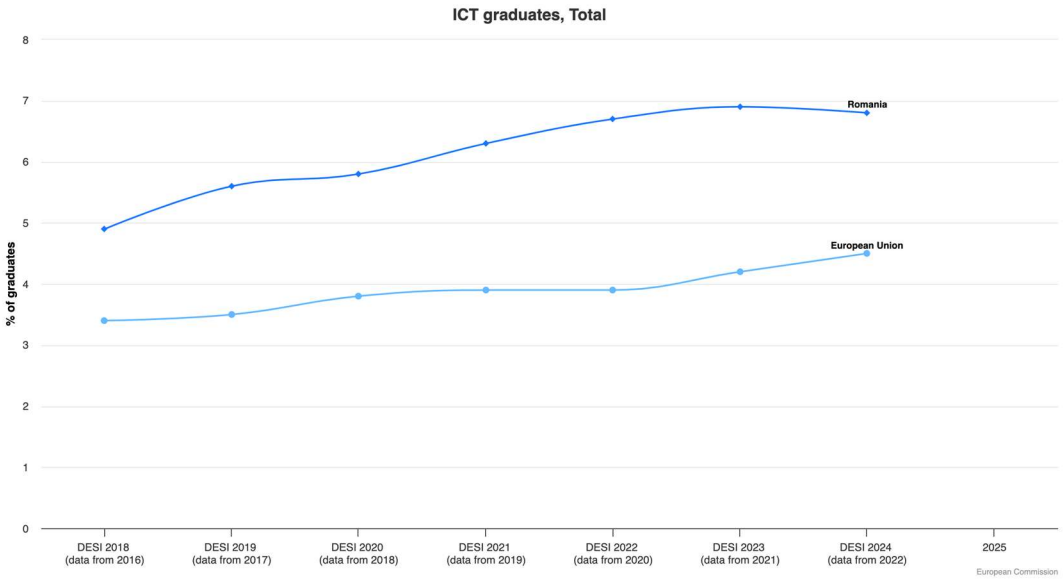

Figure 4: ICT graduates, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

From the point of view of the digital infrastructure, the differences in connectivity between Romania and the EU can be seen in Figure 5 and Figure 6. For both the FTTP coverage and VHCN coverage indices, Romania's reported values are higher than the average for all of Europe. Although there are minor changes beyond 2022, both trends have increased in both statistics.

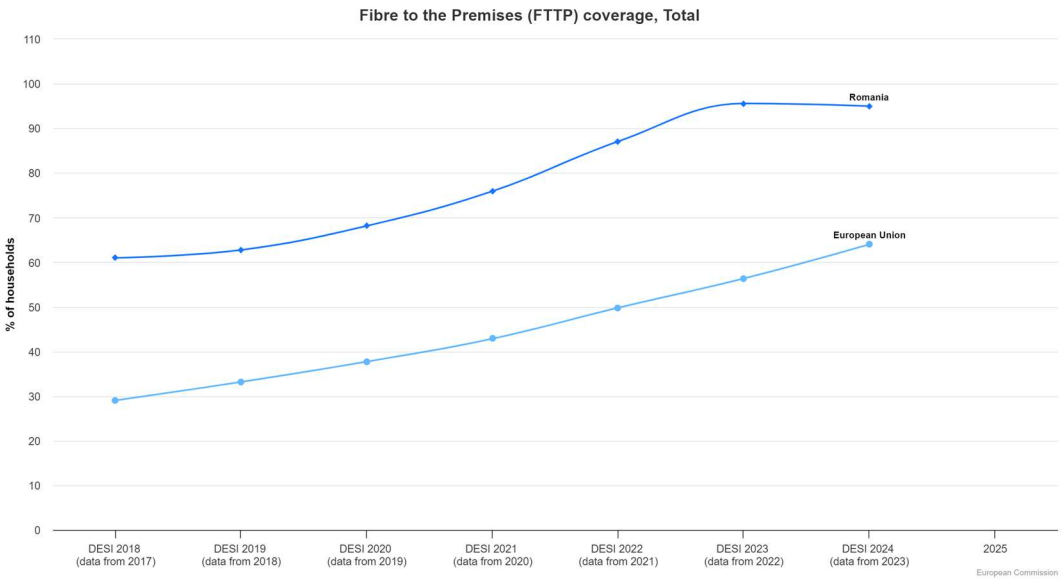

Figure 5: Fibre to the Premises (FTTP) coverage, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

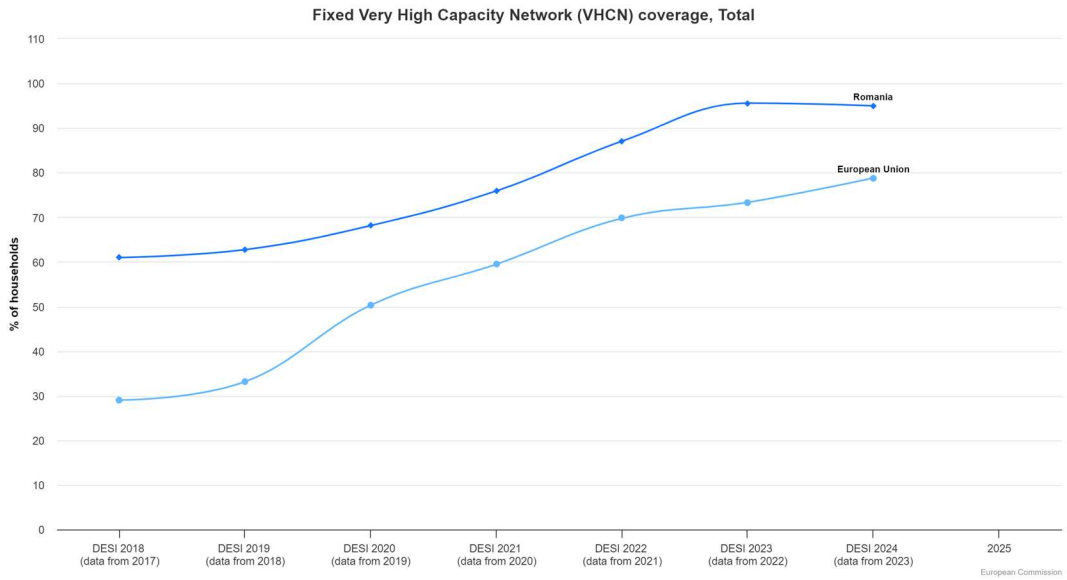

Figure 6: Fixed Very High-Capacity Network (VHCN) coverage, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

One distinguishing feature of a country's digitalization adaption is the manner in which organisations evolve with digital technology. The illustrated indicators for the dimension of business digitalization are: small and medium enterprises (SMEs) selling online, Enterprises sending e-invoices and electronic information sharing, the unit of measure being the share of enterprises.

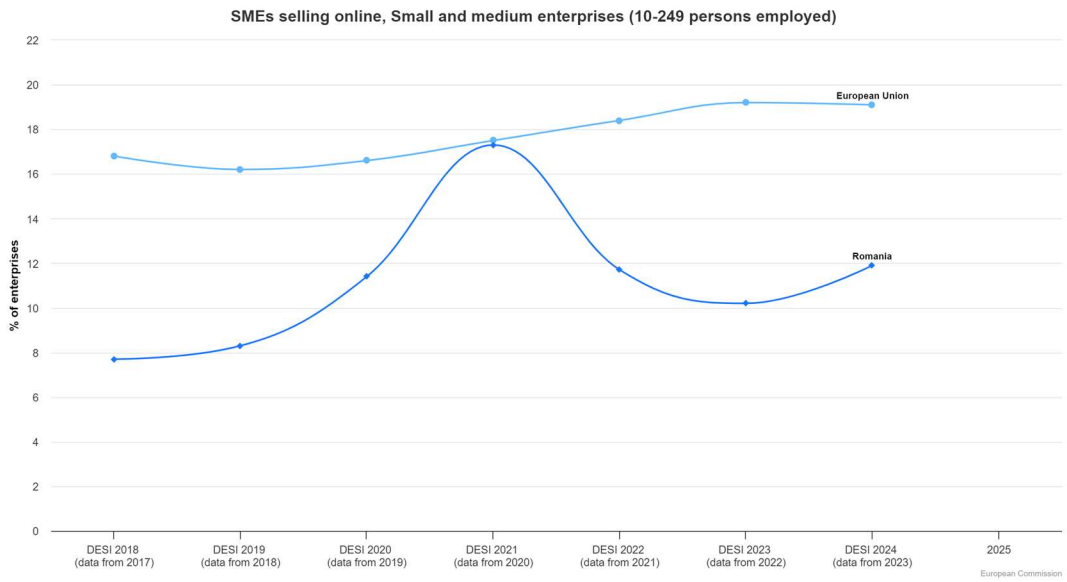

Figure 7: Small and medium enterprises (SMEs) selling online, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

The statistics presented in Figure 7 illustrates an extremely unstable pattern with regards to the proportion of businesses who conduct online transactions in Romania. Having seen an

abrupt increase between 2018 and 2021, when it reached its highest point at 17.30% of businesses, Romania then experiences a sharp decline until 2023, followed by a modest rise until 2024. The year 2021 marks Romania's closest contact with European media.

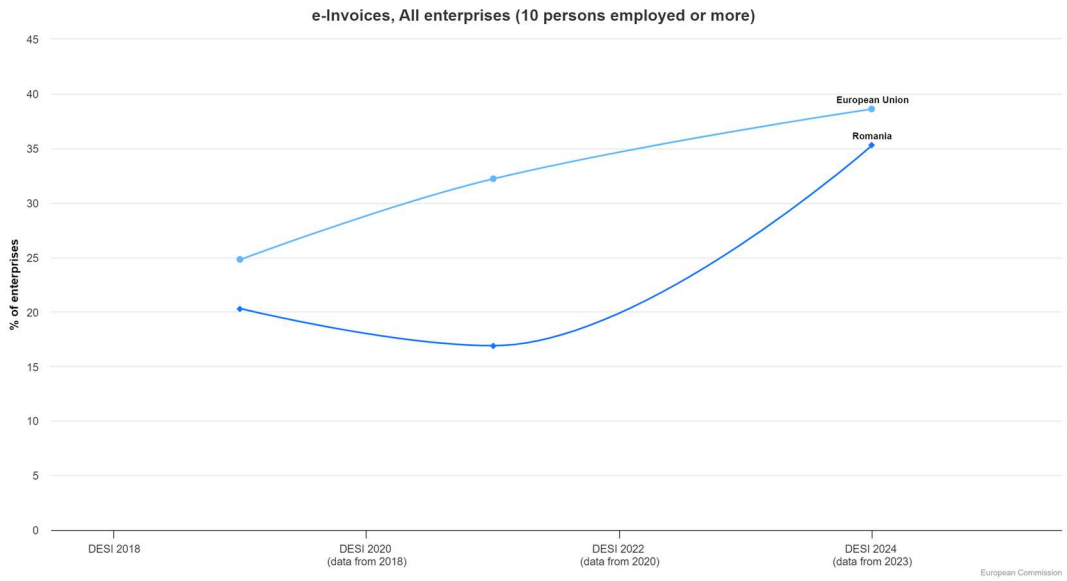

Figure 8: Enterprises sending e-invoices, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

For the proportion of businesses that provide electronic invoicing, the data given is summary only, covering the years 2019–2024. After a significant decrease until 2021, the proportion of Romanian businesses providing digital invoices increased rapidly until 2024, when it finally gets close to matching the EU value.
Comparable characteristics could be noticed in the percentage of businesses that transfer information across several functional areas using an Enterprise resource planning (ERP) system (Figure 9. A sharp decrease is noted again in the case of Romania until 2022, followed by a constant increase until 2024.
Regarding these trio of metrics, the European Union's average is marginally rising, highlighting annual improvements.

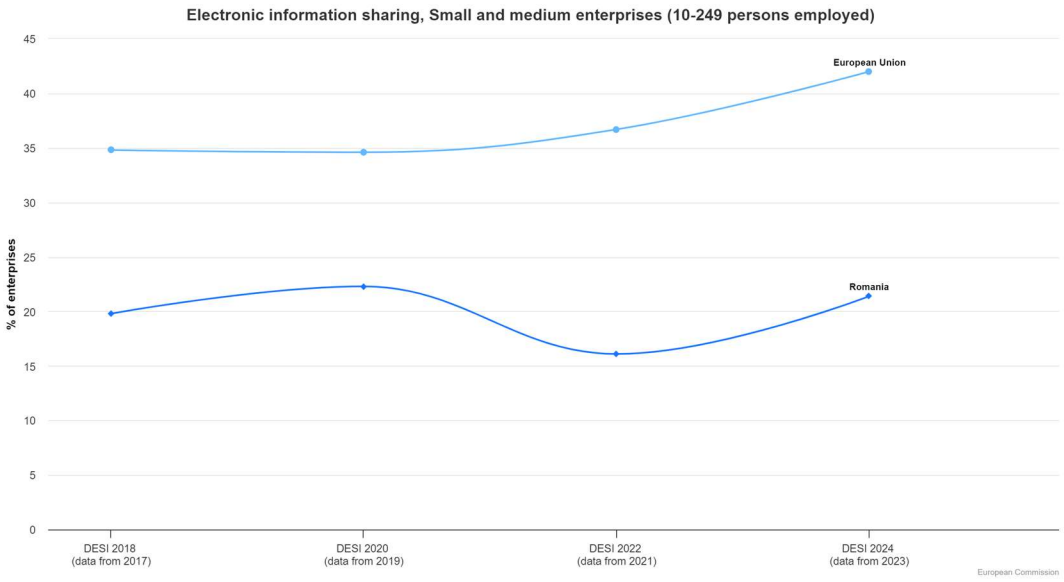

Figure 9: Electronic information sharing, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

The last component dimension of the DESI index is the digitalization of public services, and the analysed indicators are: Digital public services for businesses and Digital public services for citizens. These two measures quantify the proportion of online administrative steps for significant life events and the proportion of governmental services required to launch a business. Therefore, the goal is to achieve the highest possible score of 100 by completing as many online steps as feasible for significant life events and by utilising as many online business services as possible. Regarding the two graphs (Fig. and Fig.), it is visible that the trend is upward with slightly comparable variances at both the European and Romanian levels. Both public services provided to businesses and to citizens experienced declines after 2020; however, the decline in services provided to citizens was more noticeable.

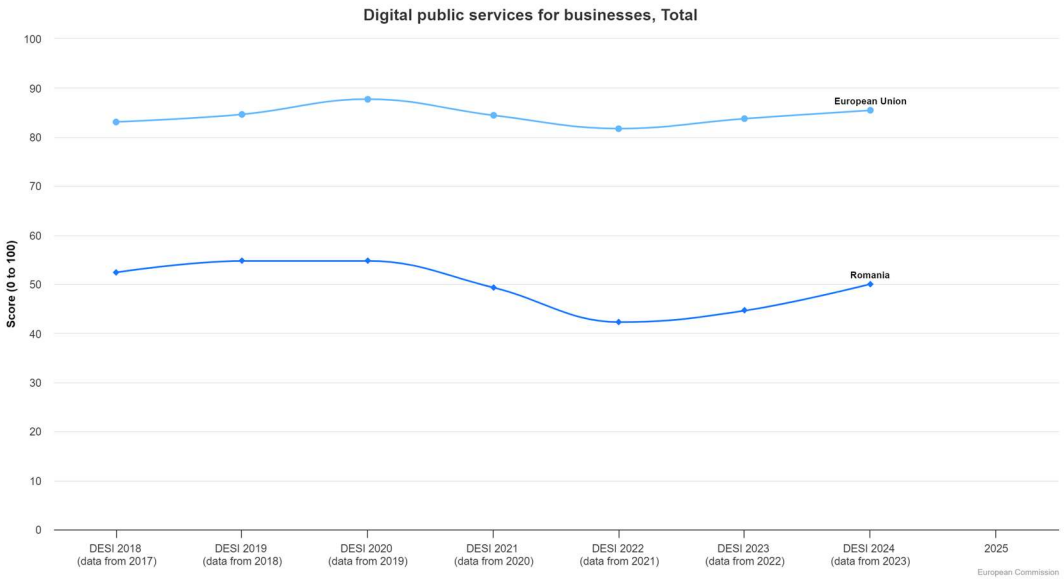

Figure 10: Digital public services for businesses, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

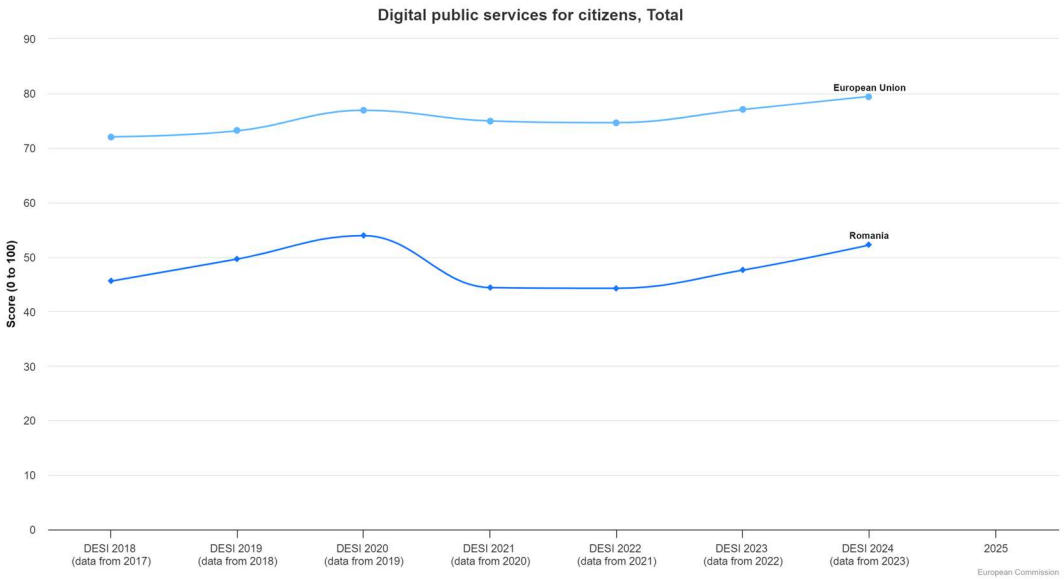

Figure 11: Digital public services for citizens, EU vs Romania
Source: Author's computations on digital-decade-desi.digital-strategy.ec.europa.eu

4. Conclusions

All economic sectors are starting to experience the effects of digitalization, which is now playing a significant role in the global economy. Therefore, strengthening digital skills while providing an infrastructure capable of supporting technological advancement are the primary requirements for achieving a balanced transition towards the ideal scenario that the EU government has proposed. This study focused on evaluating similarities and differences between Romania and the European Union, taking into account the particular dimensions of

the DESI index. Consequently, it was discovered that the overall picture of this comparison is not regular according to the analyses based on the indicators specific to each dimension. Romania has an advantage when it comes to human capital, demonstrated by the rapid growth of internet access between 2018 and 2024, which is effectively on pace with the average of EU. However, the indicator that monitors the percentage of ITC graduates is more significant for this dimension; in Romania's instance, it disclosed much higher values than the average of EU. Given the significant gap in FTTP and VHCN coverage between Romanian and the EU average, one of the country's assets is its digital infrastructure. Romania achieved values up to 30% higher than the European average for the 2008–2024 reference period, demonstrating the potential for digitalization on this infrastructure.

Considering the importance of an infrastructure that can support the digital transformation of a country and an educational system that is able to match the advance on the labour market, these two dimensions can represent the potential for exploring digitalization in Romania.

The sector that embodies this country's weak point is the digitalization of organizations; consequently, it has been proved that, despite substantial variances, Romanian organizations tend not to implement the digital strategies advised on a European scale. Although in 2021 the two figures were similar, the percentage of enterprises selling online is much lower than the European one. While the usage of digital invoicing has been insufficient in the previous three years, the trend appears to be approaching the EU level.

The digitalization of public services is the final component to be evaluated and its context has similarities to the context of digitalizing businesses. With recorded values around 30 points lower on a 0–100 scale than the European average, Romanian public services have not been sufficiently digitalized to be able to stay competitive with the rest of the EU. The trend in this instance is slightly increasing but it does not suggest an outcome where it will go adjacent to the EU average.

The digital context in Romania can be characterized by the digitally developed human capital achieved through the implementation of an educational system based on digital skills and ensuring access to the Internet on a large scale and the necessary infrastructure to ensure the support of a harmonious digital development. Unfortunately, these characteristics that outline a positive scenario in line with the target for 2030 proposed by the EU government are associated with deficiencies in terms of the digital transition of businesses and public services. The last point can have a significant negative impact on both businesses and citizens, as deficiencies in public services have a major effect on the participants in the economy.

The findings of this paper demonstrate Romania's degree of digitalization for each DESI index dimension: lower for digitalization of public services and business transformation, and high for digital skills and digital infrastructure. For a balanced development from a digital point of view, the last two dimensions must be improved through various digitalization policies, according to the recommendations of the EU government.

The limits of this paper are associated with the limited availability of data specific to digitalization of European Union and Romania. Future research may include various indexes related to the digital transformation which will provide a comprehensive perspective among the analysed subject.

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Bio-note

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