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DIGITAL HORIZONS: A COMPARATIVE STUDY OF ROMANIA AND BULGARIA'S JOURNEY WITHIN THE EU'S DIGITAL TRANSITION

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Abstract: *Confronted with a kaleidoscope of crises and a package of challenges, the European Union is obliged to manage a complex set of transitions. One of these paradigm shifts is the digital one due to the pandemic situation, experiencing increased interest and addressability within the national and common regulatory and institutional framework. This research focusses on the steps ahead that Romania and Bulgaria have taken and evaluates their Digital Economy and Society Index (DESI). As tackling the digital gaps among its members represents a key priority for the EU, the authors underlined the results of measures implemented by these countries to optimise digitalisation for economic and social gains. Special attention was paid to the specific scheme of support available to the member state under the Recovery and Resilience Facility, with the aim of accelerating the twin transitions – digital and green - in the process of making economies more sustainable and resilient. This research adopts a mixed methods approach, allowing a nuanced understanding of the digital landscape in Romania and Bulgaria. It combines quantitative data analysis derived from the comprehensive metrics of DESI with qualitative insights, providing relevant information through the comparative analysis of the two countries. The results indicate that the lowest aggregate scores of Romania and Bulgaria are determined by scoring below the EU average in most indicators. The findings of the analysis of the NRRPs highlight their significant role in achieving the digital transition through reforms and investments aligned with the provisions of digital-related European strategies and policies.*

Keywords: *digital transition, resilience, Digital Economy and Society Index, Recovery and Resilience Plan*

JEL classification: *O30, O33, O38, L86*

1. Introduction

In the current context of a kaleidoscope of multiple crises and challenges, the European Union (EU) faces the need to manage a complex set of transitions. One of these major transitions is the digital one, significantly accelerated by the emergence of the Fourth industrial revolution. The importance of the digital transition needs to be taken into consideration, as it plays a key role in the process of increasing economic competitiveness and improving social cohesion within the EU. In this respect, Member States are obliged to align their national regulations and institutions with acquis communautaire in order to facilitate this transition.

In recent years, the European Union has been facing a Digital Transformation, now particularly accelerated by the rise of digital solutions across every sector of society. Although the COVID-19 pandemic has spurred the acceleration of the digital transition, the topic has been constantly on the agenda of the European Union. The Digital Single Market Strategy (European Commission, 2015), one of the 10 political priorities of the European Commission, is based on three strategic pillars: improving access to digital goods and services; a societal environment where digital networks and services can prosper; transforming digital driver as a tool of growth. Furthermore, the European Commission (2020) described the “Digital Package”, containing the communication: Shaping Europe’s digital future, A

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Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

European Strategy for Data, and the White Paper on Artificial Intelligence, focussing on a complex, horizontal, and cross-sectoral approach to Europe's top priorities for digitalisation.

Updating this path of digital regulatory drivers, the European Union decision makers (Commission, 2021a) permanently improve the framework that encompasses the targets, the objectives, multi-country projects, and also the rights and principles of the Digital Decade. The 2030 EU digital goals are based on four key pillars: *Skills* (related to the population and professionals), *Digital transformation of businesses, Secure and sustainable digital infrastructures, Digitalisation of public services***.** The European Commission monitors the digital progress of EU countries using a specific instrument published annually since 2014, the Digital Economy and Society Index (DESI), which tracks progress in digital competitiveness in four interconnected areas and addresses the principal policy areas of the 2030 Digital Compass.

To mitigate the socioeconomic consequences of the different types of crises the EU is confronted with, one of the main priorities become the appropriate enforcement of NextGenerationEU, the most important package ever financed by the EU budget. The main programme of this instrument, the Recovery and Resilience Facility (RRF), benefits from a budget of EUR 723.8 billion at current prices (EUR 672.5 billion at 2018 prices), to facilitate the adoption of national recovery and resilience plans (NRRP) as soon as possible and accelerate green and digital transitions, making economies more sustainable and resilient. In this context, the concept of "resilience" has gained new connotations and definitions, namely "the ability to face economic, social, and environmental shocks or persistent structural changes in a fair, sustainable, and inclusive way". As one of the most important regulatory and financial drivers, the Recovery and Resilience Facility supports digital transformation after COVID-19, based on the minimum percentage of 20% of funds allocated to digital objectives and targeted investments in infrastructure, skills, public services, and business digitalisation.

There are more and more evidences that digital resilience represents both a challenge and an opportunity for the EU, and some relevant requirements must be positioned in correlation with environmental resilience, sustainable growth, and new competitiveness. It serves as a foundational element for managing and recovering from social turmoil and is essential for economic, social, and territorial cohesion throughout the EU. Thus, digital resilience is very important for all types of transformation, enabling sustainable and cohesive transformations at both the European and national levels.

This study focusses on analysing the progress made by Romania and Bulgaria in the field of digitalisation, using the Digital Economy and Society Index (DESI) as the main assessment tool. Answering the following question: How and to what extent have Romania and Bulgaria progressed in the digital transition compared to the EU average, and what are the drivers of these developments? – The research stresses, in particular, the steps ahead performed by Romania and Bulgaria toward digital transformation and evaluates their Digital Economy and Society Index.

2. Literature review

Aspects of digital transformation, both as a goal and as a necessary response to the challenges of contemporaneity, have been extensively explored in the specialised literature through various analytical and methodological perspectives. Researches emphasise that the digital transition is not limited to digitalisation; Although technology has a central role in digital transformation, it requires the integration of digital technology into all aspects of an area of activity, which generates fundamentally changes and provides distinct added value for stakeholders (Durach et al., 2021).

Ciobotea et al. (2022) explore digitalisation in Romania using DESI, highlighting significant performance gaps between Romania and the EU average. The study reveals that while Romania excels in areas such as fixed connectivity and ICT graduates, it lags significantly in digital skills and the digitalisation of public services. The research uses comparative and factorial analysis to assess the impact of the COVID-19 pandemic on digitalisation, presenting two scenarios: the actual digital evolution during the pandemic and an estimated trend had the pandemic not occurred. Their findings

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

suggest that the pandemic has acted as a catalyst for certain aspects of digitalisation, particularly in areas where immediate remote capabilities were necessary. However, the overall slow progress in digital public services indicates that more targeted efforts and investments are needed to sustain and build on these gains.

This complex topic was also on the agendas of the Authority for the Digitalisation of Romania (ADR) that analyses the barriers to digitalisation in both the private and public sectors in Romania (ADR, 2021). In the private sector analysis, the study is divided into two parts. *The first part* directly examines enterprises, especially SMEs and microenterprises, due to their significant role in the national economy and their major challenges in digital transformation. The analysis uses data from the Flash Eurobarometer 486 report, which provides insight into the digitalisation efforts and perceptions of these businesses. *The second part* of the analysis uses objective data from the European Index of Digital Entrepreneurship Systems (EIDES) to identify digitalisation barriers specifically affecting entrepreneurship. This dual approach helps validate the findings and offers a comprehensive view of the digital challenges faced by SMEs and micro-enterprises in Romania.

Based on the researchers results, one can stress that the primary barriers to digital transformation in the private sector are related to human capital. These include low digital skills within the workforce, inadequate digital skills specific to enterprise management in SMEs, and a limited number of IT specialists available to support SMEs. Additionally, there is a significant scarcity of funding to adopt advanced digital technologies. Furthermore, the lack of clarity and coherent development of e-Government tools also represent a pressing challenge. In the public sector, the barriers to digital transformation are multifaceted. There is a profound insufficiency of efficient and effective IT architecture to manage e-public services comprehensively. Moreover, central public institutions lack the information systems necessary to operationalise electronic public services. In addition, there is an insufficient number of e-Government specialists and IT personnel within public institutions, coupled with a lack of the necessary skills to develop and maintain these services. Furthermore, there is a deficiency in a uniform and effective legislative and procedural framework to support e-public services.

Digital transformation is the comprehensive integration of digital technology into all areas of business, resulting in fundamental changes in how businesses operate and deliver value to customers. This transformation is driven by the need for companies to remain competitive and relevant in an increasingly digital world. Bejdić (2020) outlines the multifaceted nature of this process, highlighting that it involves not only the adoption of technology but also significant changes in organisational culture, strategy, and operational models. The author emphasises that successful digital transformation requires clear strategy and strong leadership. The process typically involves four key steps: assessing digital disruption, evaluating the digital potential of the business, articulating the business's digital strategy and ambitions, and developing a detailed transformation plan. This structured approach ensures that companies can navigate the complexities of digital transformation, using new technologies to enhance productivity, competitiveness, and customer satisfaction.

Shishmanov (2022) explores the digitalisation efforts of these two countries, emphasising the multifaceted nature of digital transformation. The study highlights that while Romania and Bulgaria have made significant progress in certain areas, such as connectivity and digital public services, they still lag behind in critical aspects such as digital skills and the integration of digital technologies in businesses. The author uses DESI data to analyse and compare the digital transformation journeys of Romania and Bulgaria, revealing that, despite improvements, both countries consistently rank at the bottom of the DESI index among EU Member States. In his research, the author identified several barriers to digital transformation. For Romania, these include inadequate digital skills among the general population and insufficient IT infrastructure in the public sector. Similarly, Bulgaria faces challenges related to low levels of digital skills and limited adoption of digital technologies in the private sector. The research underscores the importance of addressing these barriers to enhance overall digital competitiveness and achieve the EU's Digital Decade targets.

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

The digitalisation efforts within the EU are explored by Borowiecki et al. (2021), with a focus on the concept of digital convergence. This study uses DESI data from 2015 to 2020 to analyse the progress of EU Member States in developing their digital economies and societies. The authors employ basic measures of time series dynamics and cluster analysis to classify countries based on the similarity of DESI values and structures, identifying clusters of countries with similar levels of digital development. The research reveals that while there is generally an increase in digital convergence among EU countries, significant disparities remain in the integration of digital technology. The study identifies that connectivity, human capital, use of internet services and digital public services have shown improvements toward convergence. However, the integration of digital technology exhibits an increasing polarisation, indicating that some countries are progressing much faster than others in this critical area. This divergence generates challenges in achieving a uniform digital single market across the EU.

Bánhidi et al. (2020) conduct a statistical analysis of the DESI dimensions to underly the relationships and performance patterns among EU countries. The study uses multivariate statistical methods, including correlation analysis, cluster analysis, and multidimensional scaling, to assess the interrelationships between DESI dimensions and to group countries according to their digital performance. The findings reveal that while the dimensions of DESI are interrelated, they can be reduced to two principal components: readiness, or "digital competence" encompassing connectivity and human capital, and digital application, involving the integration of digital technology and digital public services. The authors highlight that, despite DESI's effectiveness in measuring digital transformation, there are inherent challenges, such as data collection inconsistencies and the dynamic nature of digital metrics. Their research underscores the importance of understanding the statistical robustness of the DESI and suggests that the index can be further refined to improve its utility for public policy analysis. By identifying clusters of countries with similar digital profiles, the study provides a nuanced understanding of how different EU Member States progress in their digital journeys, offering insights into best practices and areas requiring targeted interventions.

Małkowska et al. (2021) investigate the effects of digital transformation across EU Member States using a comparative analytical approach. The study has a two-stage methodology: cluster analysis and the TOPSIS method. This approach allows researchers to group countries based on their digital performance and rank them according to various indicators of digital transformation. The study focusses on three main dimensions: Society 4.0, Economy 4.0, and Companies 4.0. Society 4.0 measures the digitalisation of society, Economy 4.0 assesses the economy's ability to face technological challenges, and Companies 4.0 examines the use of ICT in companies. The findings reveal significant disparities in digital performance in EU countries. The Nordic countries, along with the Netherlands and the UK, consistently rank high in all dimensions, whereas countries like Romania and Bulgaria lag behind.

Marti and Puertas (2023) explore the relationship between digitalisation, innovation, and competitiveness in EU countries. The study uses a synthetic indicator that combines the Global Innovation Index (GII) and DESI to rank EU Member States from 2017 to 2021. The authors use TOPSIS method to create a comprehensive ranking, revealing stable positions for countries over the analysed period, with Nordic countries consistently leading in both digitalisation and innovation, and Prais-Winsten regression with Panel Corrected Standard Errors to obtain robust estimators. Research identifies economic, social, and environmental factors that influence digitalisation and innovation. The study finds that GDP per capita, employment rate, number of researchers, and quality of infrastructure positively impact a country's digital and innovative capacity. In addition, social factors such as life satisfaction and gender equality, along with environmental sustainability measures, contribute significantly to a country's competitiveness in these areas.

Miron et al. (2022) study the opportunities for Romania's economic recovery in the post-pandemic period, in the context of the Multiannual Financial Framework (MFF) of the EU 2021-2027 and the NextGenerationEU programme (the temporary instrument designed to boost recovery), highlighting the medium and long-term economic impact and the dimension of the digital and green

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

transition. The first part of the study provides an analysis of post-pandemic response measures at the European Union level and includes a multilevel and multiparameter analysis of the 2021-2027 MFF and NGEU, followed by an analysis of Romania's National Recovery and Resilience Plan, compared to the recovery and resilience plans of other EU Member States. The challenges associated with green and digital transitions, as well as the prospects for the EU's economic governance framework in the post-pandemic period, are also taken into account. The conclusions of the study summarise the main results achieved and recommendations for Romania to make the most efficient use of funds under the EU's long-term budget and NextGenerationEU, for the purpose of the post-pandemic economic recovery.

In terms of research methodology, quantitative methods based on the analysis of secondary data (Eurostat statistics and databases, national statistics, various studies, reports, articles, and literature research) relevant to the research topic and qualitative methods (benchmarking, case studies, collection of best-practice examples) were used. For structural and cohesion funds and NRRP data, the official European Union database was used on the Open Data Portal https://cohesiondata.ec.europa.eu/, official information available on www.mfe,gov.ro, as well as databases of think tanks such as https://www.bruegel.org/. The research was based on the following research methods: the analysis method (MFF 2021-2027, RRF/NGEU, RRP), the historical method (the evolution of cohesion policy and the absorption of funds allocated to this policy, as reference elements for estimating the effects and evolution of contracting and absorption rates in the case of RRF/NRRP), the comparison method (the positioning of Romania in relation to the other Member States), the descriptive method/analysis (presentation of the elements specific to the research topic). Alternative scenarios have been developed to identify the possible effects of the use of the RRF/NGEU in Romania.

Schramm et al. (2022) analyse the implementation of the Next Generation EU (NGEU) recovery plan, describing the legal foundations, economic rationale, and political controversies surrounding the Recovery and Resilience Facility (RRF), which is the core of NGEU. NGEU. In 2021, the EU adopted the recovery plan, Member States developed and submitted national recovery and resilience plans (NRRPs), and the European Commission started borrowing and disbursing the first funds. NGEU has major implications for the EU's governance system, the financial sector, and the relations between the Union and its Member States. In this regard, the authors assess both formal changes and informal practices in the EU governance system. The first section of their research highlights the context of the preparation of the recovery plan, following its main objectives and the controversies involved. The second section captures the complex process of drafting, approving and implementing national recovery and resilience plans, as well as the Commission's borrowing operations. The third section outlines a broader perspective, in light of the impact that NGEU could have on Member States and on the Union's recovery from the pandemic, the opportunities and challenges ahead. Although EU institutions have created concrete guidelines and benchmarks for national recovery and resilience plans, the achievement and success of the NGEU will ultimately depend on the political will of the Member States.

Corti et al. (2022) provide a detailed and comparable overview of the investments and reforms included in the NRRPs and propose a methodology for the assessment of the national recovery and resilience plans (NRRPs), using a comparative analysis of the NRRPs. The country fiches compiled contain the following information: Macroeconomic outlook and forecasts for GDP, employment, unemployment, inflation; Countries' structural challenges before the COVID-19 pandemic in eight key areas: labour market, education and skills, justice, research and innovation, public administration, taxation, product market, social policies; Planned expenditure through grants / loans from the Recovery and Resilience Facility grants/loans; Impact of NRRPs on country GDP and employment – deviations from baseline; Distribution of investments in six pillars of the Recovery and Resilience Facility (green transition; digital transformation; smart, sustainable and inclusive growth; social and territorial cohesion; health and economic, social and institutional resilience; policies for the next generation); 10 strategic projects financed by the Recovery and Resilience Facility; Main structural reforms in eight areas; and General assessment.

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

Three main criteria are considered in the assessment of the reforms proposed in the NRRPs. Therefore, reforms must address country-specific needs and problems and be in line with the objectives defined in the Recovery and Resilience Facility. Furthermore, the reforms must be in line with the objectives pursued and the investments proposed. Moreover, the country fiches provide information on the relevance, effectiveness, and coherence of the main structural reforms contained in the plans.

3. Methodology

This research uses a mixed methodological approach, combining qualitative and quantitative methods to obtain a comprehensive landscape of the digital transition in Romania and Bulgaria and to address the following assumptions. *The first main assumption* of the authors is that Romania and Bulgaria show DESI scores below the EU average in most indicators, highlighting the need for significant improvements in almost all areas. *A second assumption* clarified during the research carried out considered the fact that there are certain specific indicators where both countries exceed the EU average, indicating relatively stronger digital performance. *The third assumption* is that National Recovery and Resilience Plans (NRRPs) play a central role in achieving the digital transition in Romania and Bulgaria through its reforms and investments aligned with European strategies and policies.

Quantitative research is based on data provided by the Digital Economy and Society Index (DESI). DESI assesses the digital performance of EU Member States in four main dimensions: human capital, connectivity, integration of digital technology, and digital public services. DESI data have been analysed in recent years, highlighting trends and progress in each of these dimensions. Comparison of the aggregate scores of Romania and Bulgaria with the EU average made it possible to identify gaps and areas of relative performance.

The qualitative approach includes documentary research and comparative analysis of the two countries. Secondary data collected from EU and national public policy documents, strategies, and plans, relevant to the research theme, were used, aligned with documentary research. These documents were examined to identify specific measures taken to accelerate digitalisation and their alignment with European objectives. A comparative analysis was performed, comparing the DESI scores and the progress made under the NRRPs of the two countries and the analysis of the NRRPs. Benchmarking has been used to identify similarities and differences in the approaches taken by Romania and Bulgaria to meet digital challenges and achieve the objectives set by the EU.

Research was designed to be carried out in two main stages. The first step was to collect and analyse quantitative DESI data for Romania and Bulgaria. It has made it possible to assess digital performance in the European context and identify key gaps and areas of performance. The combination of quantitative and qualitative methods ensured a comprehensive and nuanced approach, allowing the identification of general trends and national specificities in the digital transition of Romania and Bulgaria. Research thus provides a solid basis for formulating relevant recommendations for improving digital performance in these countries and aligning them with EU objectives. The second stage involved qualitative methods, including documentary research and comparative analysis of the two countries. It provided a contextual framework for the interpretation of quantitative results and allowed for a detailed examination of national policies, strategies, and plans.

4. Results and discussions

4.1. Romania and Bulgaria in the Digital Economy and Society Index

Since 2014, the European Commission has used the Digital Economy and Society Index (DESI) to monitor the digital progress of EU countries according to the European Commission (n.d.). An adjustment has been made for DESI 2021, to highlight the Recovery and Resilience Facility (RRF) and the Digital Compass for the EU's digital decade, significant policy initiatives which are expected to influence the digital transformation in the next years. The results of the Digital Economy and Society Index track progress in digital competitiveness in areas such as human capital, broadband connectivity, the integration of digital business technologies and digital public services in EU Member States.

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

According to DESI 2022, Romania and Bulgaria rank at the bottom of the EU Member States, with Romania at the 27th position and Bulgaria at the 26th (Fig. 1). DESI scores are substantially lower than the EU average of 52.3, with Romania scoring 30.6 and Bulgaria 37.7.

Figure 1: The Digital Economy and Society Index 2022 Ranking

Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

Most countries, which are below the EU digitalisation average, have not progressed much in the last few years. This is the case especially for Bulgaria and Romania, which registered slow progress, well below the EU average (Fig. 2), although both countries were considered, along with eight markets in the region, "Digital Challengers", demonstrating strong potential for growth in the "digital economy" (Novak et al., 2018).

Figure 2: Digital Economy and Society Index, by Aggregate Score, for Romania and Bulgaria compared to the European average trend

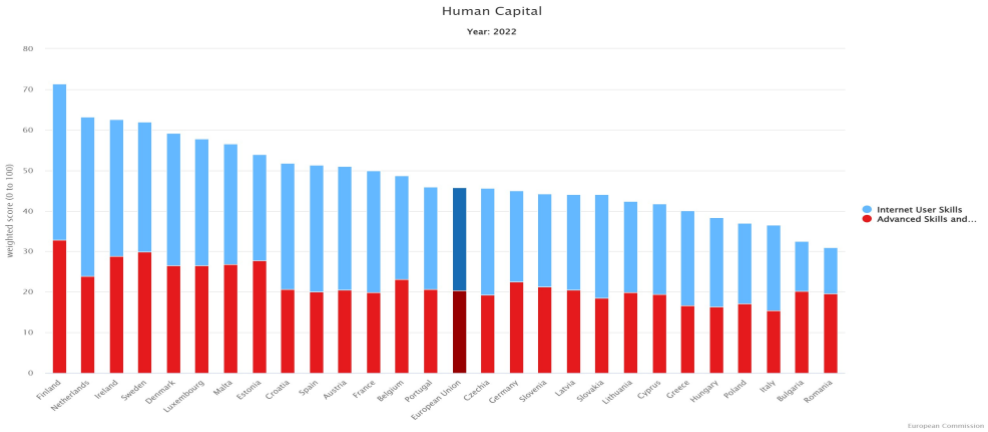
Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

According to the European Commission (2022), in terms of human capital, Bulgaria ranks 26th and Romania last among the 27 EU countries. Although both countries have a number of ICT graduates above the EU average, their ability to innovate and realise the advantages of digital transformation is limited by the scarcity of ICT specialists. On the other hand, for the indicator of female ICT specialists, Bulgaria is the leader for this indicator within the EU, while Romania is also one of the top countries. For the two countries analysed, the indicators for human capital are very similar, with most indicators scoring below average. Around a third of people aged between 16 and 74 years have at least basic digital skills, below the EU average of 54%, while a slightly higher percentage have at least digital content creation skills indicator, also below the EU average of 66%. The proportion of individuals who have

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

above-basic digital skills is less than 10% in both countries. Although there was a slight increase in the percentage of ICT specialists, they represent a lower proportion of the workforce than in the EU as a whole. The number of companies that provide ICT training to their employees is very low, 6% in Romania and 7% in Bulgaria against the EU average of 20%.

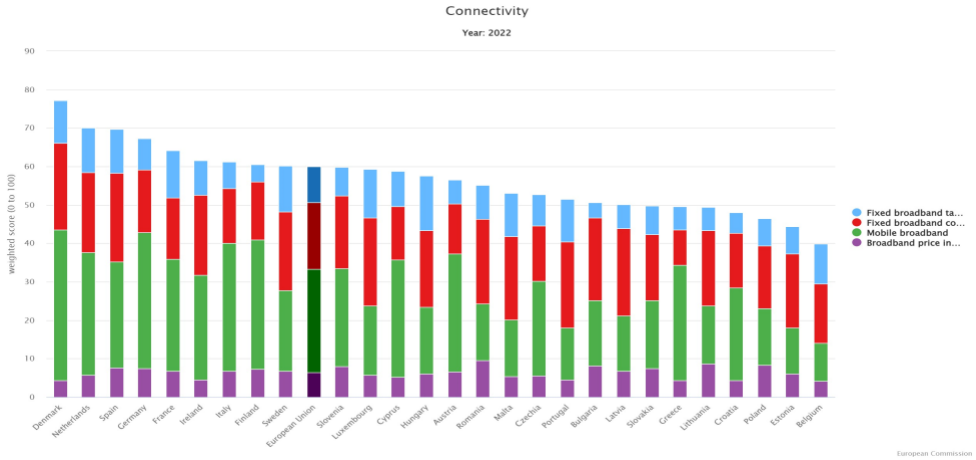
Figure 3: Digital Economy and Society Index 2022, Human Capital



Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

In terms of connectivity, the two countries score better than on the other components but still below the EU average. Romania ranks 15th, while Bulgaria ranks 19th among EU countries. The relevant indicators that generated these higher positions were: Fast broadband coverage increased to 93% for both countries, exceeding the EU average; Fibre to the Premises (FTTP) coverage indicator of 87% for Romania and 85 % for Bulgaria, also above the EU average. For other indicators, namely, at least 100 Mbps fixed broadband take-up and at least 1 Gbps take-up are also above the EU average, only Romania scored above the EU average. All other indicators, including the fixed broadband take-up indicator and 5G spectrum and coverage, are lower than the EU average, even though for most of them an increase was observed.

Figure 4: Digital Economy and Society Index 2022, Connectivity

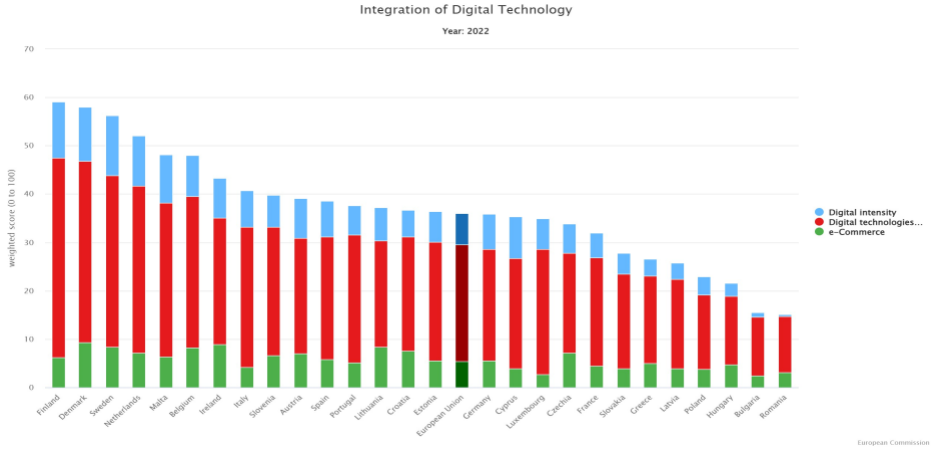


Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

For the integration of digital technology dimension, Bulgaria ranks 26th and Romania 27th. For both countries, most indicators are below the EU average (SMEs with at least a basic level of digital intensity, Electronic information sharing, Social media, Big data, Cloud, AI, e-Invoices, e-Commerce turnover, Selling online cross-border), except ICT for environmental sustainability where they score slightly above the EU average (68% compared to 66% EU average).

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

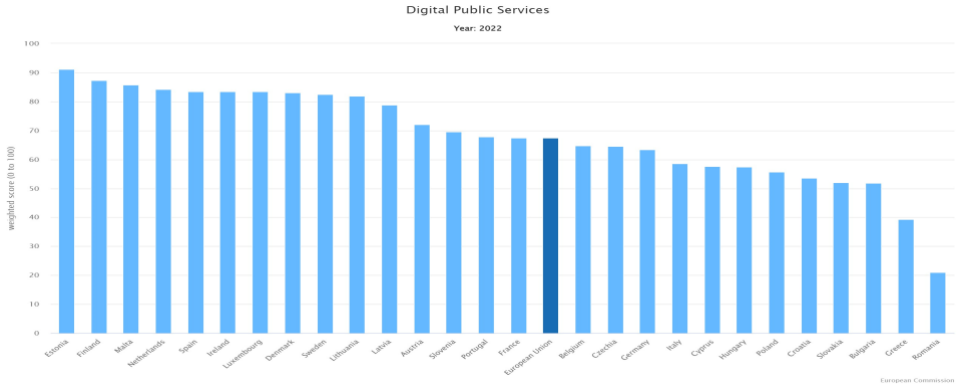
Figure 5: Digital Economy and Society Index 2022, Integration of Digital Technology



Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

According to the European Commission's Report on Romania's Economy and Digital Society Index, in terms of digital public services, Romania ranks 27th and Bulgaria 25th. In both cases, all indicators from this domain are below the EU average, namely, Government users, pre-filled forms, and Digital public services for citizens. Open data Digital public services for businesses. Although Romania registers significant differences compared to the EU average, Bulgaria scores are relatively better.

Figure 6: Digital Economy and Society Index 2022, Digital Public Services



Source: https://digital-strategy.ec.europa.eu/ro/policies/desi

Table 1: Comparative analysis based on DESI metrics: Romania and Bulgaria

Component	Country	Rank	Score	Weaknesses / Strengths
Human Capital	Romania	27th	30.9	Severe deficiencies in digital skills among its population (only 28% of individuals possess at least basic digital skills, compared to the EU average of 54%). The proportion of ICT specialists in employment (2.6%), below the EU average
	Bulgaria	26th	32.6	Severe deficiencies in digital skills (only 31% of individuals have basic digital skills). The proportion of ICT specialists in employment (3.5%) is below the EU average (slightly better than Romania).
Connectivity	Romania	15th	55.2	Romania excels in connectivity, with high coverage of fast broadband (93%) and very high-capacity networks (VHCN) (87%). The overall take-up of fixed broadband remains low at 66%, primarily due to low digital skills and socioeconomic factors.

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

Component	Country	Rank	Score	Weaknesses / Strengths
	Bulgaria	19th	50.7	Bulgaria shows strong performance in Fibre to the Premises (FTTP) coverage, which stands at 85%, well above the EU average of 50%. The overall take-up of fixed broadband is low, at 63%.)
Integration of Digital Technology	Romania	27th	15.5	Romania has the lowest integration of digital technology among EU countries. Only 22% of SMEs have a basic level of digital intensity. The adoption of advanced digital technologies, such as AI and cloud computing, is very low.
	Bulgaria	26th	15.5	Bulgaria shares similar struggles, with only 25% of SMEs having basic digital intensity. Adoption rates for AI (3%) and cloud services (10%) are among the lowest in the EU.
Digital Public Services	Romania	27th	51.9	Romania's performance in digital public services is poor, with only 24% of internet users interacting with the government online. Digital public services for both citizens and businesses are underdeveloped.
	Bulgaria	26th	51.9	Bulgaria performs slightly better in this category, but still ranks low overall. The interaction rate with e-government services is also 34%, indicating similar challenges to those of Romania.

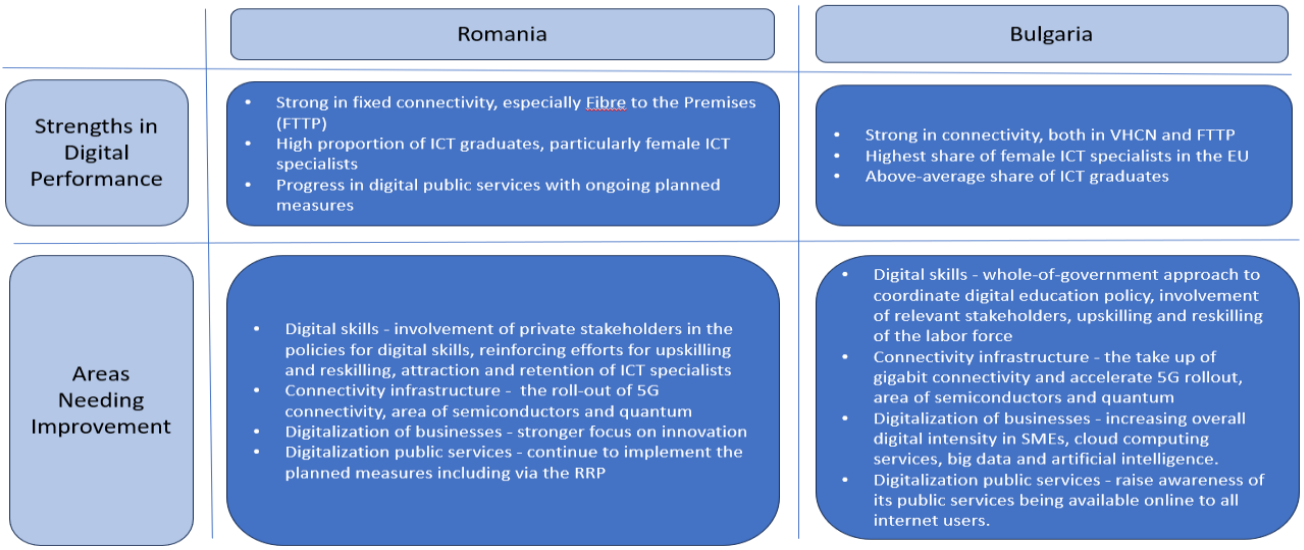
Source: Compiled by the authors, based on data from the Digital Economy and Society Index 2022 (European Commission, 2022)

The analysis performed reveals that, what concern human capital, both countries have significant gaps in digital skills, which is a major barrier to their digital transformation. Bulgaria marginally outperforms Romania in human capital metrics, but both are far below the EU average and require substantial improvements in education and workforce training. Both countries perform relatively well in connectivity, particularly in terms of network coverage. Romania has a slight edge over Bulgaria in terms of overall connectivity score and fixed broadband use. Both countries must address the issue of low broadband adoption despite good infrastructure availability. Romania and Bulgaria rank equally in the integration of digital technology, highlighting a critical area that needs improvement. Increased support and incentives for SMEs to adopt digital tools and processes are essential for Romania and Bulgaria to enhance their digital economies. In addition, significant improvements are needed in digital public services in the two countries. Enhancing e-government services and increasing citizen participation in these services are crucial steps for both Romania and Bulgaria.

The research carried out supports hypothesis 1, that is, Romania and Bulgaria show DESI scores below the EU average in most indicators, highlighting the need for significant improvements in nearly all areas. The second assumption clarified during the research carried out considered the fact that there are certain specific indicators where both countries exceed the EU average, indicating relatively stronger digital performance, i.e., female ICT specialists, ICT graduates, Fixed Very High-Capacity Network (VHCN) coverage, Fibre to the Premises (FTTP) coverage, Broadband price index, ICT for environmental sustainability.

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

Figure 7: Romania and Bulgaria: Comparative analysis of digital transformation. Strengths and areas that need improvement.



Source: Compiled by the authors, based on data from the Report on the state of the Digital Decade (European Commission, 2023)

4.2. Digital aspects of the Romanian and Bulgarian Recovery and Resilience Plans

The European Parliament and the Council of The European Union (2021) established the Recovery and Resilience Facility (RRF), which aims to mitigate the economic and social impact of the COVID-19 pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of green and digital transitions. The RRF is a key component of the EU's broader recovery strategy, providing financial support to Member States to implement reforms and investments that drive digital and green transformation. By fostering economic resilience and enhancing digital infrastructure and skills, the RRF seeks to ensure that all EU countries, including Romania and Bulgaria, can achieve the ambitious targets set out in the EU's Digital Decade strategy.

In September 2021, the European Commission endorsed Romania's EUR 29.2 billion recovery and resilience plan (grants and loans), and in April 2022 had adopted a positive assessment of Bulgaria's EUR 6.27 billion recovery and resilience plan (grants). The plans will be implemented by 2026 and will support the implementation of investment and reform measures put forward by Romania and Bulgaria as a response to the COVID-19 pandemic. The contributions of both plans to the digital transition exceed the minimum of 20% required by the RRF Regulation, as one of the seven criteria established by the European Commission for the assessment of each NRRP (20.5% - Romanian plan and 25.8% - Bulgarian plan). Through the National Recovery and Resilience Plans, which have an important component dedicated to the digital transition, investments will be made that will increase the values of the DESI indicators.

Table 2: Romania and Bulgaria: Financing and Key Measures for Digital Transition

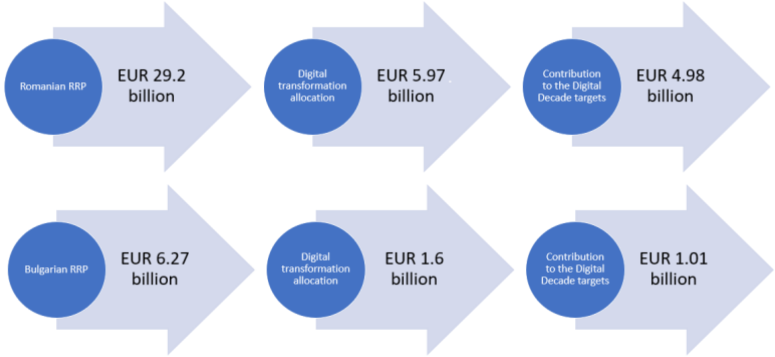
Member State	Financing through the Recovery and Resilience Plan	Digital Transition - Reforms and Investments	
		Percentage of the total allocation of the plan	Key Measures to Support Digital Transition
Romania	€14.2 billion in grants and €14.9 billion in loans	20.5%	Digitalisation of public administration: digitalising public administration in key areas such as justice, employment, and social protection, environment, civil service management and skills development, public

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

Member State	Financing through the Recovery and Resilience Plan	Digital Transition - Reforms and Investments	
		Percentage of the total allocation of the plan	Key Measures to Support Digital Transition
			procurement, cybersecurity, tax, and customs, while building a secure government cloud infrastructure and supporting eID deployment. €1.5 billion. Digitalisation of health: development of an integrated e-Health system, connecting over 25,000 healthcare providers and telemedicine systems. €470 million Digitalisation of education: improving digital pedagogical skills, educational content, and equipment and resources, including in universities. €881 million
Bulgaria	€6.27 billion in grants	25.8%	Large-scale deployment of digital infrastructure: increasing the coverage of very high-capacity networks across the country, including in rural and sparsely populated areas. €270 million Enhancing digital skills: promoting adult learning by digital skills trainings; setting up a national online platform for adult learning. € 319 million Digitalisation of public administration: investments in the modernisation and digital transition of public administration; digital public services in key areas such as justice, health, employment, and social protection. €297 million

Source: Compiled by the authors, based on data from the European Commission data and evaluations

Figure 8: Romania and Bulgaria: Comparative Analysis of NRRPs Allocations



Source: Compiled by the authors, based on data from the European Commission data and evaluations.

According to the European Commission (2021b) and the Ministry of Investments and European Projects - Ministerul Investițiilor și Proiectelor Europene (2021), the Romanian Recovery and Resilience Plan allocates EUR 5.97 billion (20.5%) towards digital transformation, with EUR 4.98 billion aimed at meeting the Digital Decade targets. Key initiatives include the digital transformation of the public sector through a governmental cloud, digitalisation of education, support for business digitalisation, and digital R&D, as well as improvements in cybersecurity and connectivity. In October 2022, Romania received an initial payment of EUR 2.6 billion, which funded the establishment of a digitalisation task force, the adoption of the 5G security law, and the development of a cybersecurity strategy. The second payment request, partially approved by the Commission in June 2023, includes further significant milestones for Romania's digital transformation, such as the 5G auction, additional reforms for the government cloud, and enhanced digitalisation measures for education (European Commission, 2023).

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

According to the European Commission (2021c), the Bulgarian Recovery and Resilience Plan totals EUR 6.27 billion, with 25.8% (EUR 1.6 billion) dedicated to digital transformation. Of this amount, EUR 1.01 billion is aimed at contributing to the Digital Decade targets. For the first payment request, Bulgaria achieved 11 milestones and targets, including several digital initiatives such as reducing spectrum fees, implementing legislative changes based on the Connectivity Toolbox recommendations, and awarding contracts for the development of the TETRA system and radio relay network. For the second payment request, Bulgaria is expected to meet 66 of the 346 milestones and targets outlined in the plan (European Commission, 2023).

Research substantiates hypothesis 3 by thoroughly analysing the National Recovery and Resilience Plans (NRRPs) of Romania and Bulgaria, demonstrating their critical role in driving the digital transition. Both countries have allocated significant portions of their NRRPs towards digital transformation. These investments target key areas such as public sector digitalisation, business digitalisation, digital education, and cybersecurity, align closely with the EU's Digital Decade targets. The successful implementation of these measures, evidenced by the milestones and targets already achieved in both countries, underscores the pivotal role of NRRPs in the promotion of digital transformation. This alignment with European strategies and policies not only supports the hypothesis, but also highlights the effectiveness of NRRPs in bridging digital gaps and promoting sustainable and resilient digital economies in Romania and Bulgaria.

5. Conclusions

The study adds value to the increasing knowledge on the topic of digital transition by proposing a compared analysis of Romania and Bulgaria, which integrates the scores and rankings of the Digital Economy and Society Index (DESI) and the Recovery and Resilience Plans, as means of investments that will increase the values of the DESI indicators.

The results of the study indicate that Romania and Bulgaria are making some progress in their digital transformation but face significant challenges. The lowest aggregate scores registered by Romania and Bulgaria in DESI 2022 are determined, in both cases, by scoring below the EU average on most indicators. By contrast, the analysis reveals some common indicators situated above the EU average, i.e., female ICT specialists, ICT graduates, Fixed Very High-Capacity Network (VHCN) coverage, Fibre to the Premises (FTTP) coverage, Broadband price index, ICT for environmental sustainability. In terms of ranking and scores related to the four dimensions of DESI 2022, both countries have a relatively good performance on the Connectivity dimension (Romania 15th, Bulgaria 19th), while for the other dimensions, they are at the end of the ranking. There is still significant improvement required for both countries, across all areas, considering also the Digital Decade target levels.

The findings of the analysis of the NRRPs highlight the significant role of these plans in achieving the digital transition through reforms and investments aligned, in both cases, with the provisions of European strategies and policies on digital transformation. Therefore, correct implementation of the NRRPs will be essential in order not to waste this opportunity.

The journeys of digital transformation of Romania and Bulgaria are marked by both progress and persistent challenges. Although both countries have made notable advances in connectivity and ICT education, they continue to struggle with digital skills and the digitalisation of public services and businesses. This research contributes to the existing literature by providing a comprehensive analysis of the digital landscape in these countries, highlighting the role of the RRF in addressing digital gaps, and offering insights into strategies for achieving the EU's Digital Decade targets. By addressing these gaps, Romania and Bulgaria can better align with the broader digital transformation goals of the EU, ensuring more inclusive and resilient digital economies.

Research focusses mainly on the short-term impacts and immediate results of the implementation of NRRPs in Romania and Bulgaria. Digital transformation is an ongoing process, and the long-term effects and sustainability of these reforms and investments are yet to be seen. A longitudinal study would be necessary to fully understand the lasting impacts of these initiatives. Although the study provides a

Vol. 76, issue 4 Year 2024
DOI: 10.56043/reveco-2024-0031

comparative analysis of Romania and Bulgaria, it does not cover other EU Member States extensively. Including a broader range of countries could provide more context and allow a more comprehensive understanding of where Romania and Bulgaria stand in relation to the rest of the EU.

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Vol. 76, issue 4 Year 2024
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