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Measuring tax digitization using the E-Governance Development Index in Romania and worldwide

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Abstract: In this article we set out to analyze the level of fiscal digitization using the E-Government Development Index (EGDI) developed by the United Nations, focusing on Romania's evolution in the global and European context from 2003 to 2024. The research highlights significant regional disparities, with Europe remaining consistently at the top of the global ranking.

The analysis of the EGDI components reveals Romania's high performance in telecommunications infrastructure and institutional framework, but significant shortcomings in e-government education and online services. The results indicate the need to intensify efforts to educate taxpayers and improve digital services in order to optimize the tax digitalization process in Romania.

Keywords: E-Governance, Fiscal Digitalization, Digital Infrastructure, Online Services, Human Capital.

JEL classification: H11, H20, O33, O38, L86

Introduction

Tax digitization is a fundamental pillar of modernizing public administration in the digital age, essential for streamlining tax processes, reducing red tape and increasing government transparency. In the context of accelerating digital transformation globally, objectively measuring progress in the implementation of digital tax solutions becomes crucial for assessing national performance and identifying directions for improvement.

In this article we used the United Nations E-Government Development Index (EGDI) to analyze the evolution of fiscal digitization in Romania compared to global and regional trends over the period 2003-2024.

The EGDI is a complex assessment tool, incorporating three key dimensions: the Online Services Index (ISO), the Telecommunications Infrastructure Index (TII) and the Human Capital Index (HCI).

Our research highlights significant regional disparities in eGovernment implementation, with Europe consistently remaining at the top of the global rankings. For Romania, the analysis reveals a paradox of digitization: although the country shows a consistent improvement in its EGDI score from 0.54 in 2008 to 0.76 in 2024, its position in the world ranking has deteriorated from 38th in 2004 to 72nd in 2024, suggesting that the pace of progress is lower than in other countries.

A detailed examination of the EGDI components for Romania shows strong performance in the telecommunications infrastructure and institutional framework, but significant shortcomings in e-government education and the development of online services. These findings underline the need for a balanced strategic approach, combining investments in infrastructure with taxpayer education programs and the development of innovative digital services, to optimize the process of tax digitization in Romania.

Literature

Tax digitization is a sensitive and subjective topic that requires, on the one hand, a strong and efficient governance system that can implement the digitization process. On the other hand, the success of tax digitization is only ensured by a quality infrastructure. The complexity of the tax digitization process has led to the fact that, in most of the literature, the indicators used are relatively general proxies related to internet access or the required infrastructure. The most commonly used variables are internet access of the population and the existence of secure, certified servers providing the necessary infrastructure support.

At the global level, there are a number of attempts to construct more specific, more punctual indicators that can more effectively measure the level of fiscal digitization.

They are built either by renowned international institutions or organizations such as the World Bank, the Organization for Economic Cooperation and Development (OECD) (OECD, 2016; OECD, 2016; OECD, 2020; OECD, 2021; OECD, 2022; OECD, 2024) or by private players with digitization activities, such as Huawei (2024)

For example, more specific proxies for digitization can be found in the Global Findex indicator constructed by the World Bank (Demirgüç-Kunt et al., 2013; Demirgüç-Kunt et al., 2015; Demirgüç-Kunt et al., 2018; Demirgüç-Kunt et al., 2022) within the Findex database. However, the variables used are not specifically related to tax digitization, but rather to the use of technology in the financial sector. A large part of the indicators collected focus on digital payments and the use of mobile technologies (mobile phones and related apps) in the banking sector - for payments, transfers, account openings, etc. The problems we mentioned earlier related to the difficulty of collecting information can also be seen in this database, in that the variables are collected only in three distinct years 2014, 2017 and 2021.

E-Government Development Index (EGDI)

One of the oldest concepts related to fiscal digitization present in the literature is E-Government (United Nations, 2024a) or E-Governance. It refers to the way in which government uses technology to bring innovation into the governance process and move administrative services from the physical to the online environment. One of the components of E-Governance is tax digitization, whereby both business and citizens benefit from dedicated platforms that increase the transparency of operations, but also ease the entire process of declaring

income and collecting the related taxes. Building on this concept, the United Nations (2024a) constructed **the E-Government Development Index (EGDI)**. The EGDI is a composite index, which incorporates information related to infrastructure, access, use of information technology to deliver quality e-government services, etc., thus:

- Online Service Index (ISO), which incorporates information on institutional framework, technologies, services, e-participation, etc.
- The Telecommunication Infrastructure Index (TII), consisting mainly of aspects used as general indicators of the fiscal digitization process, such as: internet users, mobile phone users, respectively price
- The Human Capital Index (HCI), which is constructed on the basis of information related to the level of education, the schooling rate, the expected number of years of schooling, the average number of years of schooling or, most importantly, the level of education in e-government.

Methodology

As the methodological explanations reveal, the EGDI has evolved from the 85 indicators initially considered to the 96 indicators currently used in its construction process (United Nations, 2016). The first available values are, at the national level, from 2003. However, the difficulty of continuously collecting information is also observed for this indicator. Estimates are available for the years 2004 and 2005, then from 2008 onwards and only every two years. Because of the lack of chronological consistency from the beginning of the EGDI measurement period, we have chosen to run more complex analyses from 2008 through 2024.

The EGDI is currently calculated for 193 (all members of the United Nations). The index takes values between 0 and 1, where 0 represents a total lack of e-governance and 1 represents perfect e-governance. Another interpretation of the index is based on dividing the sample of countries by quartiles. This highlights 4 groups of countries:

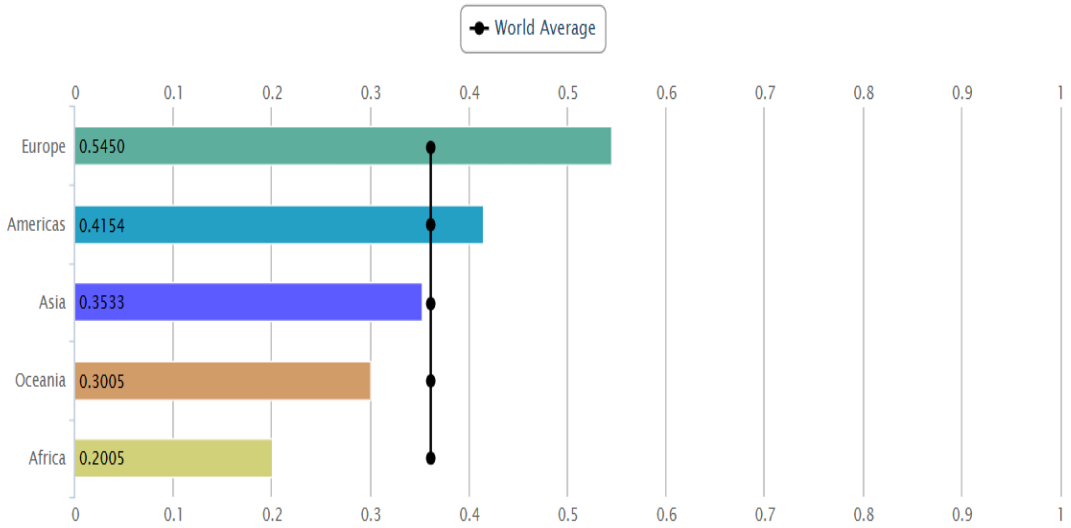
1. EGDI score between 0 and 0.249 is the group of countries with a low level of e-government process development
2. The EGDI score between 0.25 and 0.49 is the group of countries with an average level of e-government process development
3. The EGDI score between 0.5 and 0.749 is the group of countries with a high level of e-government process development
4. The EGDI score between 0.5 and 1 is the group of countries with a very high level of e-government development.

Data are available through the United Nations Data Center (United Nations, 2024b).

There are numerous studies using this indicator to assess the level of digitization of the governance process (Kochanova et al., 2020), but also specifically, that of fiscal digitization (Sagdic & Tuncer, 2017). Most of the literature using EGDI does not only present a simplistic analysis, but also relates this indicator to social economic development (Sadik-Zada et al., 2024) or to the quality of the governance process and fiscal transparency (Sagdic & Tuncer, 2017; Paul & Adams, 2024).

Moreover, this index is currently used to construct and estimate other more global digitization and e-governance indicators, such as the Global Digitization Index compiled by Huawei (2024).

Figure no. 1. EGDI by continent in 2003



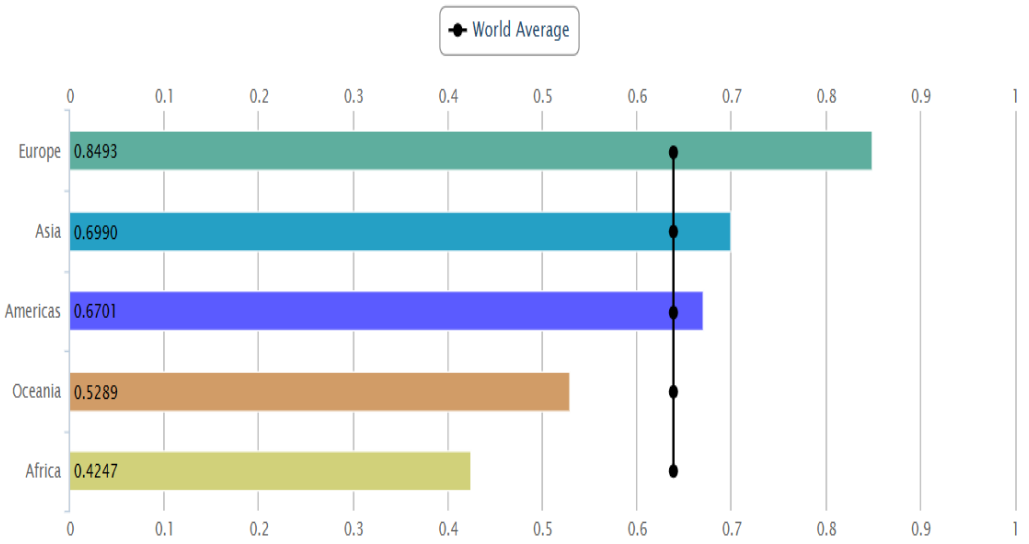
Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Region-Information

The data show that Europe is the continent with the highest level of eGovernment over the entire period analyzed. The average score of the European countries measured in this index was 0.545 in 2003, significantly higher than any of the other world regions (see Figure no. 1).

In fact, Europe was the only region surveyed that scored above the theoretical median of 0.5 in 2003. All other continents scored below this. The gradual improvement in the quality of technologies, on the one hand, but more so in their use in e-governance can be clearly seen by comparing the average scores by region in Figures no. 1 and no. 2. Thus, the average EGDI in Europe reached almost 0.85 in 2024 (Figure no. 2). Interestingly, over the period analyzed, Asia overtook America, moving into second place in terms of the average level of e-government development (average score of 0.7 compared to 0.67). Over the 22 years analyzed, Oceania also entered, with its average EGDI value, the upper half of the index's measurement scale. Only Africa remained in the bottom half, but its average score doubled from 0.2 in 2003 to 0.42 in 2024. The evolution of the EGDI over the period analyzed, by major world regions, can be seen in Figure no. 3.

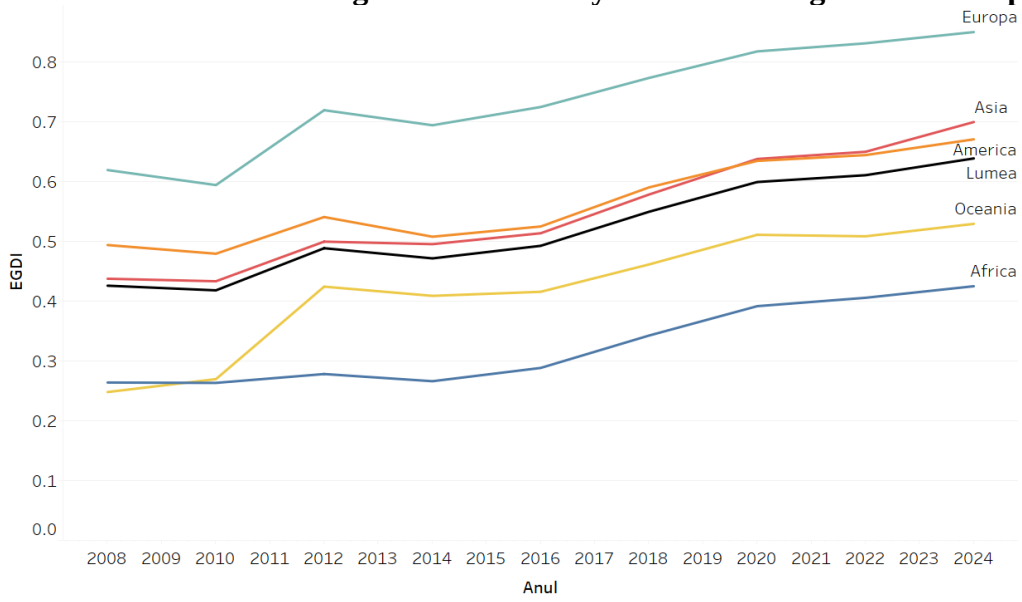
Figure no. 2. EGDI by continent in 2024



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Region-Information

Figure no. 3. Evolution of average EGDI values by main world regions over the period

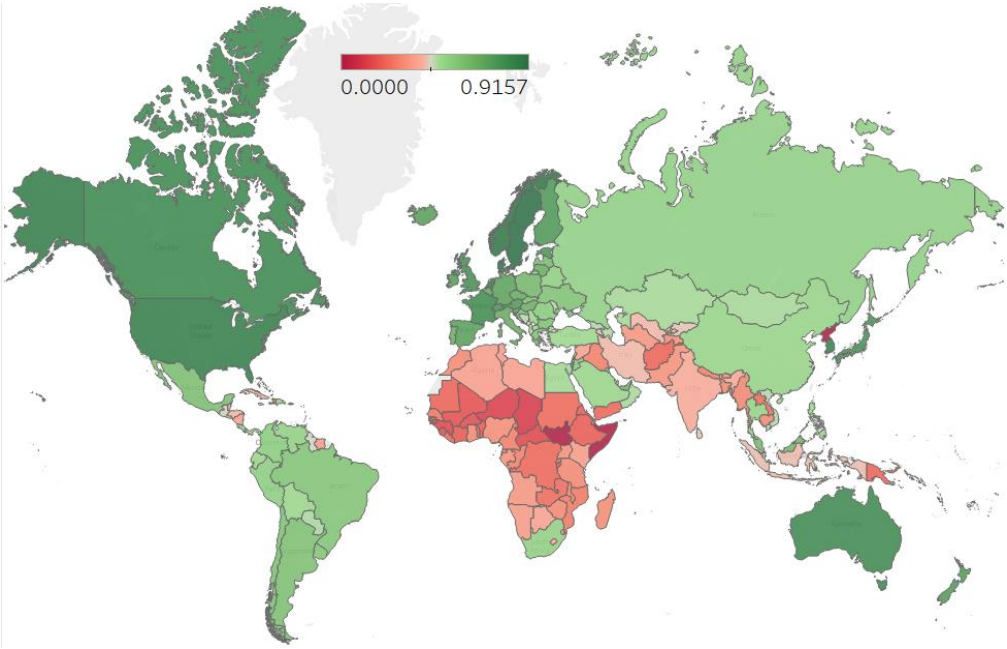


Source: own construction in Tableau 2024.3

The country-level analyses revealed that in the first year of the index, 2003, the most advanced digital governance system was in the United States with an EGDI score of almost 0.93, followed by Sweden and Australia with 0.84 and 0.83 respectively. At the end of the analysis period, the highest level of development for e-government was in Denmark, with an EGDI of 0.98. Denmark has performed well in terms of eGovernment implementation throughout the analysis period, ranking fourth in 2003. It is followed by Estonia with a score of 0.973 and Singapore with a score of 0.969. Interestingly, the level of e-government development has worsened

in the United States of America, they rank only 19th in the 2024 ranking, with a lower score than in 2003, almost 0.92.

Figure no. 4. Spatial distribution of EGDI score in the world in 2008



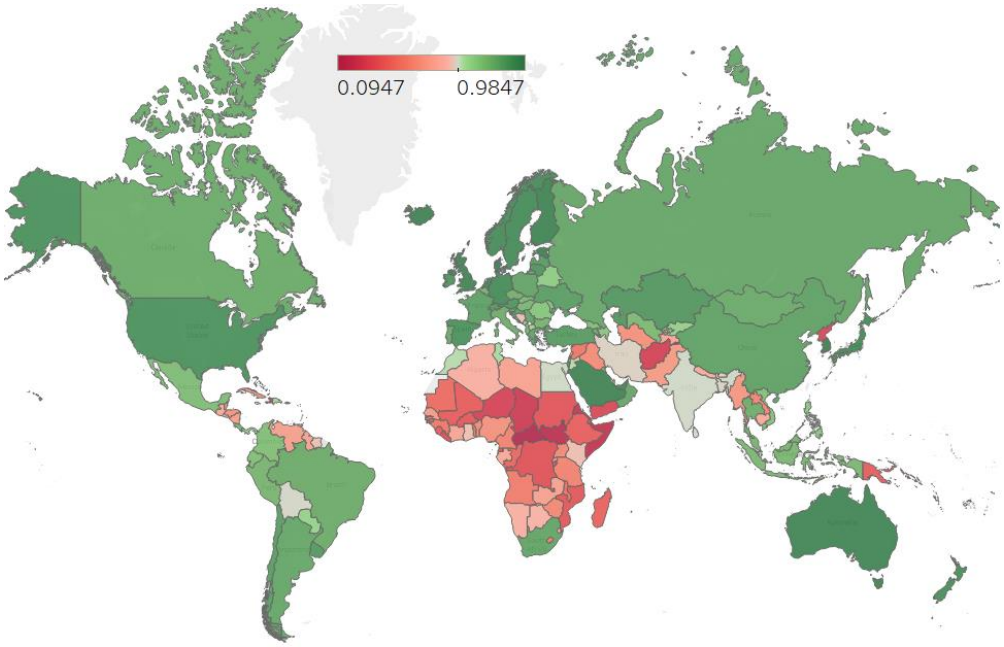
Source: own construction in Tableau 2024.3

In 2008, the highest EGDI score was estimated for Sweden - almost 0.92 (see Figure no. 4 and Table no. 1). At the opposite pole, the worst performer was Somalia, with a score of around 0.000 (see Figure no. 4 and Table no. 2).

In the year 2024, the country with the most developed e-government system was, as mentioned above, Denmark (see Figure no. 5 and Table no. 1), while the lowest score of 0.09 was recorded by the Central African Republic (see Figure no. 5 and Table no. 2). In fact, Denmark has ranked first in the EGDI rankings since 2018.

It can be seen that, for the most part, these are roughly the same countries that have, over the years, competed for first and last place in terms of e-government system development. The weakest performers are very underdeveloped countries, generally in Africa.

Figure no. 5. Spatial distribution of EGDI score in the world in 2024



Source: own construction in Tableau 2024.3

Table no. 1. Ranking of world countries by EGDI - top 5 best performers

Place	2008	2010	2012	2014	2016	2018	2020	2022	2024
I	Sweden	South Korea	South Korea	South Korea	United Kingdom	Denmark	Denmark	Denmark	Denmark
II	Denmark	USA	Netherlands	Australia	Australia	Australia	South Korea	Finland	Estonia
III	Norway	Canada	United Kingdom	Singapore	South Korea	South Korea	Estonia	South Korea	Singapore
IV	USA	United Kingdom	Denmark	France	Singapore	United Kingdom	Finland	New Zealand Dollar	South Korea
V	Netherlands	Netherlands	USA	Netherlands	Finland	Sweden	Australia	Iceland	Iceland

Source: own construction

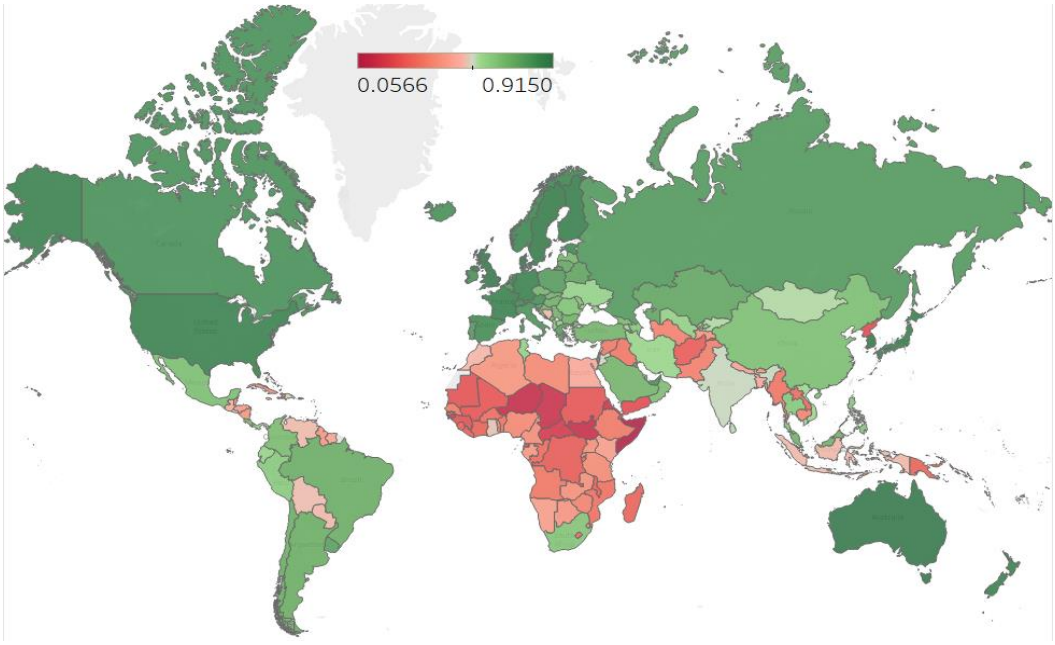
Table no. 2. Ranking of world countries by EGDI - top 5 worst performers

Place	2008	2010	2012	2014	2016	2018	2020	2022	2024
I	Somalia	Tuvalu	Libya	Somalia	Somalia	Somalia	South Sudan	South Sudan	Central African Republic
II	Tuvalu	Somalia	Guinea	Eritrea	Niger	Niger	Eritrea	Somalia	South Sudan
III	San Marino	San Marino	Central African Republic	Niger	Central African Republic	Central African Republic	Somalia	Central African Republic	Somalia
IV	Palau	Nauru	Somalia	Guinea	Eritrea	Chad	Central African Republic	Eritrea	Eritrea
V	Nauru	Monaco	Chad	Chad	Guinea	Eritrea	Chad	Chad	Chad

Source: own construction

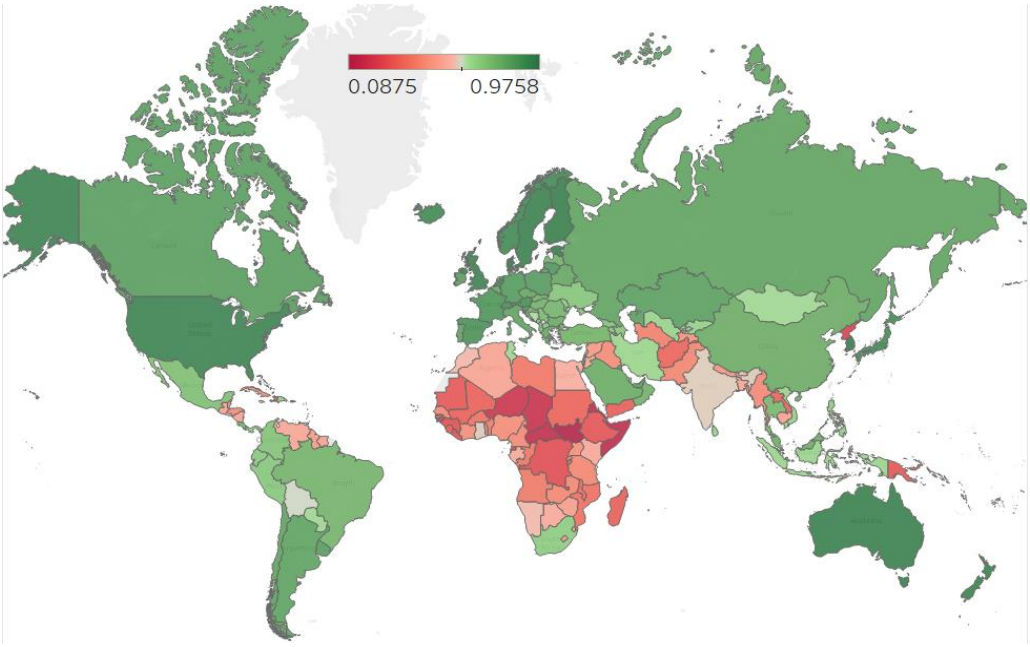
Unlike other areas, digitization has been positively impacted by the Covid-19 pandemic. Emergencies and the impossibility to leave home have forced both businesses and authorities to find online ways of offering services to agencies. Therefore, we present comparative spatial distributions of EGDI score in 2018, 2020 and 2022 in Figures no. 6, no. 7 and no. 8. We observe relatively stable spatial patterns over time, even under the influence of the Covid-19 pandemic, with African countries having the most underdeveloped e-government systems.

Figure no. 6. Spatial distribution of EGDI score in the world in 2018



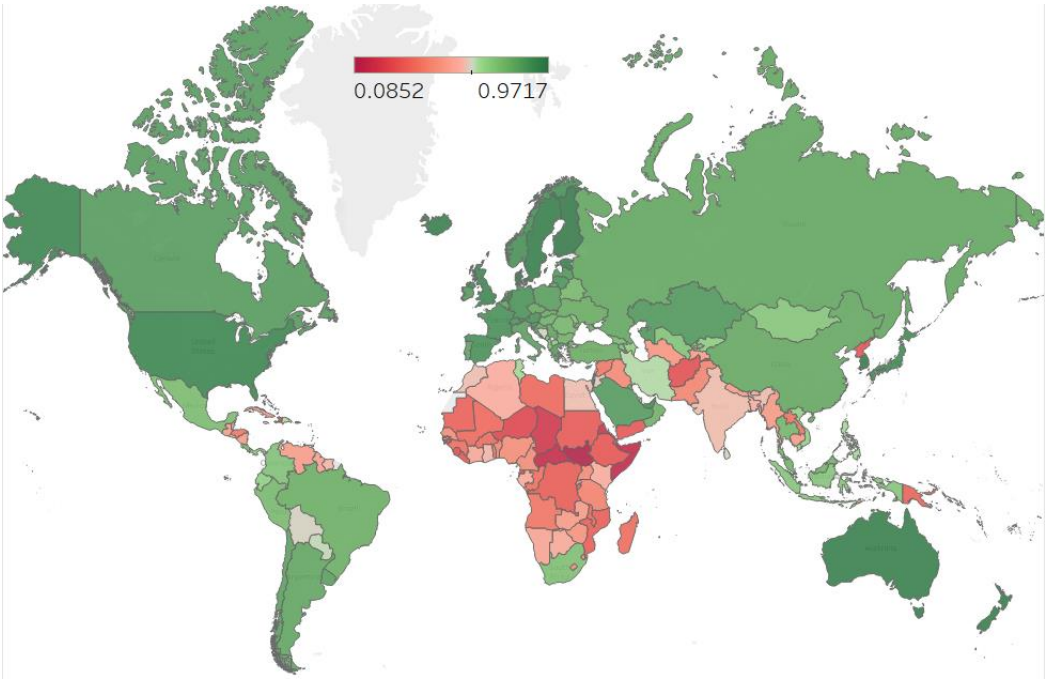
Source: own construction in Tableau 2024.3

Figure no. 7. Spatial distribution of EGDI score in the world in 2020



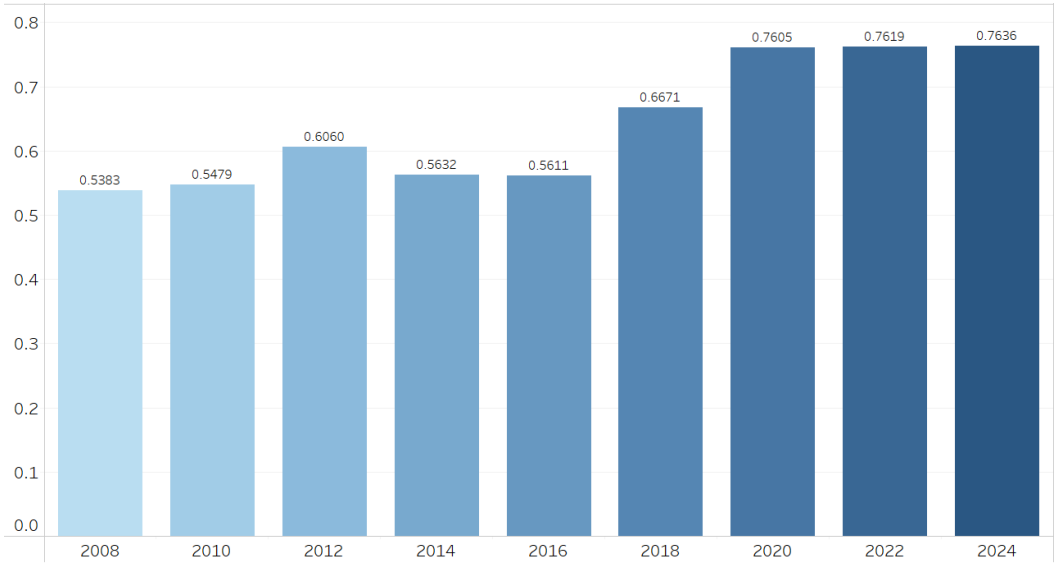
Source: own construction in Tableau 2024.3

Figure no. 8. Spatial distribution of EGDI score in the world in 2022



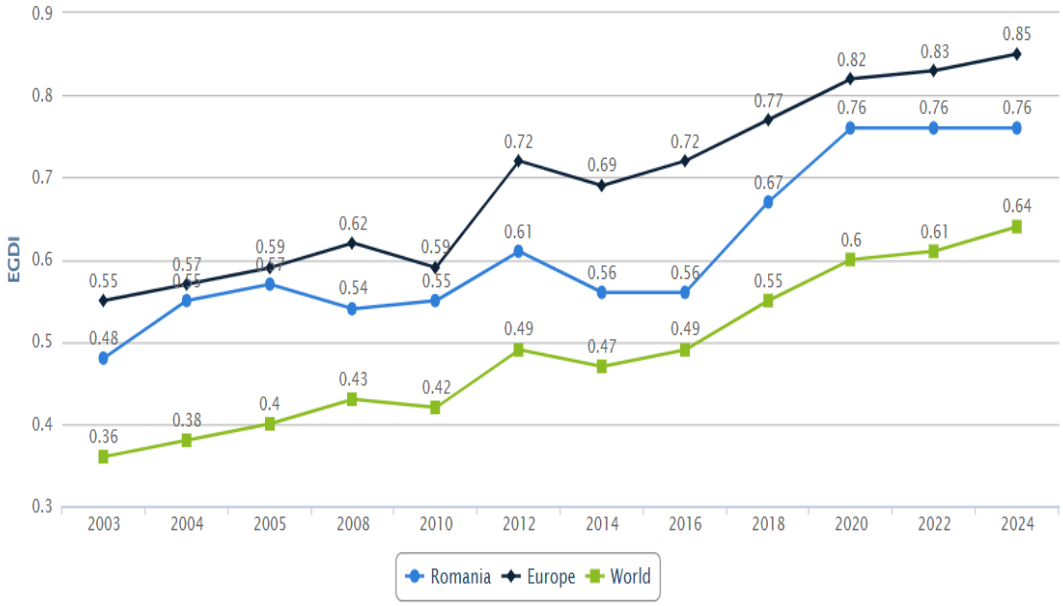
Source: own construction in Tableau 2024.3

Figure no. 9. EGDI index evolution for Romania in the analyzed period



Source: own construction in Tableau 2024.3

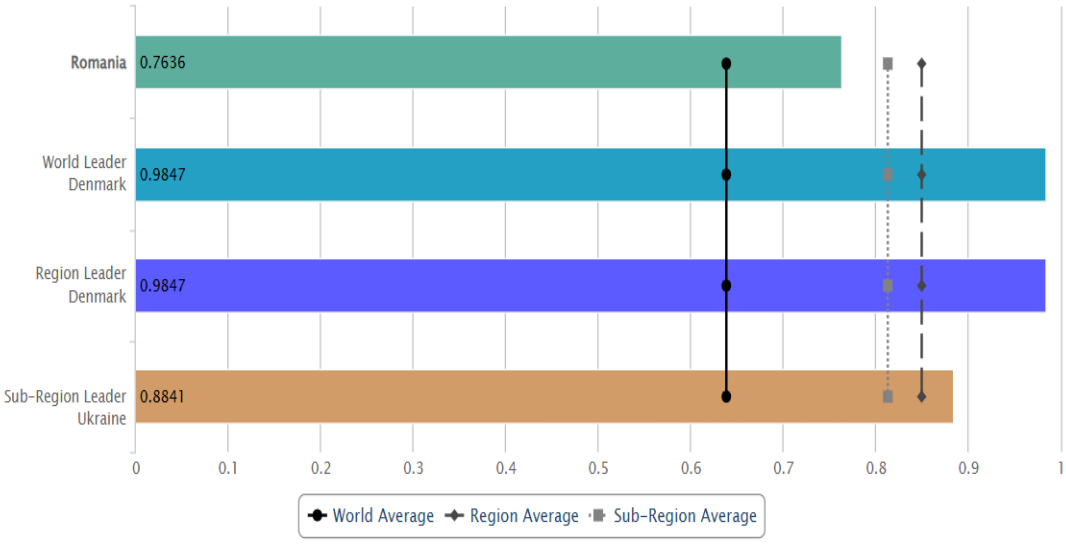
Figure no. 10. EGDI evolution in Romania - comparison with European and world averages



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

Figure no. 11. EGDI in Romania in 2024 - comparison with leading countries



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

Table no. 3. Evolution of Romania's place in the EGDI ranking during the analyzed period

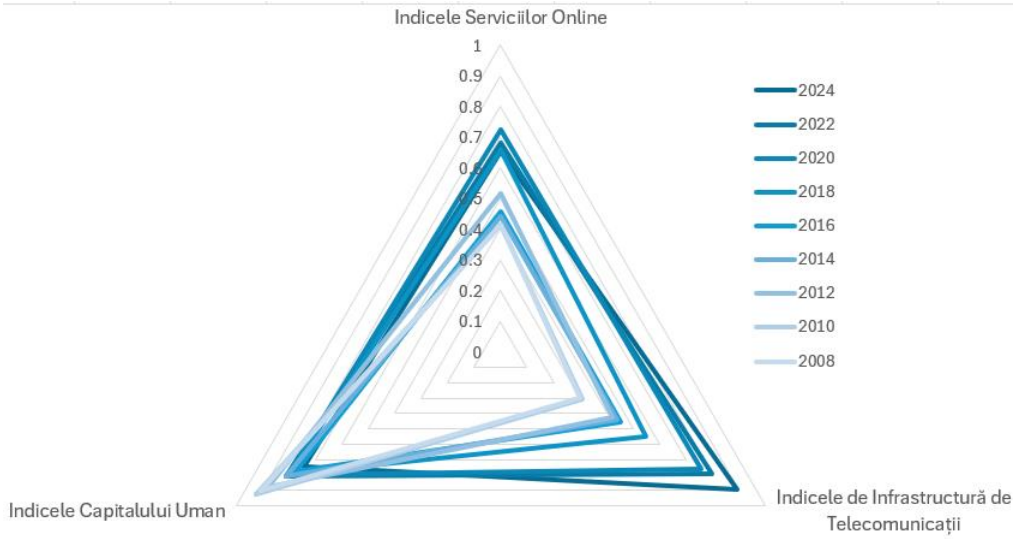
Year	2003	2004	2005	2008	2010	2012	2014	2016	2018	2020	2022	2024
Place	50	38	44	51	47	62	64	75	67	55	57	72

Source: own construction based on United Nations data

As for Romania, it has followed a similar path to the majority of the sample analysed, registering increases in the level of development of digitization of public administration in most years, as also revealed in the literature (see, for example, Frățilă et al., 2023; Panait & Rădoi, 2021). Figures no. 9, no. 10 and no. 11 show that Romania's score increased from 0.54 in 2008 to 0.76 in 2024, with a significant jump from 2018 to 2020, from 0.67 to 0.76, ranking 72 out of 193 countries analyzed in 2024. In practice, Romania has been in the top half of the ranking throughout the period analyzed, but, unfortunately, always below the continental average (Figure no. 10). A positive aspect is that the difference between the e-government performance in Romania and the world average was always significant in Romania's favor. Figure no. 11 compares Romania's score in 2024 with the score of the top performers - Denmark at global and European level and Ukraine at regional level.

In terms of place, Table no. 3 shows a worsening of Romania's position in the overall ranking, from 38th place (the best position) in 2004 to 75th place (the worst position) in 2016. However, our country remains in the group of countries with a very high level of e-government development.

Figure no. 12. EGDI component scores over time - radar plot

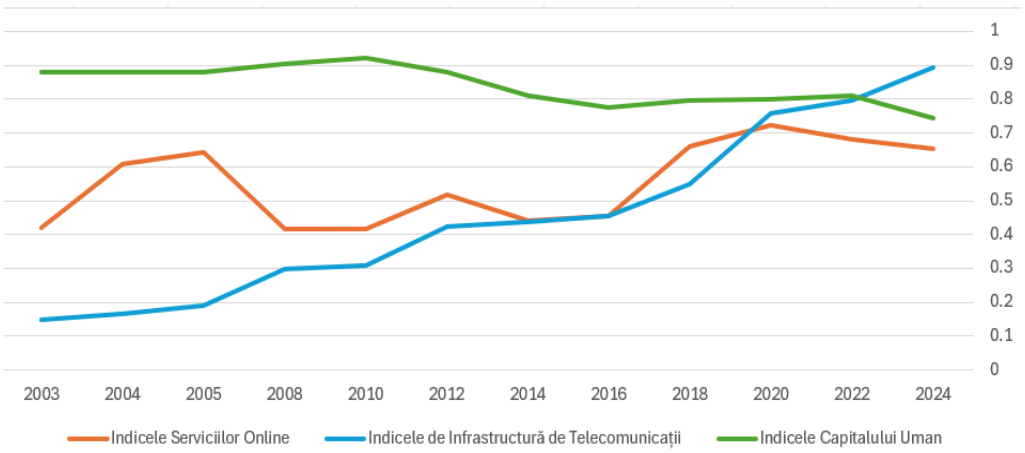


Source: own construction based on United Nations data

Given that the EGDI has, as mentioned above, three main components, in the following analysis we present Romania's situation on these components, both statically and dynamically. As a first step, we constructed the radar plot for the three components to see how they have evolved over time, but also to be able to relate them to the overall EGDI value - the larger the area covered by the plot, the higher the overall EGDI score. The results are presented in Figure no. 12 and confirm, at an aggregate level, Romania's increasing performance in the implementation of e-government tools.

Of the three components, Romania performed best in the Human Capital chapter (Figures no. 12 and no. 13) over the whole period analyzed. A relative constancy, with values fluctuating between 0.4 and slightly above 0.7, can be observed for the Online Services Index. In terms of Telecommunications Infrastructure, Romania had an extremely low score of almost 0.15 in 2003. Progress on this component has been significant over time, with the year 2024 showing our country with a score of 0.89. This component is the only one to have evolved by the end of the period under analysis, the other two having declined.

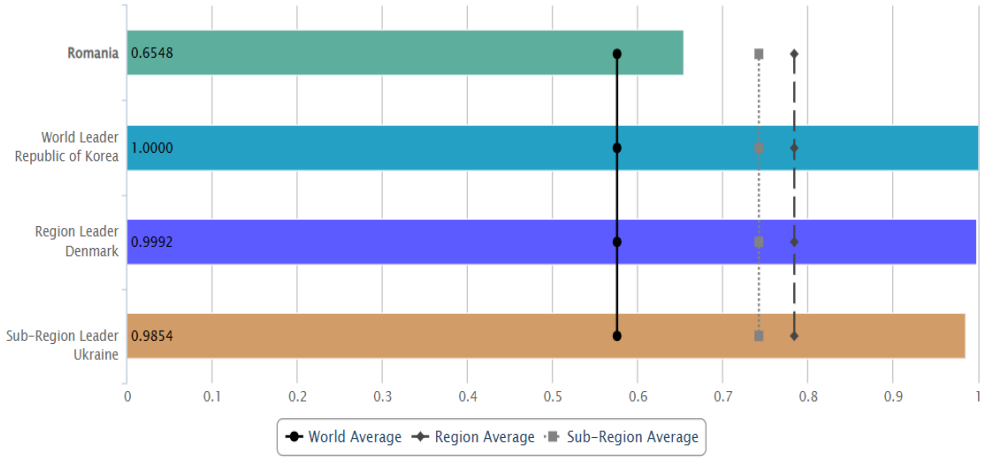
Figure no. 13. EGDI component scores over time - timeline



Source: own construction based on United Nations data

Following the pattern of presenting the EGDI comparatively for Romania and other entities, we also present the components in the same manner. Figure no. 14 shows that, in 2024, our country's score for the Online Services Index was 0.65, much lower than the world, European or regional averages. It is interesting to note that Romania is highly performing in terms of the quality and development of the institutional framework, with the highest score of 1, obviously above all averages, calculated at any spatial level.The lowest score is for the technologies used for online services, only 0.56 (Figure no. 15).

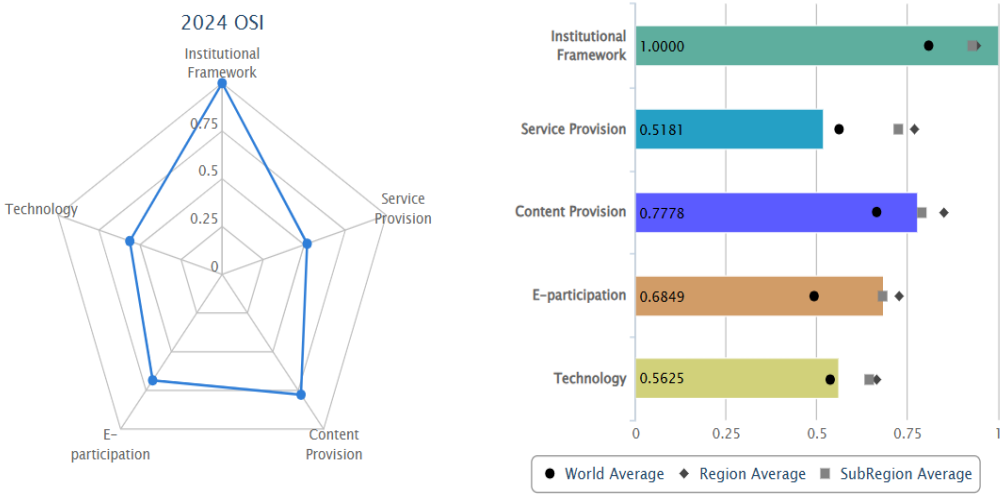
Figure no. 14. Online Services Index in 2024 - benchmarking against leaders



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

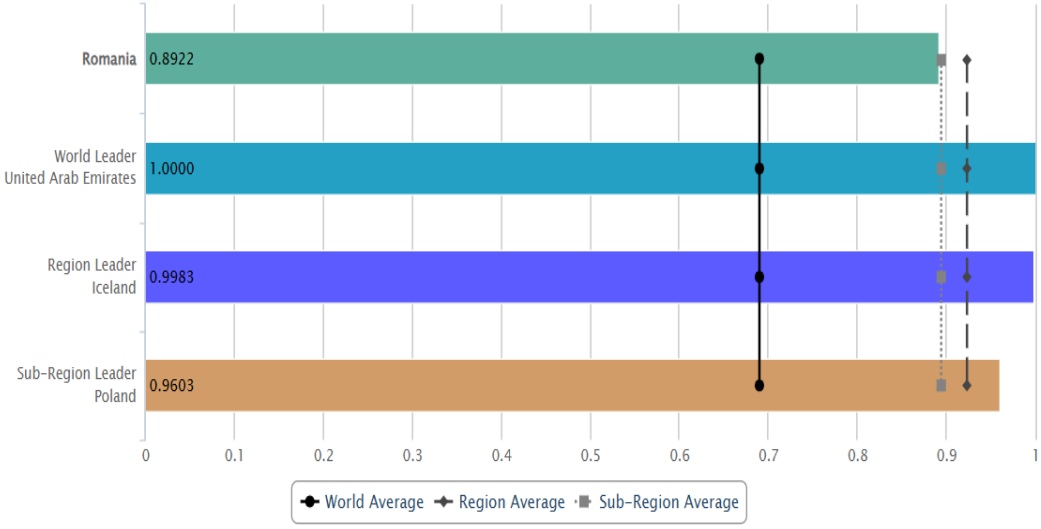
Figure no. 15. ISO sub-component scores in the year 2024 - radar plot (left) and comparisons with the rest of the world (right)



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

Figure no. 16. Telecom Infrastructure Index in 2024 - comparisons with leaders

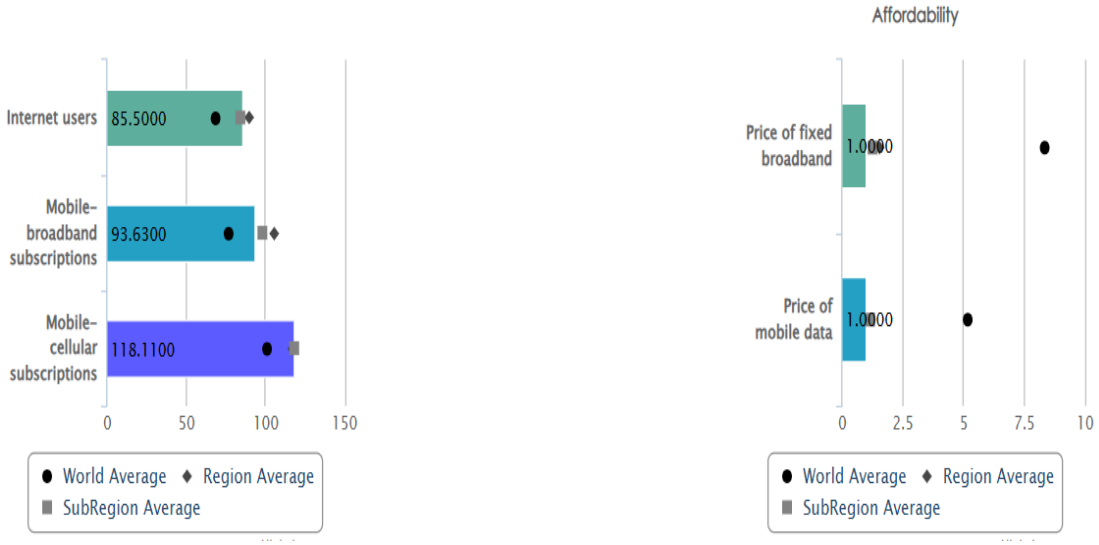


Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

Our country is the best performer in telecommunications infrastructure among the three EGDI components, with a score of 0.89 in 2024, similar to the regional average (Figure no. 16). However, this score is below the category leaders: the United Arab Emirates at the global level with a score of 1, Iceland at the European level with a score of 0.998, and Poland at the regional level with a score of 0.96. We have one of the lowest prices for both fixed and mobile internet connections, with a score of 1 for both aspects, which is top performance. The two aspects are among the few criteria for which Romania has top performance. Extremely high performance is also recorded for mobile subscriptions, significantly higher than the European average, and similar to the regional average, as shown in Figure no. 17.

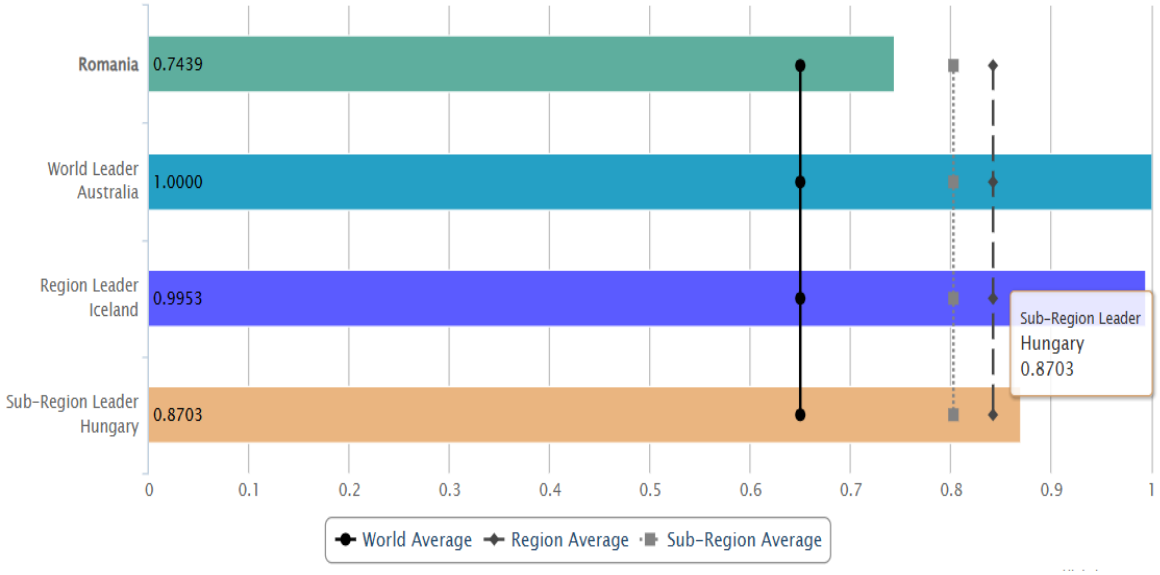
Figure no. 17. Telecommunications Infrastructure Index by its sub-components in 2024



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

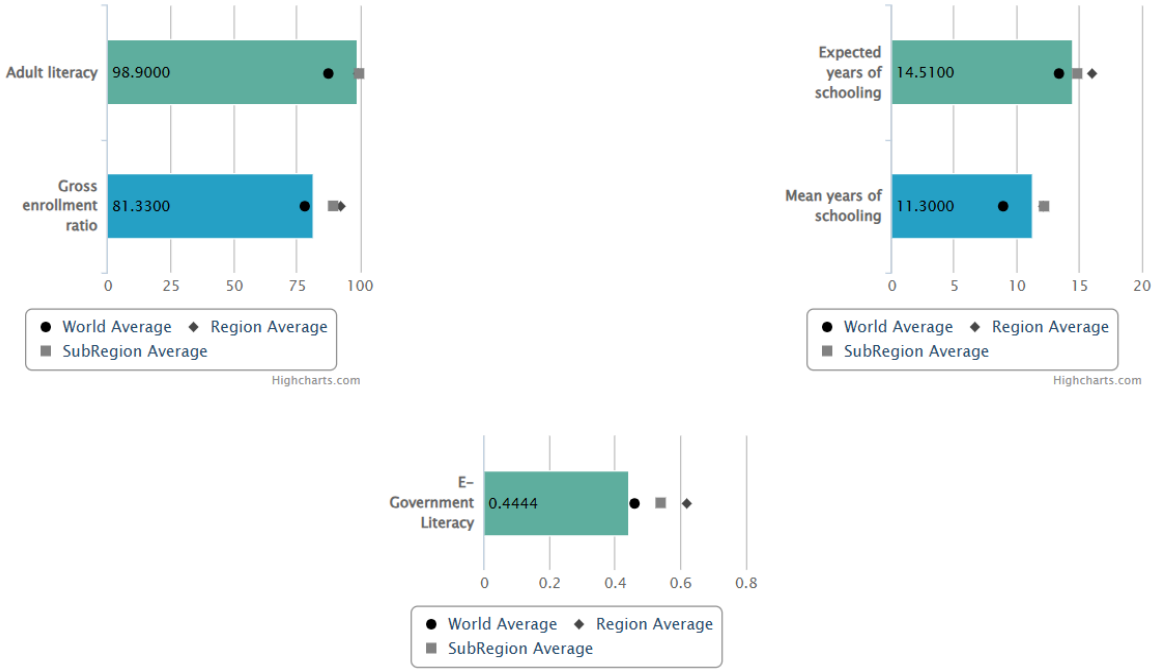
Figure no. 18. Human Capital Index in 2024 - comparison with the leaders



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

Figure no. 19. Human Capital Index by sub-components in 2024



Source: United Nations, UN E-Government Knowledgebase

https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/140-Romania/dataYear/2024

In terms of human capital, even though Romania started from a high level, the score has declined over time. By 2024, the value of 0.74 was significantly lower than the global, continental and regional averages, as the absolute performer was Australia with a score of 1, at the European level Iceland with a value of 0.995, and at the regional level Hungary with a value of 0.87 (Figure no. 18). While adult education is relatively similar to the European and regional averages (Figure no. 19), the other aspects of education considered in this sub-component are unfortunately below average. Romania's weakest performance is precisely in one of the most relevant aspects for fiscal digitization - e-government education and knowledge.

The score for this aspect is 0.44, even lower than the world average, as the world average also includes values for very weak and weakly developed African and Asian countries, which have extremely low scores.

Conclusions

One of the most common specific indicators in the literature is the E-Government Development Index (EGDI). Analyses carried out for the period for which the index is available have revealed that the European continent is the most developed in terms of e-government. Over time, the level of e-governance in Asia has increased so that this continent has overtaken the Americas in this respect. South Korea has for many years been the absolute performer in government digitization and fiscal digitization, and in other years it has been the top performer in some sub-components of the index.

Map-based spatial analyses have confirmed that the digitization process is more intense in more developed countries in terms of both economic-social and governance. Basically, the higher the quality of governance (as expressed by classical indicators, such as the World Governance Indicators constructed by the World Bank), the more central, local, and, specifically, fiscal administrations are more likely to support the digitization process in general, and fiscal digitization in particular, which would allow them to increase the efficiency of their work. The latter development also leads to increased taxpayer confidence and compliance as the transparency of the taxation and tax collection process increases, which in turn increases taxpayers' trust in the capabilities of tax administrations.

Analysis of the annual EGDI rankings revealed exactly the same type of results. Countries that are highly developed economically, socially, politically, socially, politically or administratively have consistently ranked at the top. These are countries such as the Northern European countries, recognized worldwide for their characteristics, South Korea, Australia, Great Britain, etc. At the opposite pole are countries which, in all international rankings, are the least developed - mainly countries on the African continent. Somalia, South Sudan or the Central African Republic are among the countries that have, over the years, been among the least developed in terms of e-governance. They are accompanied by Niger, Eritrea or Chad, among others. But the top 5 worst eGovernment performers are much more stable over time, in terms of composition, than the top performers. Interestingly, however, two European countries - Monaco and San Marino - were also among the worst performers up to and including 2010.

Romania, although showing a significant improvement in e-government performance in terms of score, in terms of international ranking, has worsened. The result shows that, while Romania recorded a certain rate of growth in the implementation of e-government, other countries have had an even more intense evolution, outperforming our country. Romania was, throughout the period analyzed, below the European average in this chapter, being surpassed even by Ukraine. The aspect in which our country has performed very well since the beginning of the period analyzed is human capital. But unfortunately, the evolution of this component has been negative over time. The most intense growth was recorded for the part of telecommunications infrastructure.

The evolution of the online services component was oscillating, which shows that Romania still has to make significant efforts to improve the digitalization process.

The analysis by EGDI subcomponents shows that in 2024 Romania has the highest score (1) for the quality of the institutional framework and access to communication technologies, with the cheapest fixed internet and mobile data services. An important problem of our country turns out to be the level of education and knowledge about e-governance. Our country's score on this aspect is 0.44, not only below the regional and continental averages, but also lower than the world average score. The most important conclusion of this analysis is that it is imperative for the government and tax administrations to invest heavily in educating taxpayers in the tax digitization process. It is not enough to simply support the necessary infrastructure, but services that are provided online must be developed and users educated so that the overall efficiency of the system is maximized.

Thus, in this chapter we have not only highlighted the most effective specific indicators for assessing the performance of the tax digitization process, but we have also highlighted Romania's specificities in this respect. The results open new avenues for further research in this area.

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