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## Article

# Quantifying the digitalisation impact on the EU economy: Case study : Germany and Sweden vs. Romania and Greece

Amfiteatru Economic Journal

## Provided in Cooperation with:

The Bucharest University of Economic Studies

*Suggested Citation:* Ionescu, Victor-Romeo; Zlati, Monica Laura; Antohi, Valentin Marian; Virilănută, Florina Oana; Stanciu, Silviu (2022) : Quantifying the digitalisation impact on the EU economy: Case study : Germany and Sweden vs. Romania and Greece, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 24, Iss. 59, pp. 61-76, <https://doi.org/10.24818/EA/2022/59/61>

This Version is available at:

<https://hdl.handle.net/10419/281621>

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## QUANTIFYING THE DIGITALISATION IMPACT ON THE EU ECONOMY. CASE STUDY: GERMANY AND SWEDEN VS. ROMANIA AND GREECE

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### Please cite this article as:

Ionescu, R.V., Zlati, M.L., Antohi, V.M., Vîrlănuță, F.O. and Stanciu, S., 2022. Quantifying the Digitalisation Impact on the EU Economy. Case Study: Germany and Sweden vs. Romania and Greece. *Amfiteatru Economic*, 24(59), pp. 61-76.

DOI: 10.24818/EA/2022/59/61

### Article History

Received: 22 September 2021

Revised: 12 October 2021

Accepted: 20 November 2021

### Abstract

The digital economy is an alternative to the traditional economy, an area of the future on which investment and R&D efforts are focused both by European forums and by Member States, which have understood the importance of the domain with the onset of the pandemic crisis. The aim of the research is to analyze and predict, on the one hand, the impact of digitalisation on EU Member States' economies by means of the three scenarios for the evolution of the digital component of the economy for the horizon 2025 (the baseline scenario, the high growth scenario and the challenge scenario), and, on the other hand, the Member States' ability to achieve the targets proposed by these scenarios. The analysis covers the period 2013-2025 and quantifies the dynamics of the digitalisation phenomena and processes based on dedicated statistical analyses (frequency series analysis, application of the unicriterion critical probability test, application of the Enter method, performing Pearson correlation tests) by means of the IBM-SPSS 25 software. The purpose of this research is the provision of relevant solutions to decision makers in the development of digitalisation. The study highlighted the placing of the results in favourable scenarios, the current trend regarding digital economy evolution, and presented the most likely scenario to be achieved in terms of knowing the provider offer and the needs of service users.

The topicality of the study targets a new approach on the foundations of financial allocations for the sustainable development of the digital economy needed in the current conditions of the global crisis and of the pandemic for the implementation of digital economy development policies. A novelty of this research is the conceptualization, validation and testing of an econometric model capable of quantifying the realism of the scenarios proposed by the European Union regarding the development of the digital economy.

**Keywords:** digitalisation; digitalisation indicators; digitalisation development scenarios: the baseline scenario, the high growth scenario and the challenge scenario; the econometric model of digitalisation development; digital market fragmentation: Germany, Sweden vs Romania, Greece.

**JEL Classification:** F63; O30; C40.

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## Introduction

In the current social and political context, digitalisation can be the engine of global economic growth, with developments being driven by the constraints of the COVID-19 pandemic and by the need to make progress in a sustainable manner. The European Commission is concerned with developing sustainable solutions that can enable the digital transformation of the European Union and, in order to achieve this goal, the European Commission has set three major objectives for the period 2020-2025: technologies to support the needs of citizens; the development of a fair and competitive economy; the achievement of an open, democratic and sustainable society (European Commission, 2020).

The European approach regarding digitalisation is built upon the democratic society, which relies on the welfare of European citizens. In the context of using digital solutions, economic excellence will be promoted and supported by specific “enforcement measures”. The present and future objectives regarding digitalization must increase the population trust in the process of achieving a developed European economy and in obtaining the best possible international position. Both of them will increase the fairness at the global level and will ensure a better understanding of digital economy.

From the economic point of view, the EU digitalisation will define a new European single market for data and information. Table no. 1 shows the representative indicators for the digitalisation of the European market and their evolution, in the perspective of the three scenarios (the baseline scenario, the high growth scenario and the challenge scenario) proposed by the European Commission (2020).

**Table no. 1. EU digitalisation market's indicators**

<b>Representative indicators of digitalisation</b>	<b>Current indicator growth 2019/2018</b>	<b>Forecasted growth within the baseline scenario</b>	<b>Forecasted growth within the high growth scenario</b>	<b>Forecasted growth within the challenge scenario</b>
<i>Highly specialized data professionals</i>	Annual increase of the indicator by 6%; Data professionals account for 3.3% of the total workforce in the EU economy (6 million people, 2019)	Annual increase of the indicator by 25%; Data professionals account for 5% of the total workforce in the EU economy (9 million people, 2025)	Annual increase of the indicator by 30%; Data professionals account for 6% of the total workforce in the EU economy (11 million people, 2025)	Annual increase of the indicator by 23.5%; Data professionals account for 4.7% of the total workforce in the EU economy (8.5 million people, 2025)

Representative indicators of digitalisation	Current indicator growth 2019/2018	Forecasted growth within the baseline scenario	Forecasted growth within the high growth scenario	Forecasted growth within the challenge scenario
<b>Data professionals' skill gap</b> Increasing differences between providers and users in the ability to connect/use the digital economy	Annual increase of the indicator by 24.5%; % of increasing differences between providers and users in the EU economy 6.2% (399,000 people, 2019)	Annual increase of the indicator by 31.7%; % of increasing differences between providers and users in the EU economy 8.2% (759,000 people, 2025)	Annual increase of the indicator by 46.5%; % of increasing differences between providers and users in the EU economy 10.5% (1.138 million people, 2025)	Annual increase of the indicator by 20.2%; % of increasing differences between providers and users in the EU economy 5.7% (484,000 people, 2025)
<b>Data companies (data providers)</b>	Annual increase of the indicator by 2.4%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 11.5% (149,000 data providers, 2019)	Annual increase of the indicator by 32.4%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 15% (290,000 data providers, 2025)	Annual increase of the indicator by 21.5%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 14% (193,000 data suppliers, 2025)	Annual increase of the indicator by 18.2%; % of increasing the representation of data economy suppliers in the total number of ICT and professional services suppliers 12.2% (163,000 data suppliers, 2025)
<b>Data companies (data users)</b>	Annual increase of the indicator by 2.4%; % of increasing the representation of digital service users in the total economy 5.9% (535,000 users, 2019)	Annual increase of the indicator by 18.2%; % of increasing the representation of digital service users in the total economy 6.3% (583,000 data users, 2025)	Annual increase of the indicator by 19.5%; % of increasing the representation of digital service users in the total economy 7% (627,000 data users, 2025)	Annual increase of the indicator by 17.5%; % of increasing the representation of digital service users in the total economy 6% (562,000 data users, 2025)
<b>The value of the digital economy (% of GDP)</b>	Annual increase of the indicator by 7.7%; % of EU GDP 2.6% (325 trillion euros, 2019)	Annual increase of the indicator by 28%; % of EU GDP 4% (550,000 bn. euro, 2025)	Annual increase of the indicator by 42.4%; % of EU GDP 6% (827,000 bn. euro, 2025)	Annual increase of the indicator by 22.1%; % of EU GDP 3.3% (432,000 bn. euro, 2025)

Source: Authors' contribution by using European Commission data (2020)

Table no. 1 is an effective tool for quantifying the concrete possibilities for the evolution of digitalisation, as it takes into account different scenarios, including the one related to the impact of the current global crisis due to COVID-19.

In this context, the paper proposes an analysis on the capacity of EU Member States' national economies to sustainably develop the digital economy according to the taxonomy of this economy and the results regarding the capacity of national economies in terms of technology, innovation, attracting specialists, market growth and strengthening IT service providers and users by means of information and communication, taking into consideration the following most important objectives:

- **O1:** assessment of the current state of knowledge concerning the ability of users and information providers to make the transition to data economy;
- **O2:** Analysis of the dynamics of specific data economy indicators over the period 2013-2021 and their forecast by 2025;
- **O3:** Conceptualisation of the econometric model to quantify the realism of the scenarios proposed by the EU on data economy development;
- **O4:** Testing and validation of the proposed model;
- **O5:** Assessing the capacity of Member States to achieve the targets proposed by the EU through these scenarios.

The study continues with the analysis of the literature (in which we highlight the current approach to the issue of digitalisation in the opinion of international experts and models of digital economy development in the pre and post pandemic context), followed by the research methodology (in which we present the means and methods of research and the working hypotheses, we define, test and validate the proposed econometric model), discussions (in which we present the main results of the research and demonstrate the working hypotheses) and conclusions (in which we give prominence to the topicality, originality, implications for the digitalisation policy and the research limits).

## 1. Review of the scientific literature

The current socio-economic developments call for a focus on digitalisation and the increase in the associated economic performance. More and more researchers are currently studying this interesting topic. According to the Google Scholar scientific database, more than 125,000 scientific articles on this topic were published in the period 2020-2021 (Google Academics, 2021). According to the analysis conducted by Engels (2017), large databases have a significant impact on the global economy. The influence of factors with a negative impact can hinder economic development, on both innovative and economic grounds: ranking / level of data security; high costs; lack of / insufficient know-how in the field; lack of common standards; the absence of a common regulatory framework.

Bressanelli et al. (2018) bring into discussion digital technology as a growth engine for the economy, indicating the need for a conceptual framework aimed at improving the digital product and increasing the effectiveness of these products. It is recommended to quantify some specific indicators at the level of meta-analysis: product design improvement, customer engagement (both in the first product cycle), monitoring, technical support and maintenance

(in the second product cycle) and product upgrading and renewal (in the third product cycle). These components that contribute to better effectiveness of some IT products also require a specific dynamic of suppliers and users in the digital economy.

A complex analysis of the digital and circular economy by Lewandowski (2016) focuses on taxonomy (conceptual models), adaptation factors (evaluation models) and the methodology of change. The paper represents a bibliographic analysis of the literature, new modern technology development models being identified in the studied field, whose holistic approach covers the economic, environmental, social and consumption reduction characteristics. In the paper "Digital entrepreneurship: Innovative business models for the sharing economy", written by Richter et al. (2017), the authors build a business model from the investigation regarding the evolution of companies with reduced market experience. The findings of the paper show that a significant place in economic growth is played by the following components: Extended sharing of digital content, Customers as providers and consumers, Open mind set of entrepreneurs to innovative businesses, Changing living conditions, Urbanity, and Win-win situations in a business.

According to Farboodi and Veldkamp (2021), and Aytekin et al. (2021), the rise of information technologies and Big Data analytics have generated the new economy. The authors present a model in which firms accumulate data instead of capital. The model is based on three interesting research premises in the domain: computer data is a product of economic activity; data is information used as prediction; reducing uncertainty generates profitability. In the work of the authors Youssef et al. (2021), digitalisation is analyzed from the perspective specific to the entrepreneurial sector. They conduct a literature review showing that entrepreneurial intentions are becoming dominant in the digital marketplace, with programmes encouraging entrepreneurship as a career development alternative.

In some countries, the application for the digital economy is supported at the governmental level, and education and social adhesion to the digital economy of young people, together with digital technologies, can develop the concept of entrepreneurial performance in university education (Stanciu et al., 2019).

Tolstykh et al. (2018) propose an assessment of the potential for digitalisation of the regional economy through a model that relies on a stepwise methodology, starting from the identification of the digitilisation potential of the region on the Pospelowe scale, identification of characterisation indicators, evaluation of the effect of the indicators, quantification of BI1-BI5 ranks and characterisation of the digitalisation potential based on an impact G-factor.

Kravchenko et al. (2019) analyzes digitalisation as a global trend and growth factor of the modern economy. Germany, with a retail trade volume of about \$ 73 billion, contributes 8.4% to global trade, ranking 5th after China, the United States, the United Kingdom and Japan. The authors propose an international hierarchy of the top 10 world economies by level of digitalisation, based on the indicators Digital Evolution, IMD Digital Competitiveness and Blumberg Innovation Index. Sweden ranks 2nd, Germany 4th and Romania ranks 9th in the DESI (EU) Index.

The Organization for Economic Co-operation and Development (OECD) proposes quantification indicators on a global scale regarding education, innovation, trade, digital policy, etc. in order to identify the global differences between areas in the development and progress of digital transformation (Organisation for Economic Co-operation and

Development, 2019). The study proposes 9 priority directions for action to better monitor the digital transformation: assessing the visibility of the digital economy in economic statistics, understanding the economic impact of digital transformation, encouraging the quantification of digital transformation effect and of its impact on social goods and welfare, a new conceptualization of interdisciplinary approaches in data collection, artificial and blockchain intelligence, improving data measurement and data flows, developing the skills needed for digital transformation, measuring confidence in the online environment by managing online consumer security and risk protection, and establishing the impact of the conceptual framework of government digitalisation.

The conceptualization of digital orientation is made by Quinton et al. (2018), who make a correlation between entrepreneurial orientation, market orientation and learning orientation. The factors that determine the digital orientation towards the three segments are significantly influenced by the nature of the innovation. The digital revolution is a field of great interest and profoundly beneficial to the education systems in the Member States. A correct strategy in the field of educational policies and their adaptation to the IT factor can be supported by developing the demand for educational services (Grosu et al., 2010; Cosmulese et al., 2019).

Measuring the GDP in the digital economy is analysed by Watanabe et al. (2018) as a way to argue for economic welfare and productivity. The authors appreciate that good information and technological communication can solve problems of economic stagnation and crisis, in the context of the digital economy. Social Media disseminates information with shaping effects on modern society. According to the research conducted by Pearson et al. (2016), social media contributes to the development of a sustainable society, and the use of social media technologies gives researchers and practitioners more effective means to improve research. Models for understanding consumer behaviour and models for predicting changes in consumer behaviour become easier to use with the help of criteria such as: social norms, knowledge, psychological orientations, knowledge, information, and ideology.

The study of the literature shows that digitalisation is a major concern of researchers in terms of the causes that generate it, holistic approaches thus being undertaken, but especially in terms of the effects on economy in general and on digital economy, in particular, with a short-, medium- and long-term impact.

## **2. Research methodology**

Empirical and analytical methods were used in the research, including statistical tools in the critical analysis of the evolution indicators from the period 2013-2025, related to the digital economy, according to the recommendations of the European Commission. The study of the literature was used to assess the current state of knowledge regarding the ability of users and providers of information to join the digital economy, to quantitatively identify the dynamics of phenomena and processes related to digitalisation (by studying international databases), to critically analyse these data, respectively by queries, consolidations, classifications of quantitative data inputs and forecasts of research outputs. Statistical means and procedures focused on frequency series analysis, the application of the unicriterion critical probability test, the application of the Enter method, on performing Pearson correlation tests and on other relevant statistical tests performed with the help of the Statistical Product and Service Solutions program, version 25 (IBM- SPSS 25) in order to achieve the purpose of the

research, i.e. its usefulness for decision makers in the development of the digitalisation strategy at the level of local and national public administration.

The authors aim at analysing economic information through four categories of indicators, specific to digitalisation, recommended at European level: share of Data Market on Information and Communication Technology (sector J) Spending – DM%ICT), digishare data economy impact of GDP – DE%GDP, share of Data Suppliers on Total J and M Sectors – DS%JMS and share of Data Users on Total J and M Sectors – DU%JMS (Digital Europe, 2021).

In order to carry out the research, we used official Digital Europe data, on the basis of which we built a model to quantify the contribution of digitalisation to economic growth in the EU. We referred to the whole EU area and 4 Member States, namely Germany, Sweden, Romania and Greece. After analysing the latest Eurostat information on digitalisation indicators (European Commission, 2020), we have defined two antithetical poles, namely Germany and Sweden vs Romania and Greece. The sample took into account the level of digitalisation in the four economic entities, the implemented policies on digitalisation, as well as the level of adherence of national economic actors to digitalisation. Given the global concerns, at a scientific and administrative level, regarding the creation of specific models for the development of the digital economy, the research carried out in the paper proposes the development of a valid tool (the proposed econometric model) designed to quickly quantify the digital capacity development of economy through a study on the 4 selected European states. The proposed model from the paper is based on the premise that there is a direct correlation between the degree of digitisation and the economic performance of each Member State.

The research conducted at the level of The European Commission regarding the monitoring of the digital market shows that the rapid economic growth at a national level is directly influenced by the share of digital economy-specific indicators in the economic basket, with three development strategies being developed in this direction for the 2025 horizon. (Cattaneo et al., 2020). The research proposes the use of statistical / econometric arguments to test the reality of the scenarios using the four already mentioned indicators and the forecast of the European Commission, based on the information provided by Eurostat, the International Monetary Fund, the World Bank.

In order to observe the achievement of the objectives of our research, starting from the understanding of the scientific literature, we established the following hypotheses of the research:

**H1:** According to the literature (Engels, 2017; Richter et al., 2017; Watanabe et al., 2018; Organization for Economic Co-operation and Development, 2019), there is an opinion that transparency of information sources is directly related to economic growth. Thus, the first working hypothesis is: *an increase in information and the transparency of sources for digital service providers directly leads to GDP growth, with a threshold below which the growth function becomes reflexive.*

**H2:** In the literature (Bressanelli et al., 2018; Organization for Economic Co-operation and Development, 2019), the impact of data users' receptivity on economic growth has been studied. As a result, the second working hypothesis becomes: *the increase in user receptivity is directly proportional to the economic growth related to digitalisation, the degree of reflexivity of the growth function being much lower.*



**H3:** According to the authors (Pearson et al., 2016; Engels, 2017; Watanabe et al., 2018; Organization for Economic Cooperation and Development, 2019; Farboodi and Veldkamp, 2021; Ionescu et al., 2021), the digital sector is a factor of economic growth. Therefore, we may define the third working hypothesis as: *the growth of the digital sector through information and communication (sector J) is a favourable factor for economic growth, the premise of reflexivity also being present here, i.e. the point from which efforts do not generate significant effects.*

**H4:** The fourth working hypothesis considers the current situation of the economy during the pandemic period and is defined as follows: *the digital economy is less dependent on the pandemic shock than the classical economy and is a sustainable pillar of economic growth.*

To verify the research hypotheses, an econometric model, based on the least squares method, was developed, a model with a multiple linear regression function, which is defined as follows:

$$DE\%GDP = \alpha DM\%ICT + \beta DS\%JMS + \gamma DU\%JMS + \varepsilon \quad (1)$$

where:

DE%GDP – share data economy impact of GDP;

DM%ICT – Share of Data Market on Information and Communication Technology (sector J) Spending;

DS%JMS – Share of Data Suppliers on Total J and M Sectors;

DU%JMS – Share of Data Users on Total J and M Sectors;

$\alpha, \beta, \gamma$  – regression coefficients;

$\varepsilon$  – residual value.

The data were analysed with the help of the Statistical Product and Service Solutions software, version 25 (IBM-SPSS 25), and the results identified Pearson correlations. The Pearson correlation table, presented in table no. 2, reflects a better correlation of the dependent variable with the information and communication indicators, regarding outputs resulting from reduced user reluctance. Also, from the correlation table, it can be seen that the weakest correlation of the variables is between the result of increasing supplier information and data user reluctance reduction. This demonstrates the different structure of digital service providers and users. The first category is very open to take up and use the news and opportunities offered by the digital market. The second category, depending on the age range of the users, is more or less open to digital opportunity assimilation.

**Table no. 2. Pearson Correlation**

Indicators	EU*DE%GDP	EU*DM%ICT	EU*DS%JMS	EU*DU%JMS
EU*DE%GDP	1.000	0.984	0.939	0.868
EU*DM%ICT	0.984	1.000	0.925	0.926
EU*DS%JMS	0.939	0.925	1.000	0.738
EU*DU%JMS	0.868	0.926	0.738	1.000

By applying the Enter methodology, regression variables were tested against the dependent variable to exclude data redundancy and autocorrelation, the result being valid, with all three regression variables accepted and no variable excluded.

The model summary, presented in table no. 3, indicates a statistical coefficient of determination of 97.8%, which means that the impact of the digital economy on GDP is influenced in a percentage of approximately 98% by the improvement of information and communication services, including the implementation of related technologies (one-unit increase in this indicator influences GDP growth by 0.7%). The other variables are inversely proportional to the increase in GDP with the mention that suppliers' information is less inversely proportional than users' (-0.05 compared to -0.3).

**Table no. 3. Model Summary**

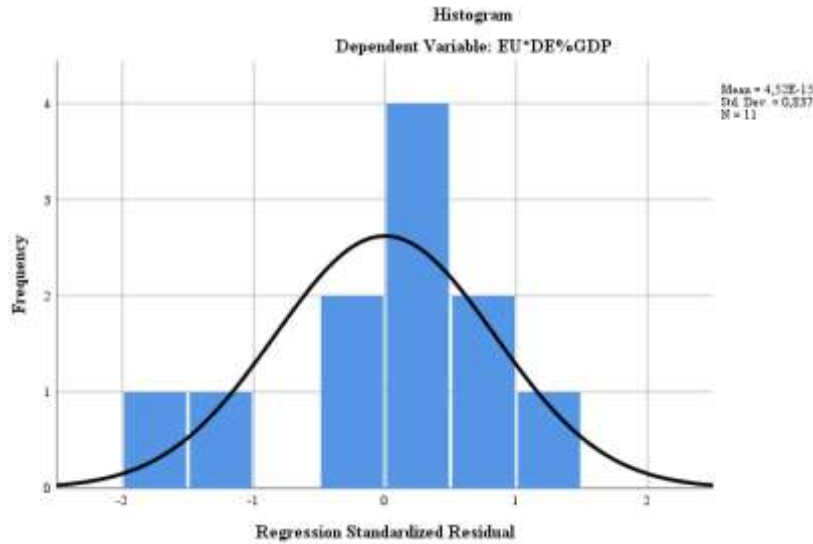
Model <sup>a,b</sup>	Correlation coefficient ®	Determination coefficient (R <sup>2</sup> )	Adjusted determination coefficient (R <sup>2</sup> )	Std. Error of the Estimate	Change Statistics	
					R <sup>2</sup> Change	Changing the correlation factor (F)
The digitalisation development econometric model	0.992 <sup>a</sup>	0.984	0.978	0.19097%	0.984	147.986
	Change Statistics					
	Regression degrees of freedom (df1)		Residual function degrees of freedom (df2)	The coefficient Sig. of the F correlation factor change	Durbin – Watson	
	3		7	0.000	1.301	
a. Predictors: (Constant), EU*DU%JMS, EU*DS%JMS, EU*DM%ICT						
b. Dependent Variable: EU*DE%GDP						

Following the ANOVA test, valid results of the general model were obtained. The value of the regression squares is significant in the total equation in a proportion of 98.5% of the obtained result and an F test of 147.99 and the Sig coefficient tending to 0, which demonstrates the homogeneity of the model (Table no. 4).

**Table no. 4. ANOVA test**

Model <sup>a,b</sup>		Sum of Squares	Degrees of freedom	Mean Square	Correlation factor (F)	Sig. coefficient.
The digitalisation development econometric model	Regression	16.190	3	5.397	147.986	0.000 <sup>b</sup>
	The residual component	0.255	7	0.036		
	Total	16.445	10			
a. Dependent Variable: EU*DE%GDP						
b. Regresors: (Constant), EU*DU%JMS, EU*DS%JMS, EU*DM%ICT						

The histogram distribution of the dependent variable respects the ordering under the Gaussian curve with inflection point on the ascending slope (median area of the slope) and on the descending slope (maximum area). For the analysed period, 2013-2025, the standard deviation is 0.837 (Figure no. 1).



**Figure no. 1. Regression analysis of the dependent variable**

The proposed model was also tested for the 4 Member States based on the proposed model equation, obtaining statistical representativities of over 85% in all cases. This shows that economic growth based on the digitalisation component is strongly influenced by the promotion, information and communication of downstream and upstream users.

The distribution of the regional dependent variable calculated for Romania, Greece, Germany and Sweden reflects the fact that the economic achievements and growth achieved in the period 2014-2018 are aligned with a regressive trend curve, which predicts the onset of a crisis in the digital economy segment. The repositioning of the trend perceived by the market in 2020, with the onset of the Covid pandemic, creates the premises for the validation of scenario 3 (challenge) as having a higher probability of realization compared to the other two scenarios provided by the European Commission.

The econometric model of digitalisation development designed for the Community data series generated valid values that would confirm the correlations between the analysed indicators, both in terms of homogeneity and of statistical representativeness.

### 3. Discussions

According to the recommendations made by The European Data Market Monitoring (2015), financial analysts indicate the possibility of projecting at least three scenarios for the development of the European Data Economy (Cattaneo et al., 2020).

The first scenario, called the baseline scenario, which proposes a healthy growth of innovation, a moderate concentration of data owners and a wide distribution of information on the benefits of innovation in society. This scenario is regarded by specialists as most likely and achievable.

Scenario 2, the high growth scenario, is characterised by a high level of data innovation, a low concentration of data portals and high data sharing for the benefit of the pro-innovation information society. This scenario is proposed as a model for policy makers in the field of digital economy.

Scenario 3, challenge, is characterised by a low level of innovation, a high concentration of data power due to the fragmentation of the digital market and an uneven distribution of the benefits of innovation in society. It is the weakest digital development option in the European Union for 2025.

The proposed model critically analyses the data provided by the European Commission (2020) on the reality regarding the frequency distribution of the three scenarios. Within the research, the descriptive statistics presented in table no. 5 were calculated for the four selected European economic entities (Germany – GE, Sweden – SW, Romania – RO and Greece – GR).

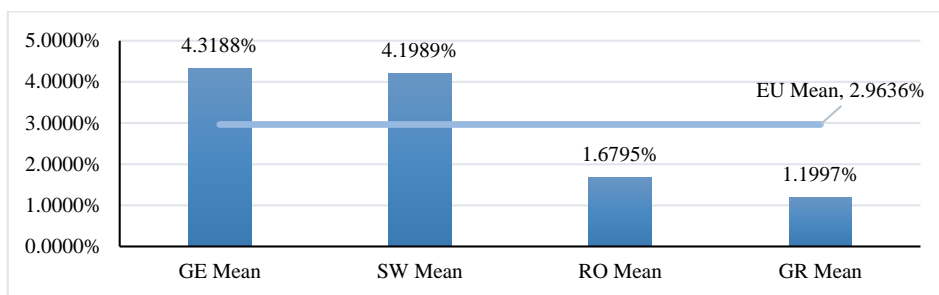
**Table no. 5. Descriptive statistics of the regional frequency series analysed between 2013-2025**

	Share data economy impact of GDP	Share of Data Market on Information and Communication Technology (sector J) Spending	Share of Data Suppliers on Total J and M Sectors	Share of Data Users on Total J and M Sectors
<b>EU Mean</b>	2.9636%	11.4182%	15.8685%	4.8000%
<b>EU Standard Deviation</b>	1.28240%	2.88715%	4.59519%	1.98997%
<b>GE Mean</b>	4.3188%	16.6394%	23.1247%	6.9949%
<b>GE Standard Deviation</b>	1.86880%	4.20736%	6.69643%	2.89993%
<b>SW Mean</b>	4.1989%	16.1772%	22.4823%	6.8006%
<b>SW Standard. Deviation</b>	1.81689%	4.09049%	6.51042%	2.81938%
<b>RO Mean</b>	1.6795%	6.4709%	8.9929%	2.7202%
<b>RO Standard Deviation</b>	0.72676%	1.63620%	2.60417%	1.12775%
<b>GR Mean</b>	1.1997%	4.6221%	6.4235%	1.9430%
<b>GR Standard Deviation</b>	0.51911%	1.16871%	1.86012%	0.80554%

As far as the growth of the digital economy is concerned, one may notice that the annual average of regional distribution is 3%, with significant differences of up to 400% between the growth rates of the digital economy in developed European countries (Germany and Sweden) as compared to those with emerging economies (Romania and Greece).

The calculated value of the standard deviation confirms this, namely that developed European countries with a strong digital economy (such as Sweden) have at least 50% higher volatility in economic growth as compared to countries whose traditional economies are infused with know-how and permanent investment support (Germany). In the case of emerging countries, the standard deviation of the economic growth indicator is smaller, maintaining a system inertia caused on the one hand by the lack of user information and on the other hand by the lack of infrastructure and investment in the digital economy.

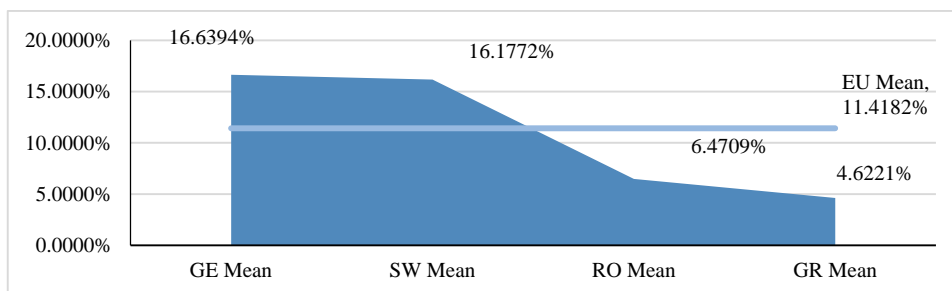
The emerging economy countries (Romania and Greece) are characterised by the prevalence of transition to EU digital development programmes and the lack of support for projects by the national economy, fact which leads to business instability in the digital sector, an instability that is delimited by the monitoring horizon established at EU level (Figure no. 2).



**Figure no. 2. Analysis of the average annual distributions of regional economic growth in the digital economy sector in the period 2013-2025 (% of GDP)**

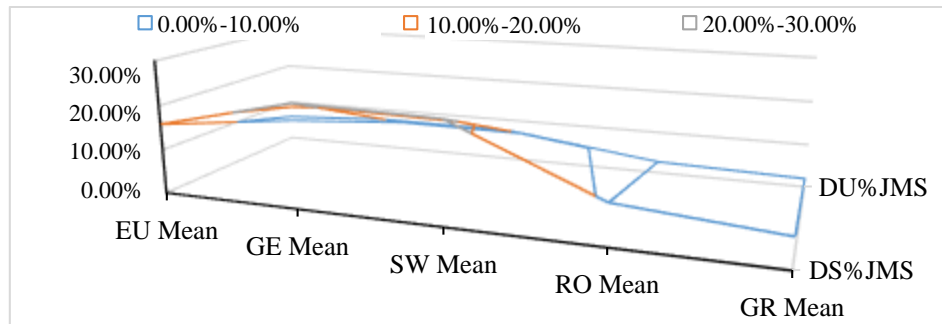
Regarding the information and communication action to support the growth of the digital economy, although the European Union data show significant discrepancies between the average growth rates in the innovation benefit dissemination in society and the interest of users through information and communication methods in the digital sector (of up to 360%), it can be seen that, compared to the general dynamics of digital economic growth, there are fewer disproportions than in the case of the first analysed indicator.

It can be appreciated that this is a basic element in economic growth, developing advantages and disadvantages and enhancing the generating effect of economic growth (Figure no.3).



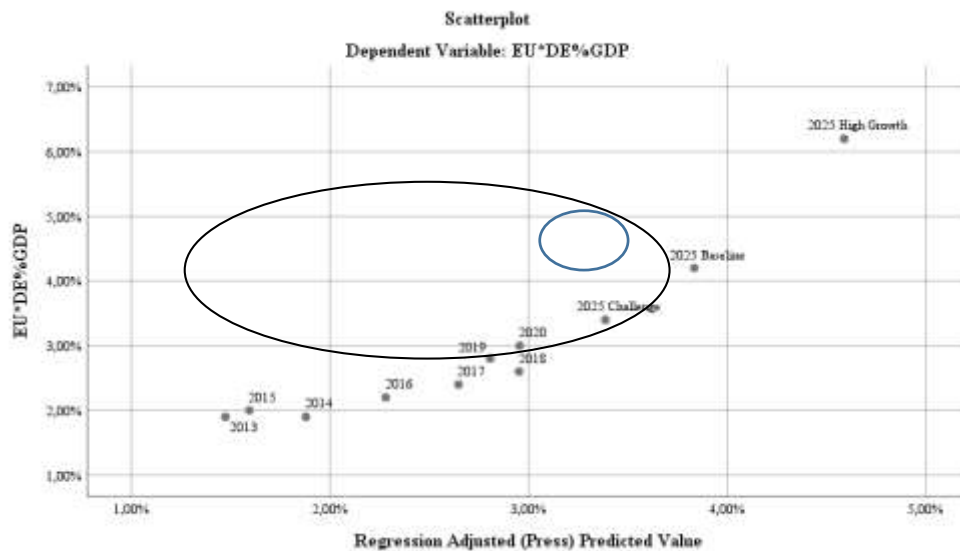
**Figure no. 3. Analysis of the average annual distributions of the information percentage on the data market and of the expenses related to the communication technology (Sector J) in the period 2013-2025**

The analysis of the last two indicators reflects the fact that, at the level of J sector users (Information and communication) and of M sector users (Professional scientific and technical activities), there is a negative gap in the degree of development of demand as compared to supply, of over 16% in developed countries and over 4% in emerging countries (Figure no. 4).



**Figure no. 4. Analysis of annual distributions of data providers and users by total J and M sectors in the period 2013-2015**

These aspects lead to the conclusion that the third scenario has a higher probability of realization, according to the model proposed by the authors (Figure no. 5).



**Figure no. 5. Analysis of the average annual distributions according to the 3 scenarios using the proposed digital economic growth mode in the period 2013-2025**

This analysis quantified the impact of digitalisation on the EU Member States' economies as being low to medium, based on the fragmentation of the digital market and the unequal innovation benefit distribution in society.

Following the model validity testing, significant results were obtained at Community and regional level, leading to the rejection of the null hypothesis (the unicriterion critical probability test) and to the retention of the alternative hypothesis of the model, thus confirming the working hypotheses, namely:

- The economic development is favoured to a certain extent by digitisation, the difference in effort for growth above the reflexivity point being counterbalanced by the

technical rigidity of the market and the difficulty of adapting to the new. This confirms hypothesis **H1**: *Increasing information and source transparency for digital service providers directly drives GDP growth, with a threshold after which the growth function becomes reflexive.* (Table no. 2 and Table no. 3)

- The user is the least educated element in the market with the highest information cost attached to it, and reducing user reluctance is directly and immediately reflected in the economic growth. This confirms hypothesis **H2**: *The increase in user responsiveness is directly proportional to the economic growth associated with digitisation, as the degree of reflexivity of the growth function is much lower.* (Table no. 2 and Table no. 3)

- The communication efforts need to be carefully analysed before making the action plan because this segment leads to high costs and failure of the communication strategy can lead to economic crises. This confirms hypothesis **H3**: *The growth of the digital sector through Information and Communication (sector J) is an enabling factor for economic growth, and there is also the premise of reflexivity, i.e. the point from which efforts do not generate significant effects.* (Table no. 2 and Table no.3)

- The positive economic development in the period 2014-2018 was followed by the pandemic crisis, with strong socio-economic effects, that supported the validation of Scenario 3 (challenge), as more likely to be achieved than the other two scenarios proposed by the European Commission (see Figure no. 5). This proves hypothesis **H4**: *The digital economy is less dependent on pandemic shock than the traditional economy and is a sustainable pillar of economic growth.* (Table no. 2 and Table no.3)

## Conclusions

The topicality of the study is based on the critical component regarding the foundations of financial allocations for the sustainable development of the data economy. The authors identify, by relying on the study of the literature and in accordance with the research results, the significant components that can generate consistent changes in the development policies of the data economy. An element of originality and novelty of this research is the conceptualization, validation and testing of the econometric model concerning the development of digitalisation, capable of quantifying the realism of the scenarios proposed by the European Union on the development of the data economy. This analysis took into account the three scenarios proposed by the European Union (the baseline scenario, the high growth scenario and the challenge scenario), the critical analysis being built upon data reported by Eurostat for the period 2013-2021, and the data forecast for the 2025 horizon.

The objectives of the study were fully achieved, with the authors assessing the current state of knowledge on the capabilities of users and providers of digital information to join the digital economy.

The testing of the scenarios was performed based on the analysis regarding the dynamics of the respective scenarios. The proposed econometric model of digitalisation development validated the third scenario as the most likely to be achieved, according to the indicator dynamics, the model being validated in specific statistical tests.

For the 4 states considered in conducting the research, an individual assessment was made of their ability to achieve the targets proposed by these scenarios developed by the European Union.

The study was conducted on the basis of proven working hypotheses, being useful to government decision-makers in order to adjust the national digitalisation strategy. The results of the research lead to a proposal for a critical review of digital development models, based on reliable data, in line with current trends in the evolution of the digital market.

The limits of the study consist of the limited number of economic units analysed and of digitalisation indicators quantified by modeling. The authors intend to extend the research in a further study, both in terms of the number of economic entities analysed and in terms of the number of digitalisation indicators, considering that this can provide opportunities to improve scientific results with a theoretical and practical impact.

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