THE MAIN TRENDS OF THE DEVELOPMENT OF THE DIGITAL ECONOMY IN THE EU COUNTRIES

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Abstract. *The development of information technologies in recent decades requires active reforms in the digitization of all processes and the adaptation of the population to them from individual individuals, enterprises and organizations, as well as from states. Issues related to the emergence of potential threats to the economic security of the state attract special attention in this regard. The purpose of the research is to analyze the main trends in the development of industry 4.0 on an international scale and establish its impact on the economic security of the state by identifying potential threats to its development. The methodological basis of the study is the analysis of the results presented by the European Commission in its report "Digital Economy and Society Index (DESI)", which is developed annually to monitor the digital progress of member states. The article examines the features of the Fourth Industrial Revolution and Industry 4.0, which made it possible to clarify the main directions of the development of society: the formation of digital competences and the development of human capital; formation of digital infrastructure; integration of digital technologies in business and everyday life; improvement of digital public services. Finland, Denmark, the Netherlands and Sweden have the most developed digital economies in the EU, followed by Ireland, Malta and Spain. Romania, Bulgaria and Greece have the lowest DESI scores. Estonia, Finland, Malta and the Netherlands have the highest scores for digital public services in the DESI, while Romania and Greece have the lowest. The main results of the conducted research are the identification and systematization of potential threats to the economic security of the state, the occurrence of which can negatively affect its development. It was established that the main threats to the economic security of the state during Industry 4.0 are: the absence or insufficient level of digital competences; high cost of software development; non-acceptance of digital innovations by society; cyber attacks; sources of personal data; falsification of data, etc. A detailed study of the specified threats and their impact on the economic security of the state can become a direction of further research.*

Keywords: *digitalization of society, industry 4.0, economic security of the state, threats.*

In recent years, information technologies have played a significant role in the life of every person, and therefore are directly related not only to his personal life, but also to his work, financial calculations, security, etc. A significant surge in the development of information technology occurred during the COVID-19 pandemic, during which most workers performed their work separately, and most enterprises were forced to change their business processes taking into account the demands of the times.

It was during the pandemic that the most urgent issues for all enterprises became the improvement of digital skills of personnel and digitalization of business processes.

The digital economy and digital competitiveness are among the most commonly used terms referring to the socio-economic development perspectives of contemporary society. In a broader sense, the digital economy describes the development of a technological society and implies the widespread use of ICTs in all spheres of human activity. ICTs enable people to perform ordinary tasks more efficiently and have emerged as a response to societal needs (Sendlhofer & Lernborg, 2018). In addition to the impact on individuals, ICTs also have an important impact on companies, since they provide new opportunities for companies and facilitate the worldwide availability of their products and services (Elia et al., 2016). ICTs have contributed to transforming the nature and handling of the uncertainties typical for the entrepreneurial process and its outcomes (Nambisan, 2017).

The advantages of applying ICTs in companies are numerous (Rossato & Castellani, 2020): improved efficiency and effectiveness of business processes, improved understanding of user experience, increased creation and transfer of knowledge, increased awareness of the cultural value of the company's heritage, and the development of state-of-the-art employee skills. The advent of the digital economy was facilitated by the digital revolution, also known as digitalization, which represents a transition from analogue or physical technologies to digital data systems (Dufva & Dufva, 2019). Carlsson (2004) states that digitalization of information, combined with the Internet, creates a wide range of various combinations of information and knowledge use through which the application of modern technologies and the availability of greater technical possibilities can be turned into economic possibilities. The Internet of Everything, aided by economies of scale and platforms such as consumer electronics, mobile devices, and urban infrastructure, enable the wide availability of services to consumers as well as easier access to potential consumers (Leviäkangas, 2016).

The relationship between ICTs and economic growth is an issue of particular interest in terms of both theory and practice. There are two prevailing understandings about the impact of ICTs application on economic growth (Thompson Jr & Garbacz, 2011): direct impact, which implies productivity improvements resulting from the application of ICTs, and indirect impact, which means the materialization of externalities resulting from the application and development of ICT. Several studies have reported a positive link between the development and implementation of ICTs and economic growth (Myovella et al., (2020). Portillo et al., 2020; Vu et al., 2020; Bahrini & Qaffas, 2019; Nair et al., 2020). Evidence indicates that ICTs improve various aspects of productivity (Skorupinska & Torrent-Sellens, 2017; Corrado et al., 2017; Pieri et al., 2018; Kılıçaslan et al., 2017, Ivanović-Đukić, et al., 2019; Haller & Lyons, 2019;). The digitalization and digital economy contribute to productivity growth in many ways (Wyckoff, 2016): by creating new innovative businesses and reducing the number of businesses with outdated, non-innovative operations; enabling smarter, more efficient use of labour and capital to create so-called multifactor productivity growth through which even older firms can improve; introducing new opportunities and services for individuals previously removed from the global economy (such as farmers and local producers); and enhancing the efficiency of inventory management and shipping.

Examining the impact of ICTs on economic growth is of great importance to policymakers, as it provides them with guidance for creating development strategies. Nevertheless, it should be borne in mind that a large number of indicators of digital development and competitiveness exist, and that most research uses only some of these as proxies, thus all aspects of digital competitiveness have not been covered.

The following are most commonly used as proxies in the literature: mobile and fixed broadband (Thompson Jr & Garbacz, 2011), broadband speed (Mayer et al., 2020), fixed and mobile phone subscriptions (Albiman & Sulong, 2017), and digital subscriber line broadband services (Haller & Lyons, 2019), investments in ICT (Niebel, 2018). For a detailed overview of digital development proxies, see Vu et al. (2020).

Measuring and comparing countries based on digital competitiveness is a topical issue, where several methodologies for quantification have been proposed. World Economic Forum has offered the Networked Readiness Index (NRI) for measuring the propensity of a country to take advantage of the opportunities offered by ICTs (NRI, 2019).

This index measures the performance of economies in using ICTs to boost competitiveness, innovation and well-being. Another methodology is the Digital Economy and Society Index (DESI, 2019) developed by the European Commission. It is a complex index that summarizes relevant indicators on European digital performance and tracks the development of EU Member States in digital competitiveness. In 2017 the DECA (Digital Economy Country Assessment) program was developed and tested (Ashmarina et al., 2020). DECA is a multivariate model that involves analysing the readiness, use and impact of digital transformation on national socio-economic progress. The DECA methodology is focused on assessing the current level of development of the digital economy to identify critical shortcomings, challenges and opportunities for future growth, as well as areas that require more careful analysis.

The United Nations International Telecommunication Union published the ICT Development Index (IDI, 2018) aimed at comparing and monitoring the development of ICT between countries and over time. E-government Development Index (EGDI, 2021) was developed to examine the development of e-government in the member states of the United Nations. Additionally, several authors have proposed composite indices of digitalization and digital competitiveness (Yoo et al., 2018; Milenkovic et al., 2016; Nair et al., 2020; Ali et al., 2020a; Ali et al., 2020b).

The construction of composite indices has specific critical steps on which the whole process depends and which are primarily related to the determination of appropriate weighting and aggregation methods (Saisana & Tarantola, 2002). When it comes to weighting methods when constructing composite indices, they can be grouped into three main categories (El Gibari et al., 2019): equal weighting, data-based methods, and participation-based methods. The equal weighting method has the least computational complexity but has drawbacks reflected in the loss of information (Nardo et al., 2005). The participation-based methods incorporate intuition, the subjective system of values and knowledge of the decision-maker or group, which is also a disadvantage of this approach because the weighting coefficients depend on their subjective assessment and perception. The data-based methods perform criteria weights determination based on data from the decision matrix, which eliminates the subjectivity of decision-makers, and weight determination is performed using mathematical and statistical methods based on information from the model. Yet, despite the apparent shortcomings, most of the stated indices of digital competitiveness use equal weights when determining weights (Pérez-Castro et al., 2021). When it comes to aggregation methods, criteria can be aggregated into a composite index in several ways: linear aggregation, geometric aggregation or multicriteria analysis. Each method implies different assumptions and has specific consequences (Nardo, 2005). Still, it should be noted that one of the advantages of multicriteria analysis methods is that the application of these methods leads to the creation of composite indices that are non-compensatory or partially compensatory.

The need to create an adequate composite measure for assessing and monitoring the digital competitiveness of countries stems from the fact that accelerated technological development imposes the urge to make effective strategic decisions related to the digital future, as well as to assess the level of digital development and competitiveness of countries (Alam et al., 2018). Having in mind the diversity and variety of indicators, it is desirable to create a unique composite indicator of digital development and competitiveness that will include various aspects of digitalization.

The digital economy and digital competitiveness have a multidimensional nature and can be defined as a multiple-criteria phenomenon (Balcerzak & Bernard, 2017).

Each country of the world responded differently to the challenges of Industry 4.0 in the field of public administration and self-government, which in some places contributed to the faster development of the digital society in all areas, including health care and education. Without a doubt, it can be stated that such transformations directly affected the economic security of all countries of the world.

Investigating the main trends in the development of industry 4.0, we consider it necessary to establish the main features of previous industrial revolutions. Thus, the first began at the end of the VIIIX century. with the increased use of steam and water energy and led to the transition from manual production methods to machines (i.e. mechanization); the second began at the end of the 19th century with the increase in the use of electrical energy, which allowed mass production (i.e. intensive use of electricity); during the third, they began to use electronics and Internet technologies of the 1970s and automated production (i.e. digitalization) [1–9].

Market development, internationalization and increased competitiveness have led to the emergence of the so-called Fourth Industrial Revolution and parallel development as the concept of Industry 4.0, which is based on the development of fully automated and intelligent production capable of autonomously communicating with the main corporate players [10].

Industry 4.0 is based on the horizontal and vertical integration of production systems driven by real-time data exchange and flexible production to ensure customized production [11, 12].

The fourth industrial revolution will lead to full automation and digitization of processes, as well as the use of electronics and information technology (IT) in production and services in the private environment [13].

The McKinsey Global Institute defines the Fourth Industrial Revolution as the era of "cyber-physical systems"—systems that combine computing, networking, and physical processes and contain a host of technologies that include mobile devices, the

Internet of Things (IoT), artificial intelligence (AI), robotics, cyber security and 3D printing [14].

Therefore, "the consequences of the development of technologies such as 3D printing, online sales services such as car services, medical examinations from home, ordering food sent directly from the store to the refrigerator, and so on, will have a significant impact on the changes in small and medium-sized enterprises (SMEs)" [12, p. 2].

According to the visionary work of Schwab (Schwab), the Fourth Industrial Revolution is developing exponentially, not linearly, which not only changes "what" and "how" to do things, but also "who" we are [15].

The introduction of Industry 4.0 has brought and will continue to bring profound changes to the global economy in terms of variables such as investment, consumption, growth, employment, trade, security, and more.

Growth and employment are certainly the areas most affected by the introduction of innovations related to the Industry 4.0 domain [15].

It is interesting that Rüßmann M., Lorenz M. and others. [16], analyzing the German context, proposed the expected growth at different levels with the application of innovations related to Industry 4.0. According to the authors, the transformation should lead to improvements and important increases in productivity (manufacturing sectors by 90-150 billion), income growth (about 30 billion per year), employment (6 percent growth over the next ten years), and investment (about 250 billion over the next ten years).

The term Industry 4.0 was coined in Germany and first used in 2011 to define a new proposal for future German economic policy; it was based on high-tech strategies [17].

This is not surprising, as the highest level of Industry 4.0 implementation can be seen in Germany, especially in international technology corporations. Companies such as Siemens, General Electric and Mitsubishi already have a wide range of manufacturing and automation solutions. "Manufacturing and automation technology developers such as DMG Mori, Wittenstein, Bosch, Rockwell, Omron, Schneider, Stäubli, Yaskawa, Krones, PSI and Software AG are already selling many technologies and solutions as Industry 4.0" [18, p. 195].

Since 2011, the term has been widely used not only in Germany and in the field of engineering, where it was first introduced, but also in the fields of economics and management. Indeed, it radically changes the way firms are structured and, above all, managed. However, despite the fact that some articles have been published, primarily in the management literature, the academic discussion about Industry 4.0, the analysis of its content and its detailed description, as well as the explanation of its possible future developments deserve more attention [19].

So, for example, Pan M. (Pan M.) and others. claim that "Industry 4.0 represents the ability of industrial components to communicate with each other" [19, p. 1537]. At the same time, Kovacs J. and Kot S. (Kovacs, G.; Kot, S.) claim that "the essence of the concept of Industry 4.0 is the implementation of networked intelligent systems that realize self-regulated production: people, machines, equipment and products will communicate with each other one" [20, p. 122].

To date, significant scientific developments in the field of management have been published, which study the main changes in business management models and the main components of firms. Thus, the academic discussion about Industry 4.0, the analysis of its content and detailed description, as well as the explanation of its possible future developments [21-27] deserve the greatest attention.

Given that in the global dimension we are at the initial stage of digitalization of the economy, the very concept of the digital economy and some other related economic terms do not have generally accepted definitions. There is a large number of interpretations and interpretations of this term in various literature sources and analytical reports. This situation is due to the relative novelty of this topic and the lack of sufficient understanding of the phenomena of the digital economy, and the high speed of technological progress. That is, the time required to harmonize and standardize certain definitions lags behind the speed of technological change. Since the first mention in the mid-90s of the last century, the definition of the digital economy has changed significantly, due to the rapid development of technologies and their integration into various socioeconomic spheres (Barefoot et al., [7]).

In the late 1990s, studies of the digital economy were mainly related to the development of the Internet and its impact on economic indicators and phenomena, so the concept of "Internet economy" (Brynjolfsson and Kahin, 2002[8] ; Tapscott, 1996 [9]). With the expansion of the possibilities and areas of implementation of Internet technologies since the mid-2000s, scientists have shifted the focus of their research to the conditions under which the Internet economy can develop and grow. The evolution of the definition and concept of the digital economy has been based on research on various policies to support the introduction of digital technologies, on the one hand, and the growing use of information and communication and digital technologies in business, on the other (OECD, 2012 [10] and 2014 [11]). With the improvement of the quality and volume of Internet connection in developing countries and the expansion of the range of digital products and services, the subject of digital economy research is a detailed analysis of the level of digitalization in developing countries (UNCTAD, 2017 [12]; World Bank, 2016 [13]).

Over the past few years, the debate has shifted again, focusing more on the dissemination of digital technologies, services, products, and skills in different economies. This process is often referred to as digitalization, which is defined as the transformation of a business through the introduction of digital technologies, products, and services (Brennen and Kreiss, 2014 [14]). The study by Malecki & Moriset (2007) emphasizes that digital goods and services contribute to faster change in different sectors, not limited to high-tech sectors, as previously thought (Malecki and Moriset, 2007 [15]).

Reflecting these changes, the reports of international organizations and analytical studies reveal the essence of "digitalization" and "digital transformation", i.e. how digital technologies change traditional sectors to further study various intersectoral trends in digitalization (OECD, 2016 [16] and 2017 [17] ; UNCTAD, 2017). These studies are particularly relevant for developing countries, as the digital economy is actively transforming traditional sectors such as agriculture, tourism, transport, and more. Researchers have concluded that the most important economic changes may well be due to the digitalization of traditional sectors of the economy, rather than the emergence of new sectors with digital support. Important for the development of the digital economy and awareness of the consequences of its active penetration into the economy is the study of investment and public policy in the field of digital technologies and infrastructure. Equally important is the assessment of the development of the digital economy through its components. For example, the UNCTAD report (2017) notes that the development of the digital economy may be associated with the increased use of advanced technologies such as robotics, artificial intelligence, the Internet of Things (IoT), cloud computing, big data analysis, and three-dimensional (3D) printing.

Besides, compatible systems and digital platforms are important elements of the digital economy. There is an opinion of certain scientists (Brynjolfsson & Kahin 2000 [18], Bahl 2016 [19]) that the digitalization of the economy is a major driver of economic growth and has significant regional implications for business, employment, and society as a whole. This trend is especially true in developing countries, Dahlman et al. (2016 [20]) believe that digitalization in this case will accelerate economic growth, increase return on capital and productivity, reduce transaction costs and facilitate access to world markets. According to the WEF (2015 [21]), the digital economy is growing by 15-25% per year in emerging markets. To this date, some positive economic effects of digitalization can already be observed: global income convergence through wage increases in the digital sector (Beerepoot & Lambregts 2015 [22]); creating new, unique local markets for digital startups in developing countries (Quinones et al. 2015 [23]); global digital platforms that can be an effective alternative to corrupt markets and inefficient labor market institutions (Lehdonvirta 2016 [24]).

However, along with the positive developments, there are several challenges and obstacles to the digitalization of developing economies, primarily due to the low level of digital skills and technology (Dahlman et al. 2016). Also, Murphy & Carmody (2015 [25]) emphasize the existence of a potential risk of negative consequences from the development of digital technologies due to limited resources, capabilities, institutional support, etc.; Foster & Heeks (2010 [26]) note the specific volatility of digital enterprises in developing countries; while Martin (2016 [27]) warns of the possibility of marginalization of workers in developing countries. Some researchers note that in addition to the positive effects, the digitalization of the economy in developing countries can lead to undesirable consequences, especially concerning information security and confidentiality (Manyika et al. 2013 [28]) and so-called premature deindustrialization in developing countries (Dahlman et al. 2016, Rodrik 2016 [29]). The development of the digital economy is closely linked to the introduction of digital and information technologies in related fields, such as software-oriented technologies such as blockchain, data analysis, and artificial intelligence.

The introduction of the latest technologies varies from user oriented devices (computers and smartphones) to 3D printers, wireless devices, and specialized hardware of machines and equipment, such as the Internet of Things (IoT), automation, robotics, and cloud computing. The Internet of Things (IoT) is also widely used, including in energy meters, to mark RFID goods for production, in animal husbandry, in logistics (Vostriakova, 2021 [30]), for monitoring of soil and weather conditions in agriculture, in renewable energy (Lezhniuk, 2020 [31]). Rapid progress in the combination of these technologies contributes to capacity growth and a significant reduction in data storage, processing, and transmission costs. A detailed description and analysis of some recent trends and prospects for the development of these technologies are grouped in Table 1.2.

Recently, in the writings of scientists, more and more attention is paid to the issue of the development of industry 4.0 and its impact on the economic activity of individual countries and the world as a whole. Unfortunately, insufficient attention has been paid to the issue of the impact of Industry 4.0 on the economic security of states, which allows us to outline directions for further research.

The purpose of the study is to analyze the main trends in the development of industry 4.0 on an international scale and establish its impact on the economic security of the state by identifying potential threats to its development.

The methodological basis of the study is the analysis of the results presented by the European Commission in its report "Digital Economy and Society Index (DESI)", which is developed annually to monitor the digital progress of member states.

Talbe 1.2. Trends in the development of digital technologies

Name	The essence and prospects of development	Leaders of implementation
Blockchain technology	According to the forecast of the value of Gartner business chains, after the first phase of growth in 2018-2021, in 2022-2026, investment flows are projected to increase, and new successful models to be created, which is expected to increase them by more than 3 trillion. dollars USA. worldwide (WTO, 2018 [32]).	USA, China
Three-dimensional printing	Further development of three-dimensional (3D) printing has the potential to disrupt production processes, stimulating international trade in design rather than finished products. Developing countries will have to jump over traditional production processes.	USA, China, Japan, Germany, Great Britain
Internet of Things (IoT)	In 2018, more "things" (8.6 billion) were connected to the Internet than people (5.7 billion), and the number of IoT connections is projected to grow by 17% per year and exceed 22 billion by 2024 (Ericsson, 2018 [34])	USA, China, Japan, Germany, Republic of Korea, France and Great Britain
5G networks	5G networks can process approximately 1000 times more data than modern systems (Afolabi et al., 2018 [35]). In 2019, 72 mobile operators tested 5G, it is expected (Deloitte, 2019 [36]), that larger-scale implementation will begin only in 2025.	USA, Europe and AsiaPacific
Cloud computing	Cloud computing is transforming traditional business models by reducing the need for its own IT professionals, offering flexibility to scale and consistently deploy and maintain programs (UNCTAD, 2013 [37]).	North America, AsiaPacific, Western Europe
Automation and robotics	According to the International Federation of Robotics (2018 [38]), global sales of industrial robots doubled between 2013 and 2017. This trend will continue, and sales are expected to increase from 381,300 units in 2017 to 630,000 units by 2021.	China, Japan, the Republic of Korea, the United States and Germany
Artificial intelligence (AI) and data analysis	General-purpose AI technologies have the potential to increase the global economy by about $ 13 trillion by 2030, which will contribute an additional 1.2 percent to annual GDP growth (ITU, 2018 [39]).	China, USA and Japan

Source: compiled by the authors

Since 2014, the European Commission has been monitoring the progress of member states in the field of digital technologies and publishing annual reports of the Digital Economy and Society Index (DESI) [27].

Each year, the reports include country profiles to help Member States identify priority areas for action, as well as thematic sections providing EU-level analysis in key digital policy areas.

DESI 2020 discussed increasing the use of digital solutions during the COVID-19 pandemic. This trend towards greater digitization is confirmed by the slightly higher growth rate of digital adoption by both citizens and businesses at the EU level.

Overall, the pandemic is estimated to have accelerated existing trends in global remote work, e-commerce and automation, and exacerbated labor mobility. However, these trends did not affect citizens and businesses equally. The results suggest that the large expansion of telecommuting following the COVID-19 outbreak has been heavily skewed toward high-paying white-collar jobs. This reflects differences in the structure of employment, where only 33 to 44% of jobs structurally allow telecommuting.

Businesses provided more fully digitized products and services: 34% before the Covid-19 crisis and 50% during the pandemic; and bought more cloud computing services: 24% before the pandemic in 2019 and 41% in 2021.

Significant differences continue to exist between large enterprises and SMEs, with 72% of large enterprises subscribing to cloud computing services compared to 40% of SMEs.

The DESI 2022 results show that while most Member States are making progress in digital transformation, business adoption of key digital technologies such as artificial intelligence and big data remains low, even among EU leaders. Inadequate digital skills are hampering future growth prospects, widening the digital divide and increasing the risks of digital exclusion as more services, including the most essential ones, move online. Efforts must be intensified to ensure the full deployment of the ubiquitous communications infrastructure (including 5G) required for highly innovative services and applications.

Finland, Denmark, the Netherlands and Sweden continue to be EU leaders in the implementation of Industry 4.0 for several years in a row, but in 2022 it was found that digital challenges remain inherent in most leaders as well.

In 2021, only 55% of small and medium-sized enterprises (SMEs) have achieved at least a basic level of digital adoption. Sweden and Finland have the most digitized SMEs (86% and 82% have a basic level of digital intensity, respectively), while Romania and Bulgaria have the lowest SME digitization rates. To achieve the Digital Decade target, at least 90% of small and medium-sized enterprises in the EU must have a basic level of digital intensity by 2030.

Businesses are becoming more and more digital, but the use of advanced digital technologies remains low. While 34% of enterprises already rely on cloud computing (in 2021), only 8% will use artificial intelligence (AI) in 2021 and 14% will use big data in 2020. According to the "Pathway to the Digital Decade" proposal, at least 75% of companies should move to AI, cloud and big data technologies by 2030.

There is a significant gap between large companies and small and medium-sized enterprises not only in the use of advanced technology, but also in basic digital solutions such as an enterprise resource planning (ERP) software package and e-commerce engagement.

Digital Public Services DESI tracks online public services by assessing member countries on whether each step of key services can be delivered fully online. In 2021, quality scores reached 75 out of 100 for digital government services for citizens and 82 out of 100 for businesses.

Estonia, Finland, Malta and the Netherlands have the highest scores for digital public services in the DESI, while Romania and Greece have the lowest. The developed strategy "Road to the Digital Decade" set the goal that by 2030 all key public services for citizens and businesses should be fully online.

In Fig. 1.1 below shows the progress of member states in terms of the overall level of digitization of their economy and society over the past 5 years.

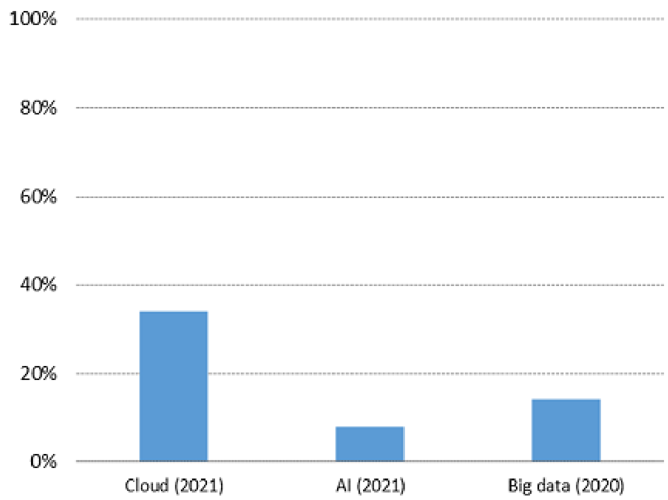

Figure 1.1. Adoption of advanced technologies (% of enterprises) in the EU, 2020/2021

Source: Eurostat, European Union survey on the use of ICT and e-commerce in enterprises [28]

Finland, Denmark and Sweden have the highest positions in the digital transformation of business.

In Fig. 1.2 presents the results of the Digital Economy and Society Index and the relative progress of member states in the period 2017-2022.

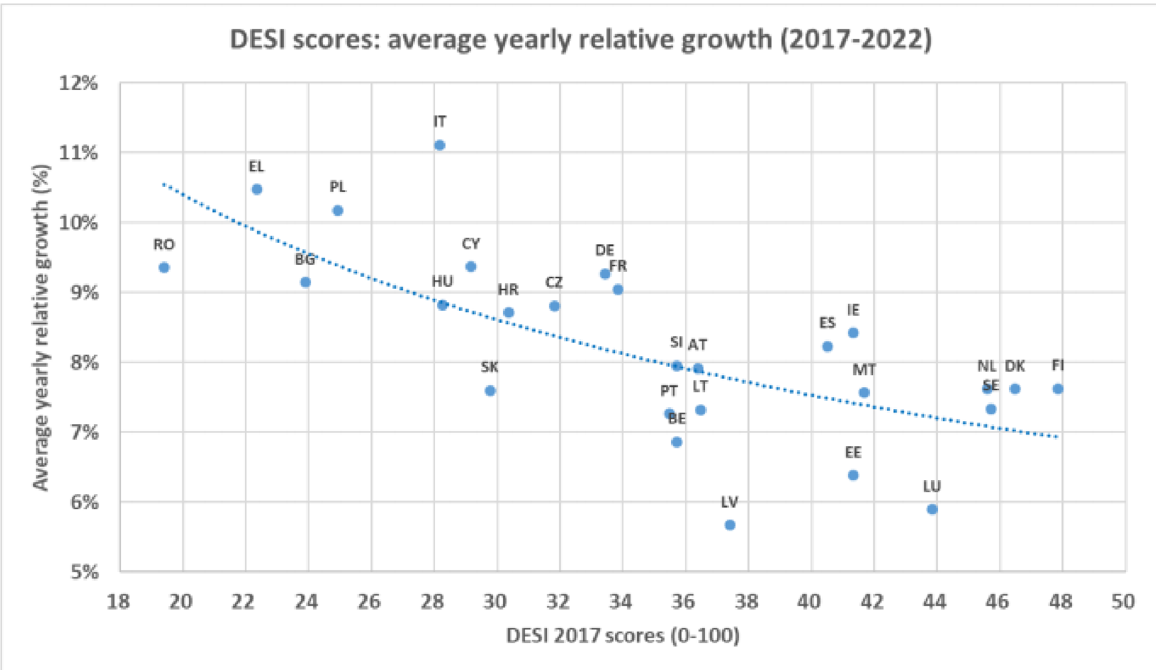

Figure 1.2. Digital economy and society index - relative progress of member states in the period 2017-2022

Source: DESI 2022, European Commission [28]

For each country, the figure shows the relationship between its 2017 DESI score (horizontal axis) and the average annual DESI growth for the period 2017-2022 (vertical axis). As in the classical theory of economic growth, general convergence is observed when countries that start with lower levels of digital development develop at a faster rate (left side of the diagram). The DESI estimates clearly show the general pattern of convergence in the EU between 2017 and 2022.

The blue line in the figure is the estimated convergence model. Countries that are above the blue line have grown more than expected by the convergence curve and are therefore "outperformed". For countries located below the blue line, the opposite is true.

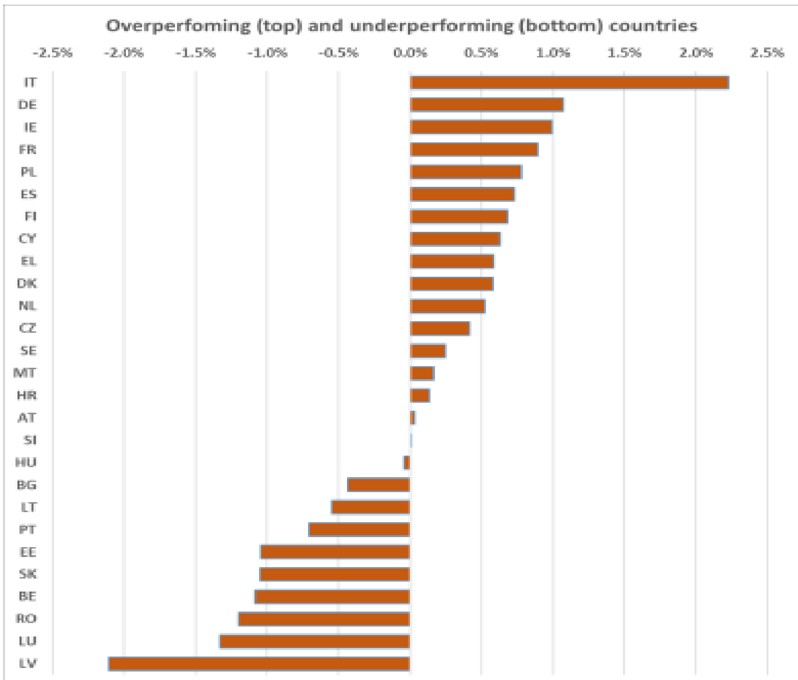

Figure 1.3. Digital Economy and Society Index - Exceeding and Lagging Member States (2017-2022)

Source: DESI 2022, European Commission [28]

The chart below (Figure 1.3) classifies countries with high performance (upper part of the chart) and underperformers (lower part of the chart) according to their distance from the convergence curve (blue line in the figure above). Italy is the best in the first group, as its growth rate significantly exceeded expectations between 2017 and 2022. It is followed by Germany, Ireland, France and Poland among the top five countries. In the bottom group of countries, Latvia improved DESI much more slowly than expected from the convergence curve, deviating from the general pattern of convergence.

Luxembourg, Romania, Belgium, Slovakia and Estonia also deviate significantly from convergence.

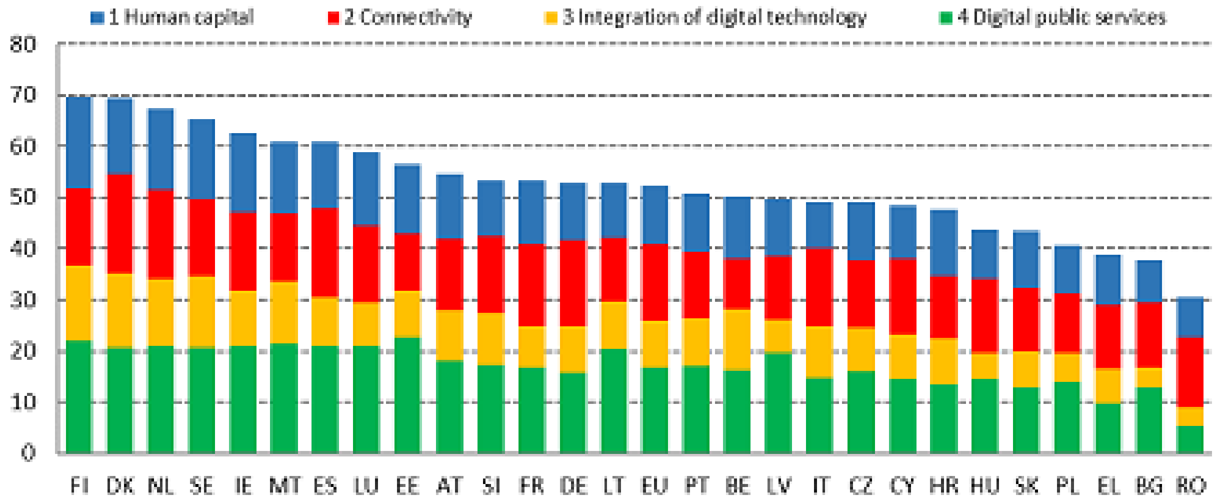

Figure 1.4. Digital economy and society index, 2022

Source: DESI 2022, European Commission [28]

In Fig. 1.4 shows the ranking of DESI member countries for 2022, according to which Finland, Denmark, the Netherlands and Sweden have the most developed digital economies in the EU, followed by Ireland, Malta and Spain. Romania, Bulgaria and Greece have the lowest DESI scores.

Based on the results of the research, the following conclusions can be drawn. The article examines the peculiarities of the Fourth Industrial Revolution and Industry 4.0, which made it possible to clarify the main directions of the development of society: the formation of digital competences and the development of human capital; formation of digital infrastructure; integration of digital technologies in business and everyday life; improvement of digital public services.

The annual reports of the European Commission, which contain the progress of member states in the field of digital technologies in the Digital Economy and Society Index, were studied. The main threats to the economic security of the state were established according to the researched directions of the development of society, namely: the formation and development of human capital (absence or insufficient level of digital competences); formation of digital infrastructure (high cost of software development); integration of digital technologies into business and everyday life (society's rejection of digital innovations); improvement of digital public services (cyber attacks, leaks of personal data, falsification of data, etc.).

A detailed study of the specified threats and their impact on the economic security of the state can become a direction of further research.

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