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ANALYSIS OF THE MAIN DIRECTIONS OF DIGITALISATION OF THE NATIONAL ECONOMY[1]

Summary

The research is devoted to the analysis of the main directions of digitalisation of the national economy and its impact on the structural transformation of the Ukrainian economy. The authors emphasise that digitalisation is a key factor in increasing the competitiveness of countries in the global environment and forms a new paradigm of economic development. The theoretical foundations of the concept of "digital economy" are revealed, in particular its three-level structure: digital sector, digitalised economy and digital society. Based on statistical data, it is shown that Ukraine is undergoing a gradual transition from an industrial-agrarian model to a service-oriented one, where information and communication technologies, finance and scientific activity are developing most dynamically. Special attention is paid to the IT sector as a driver of digital transformation: its contribution to Ukraine's GDP exceeds 4%, and the share of ICT services in the export structure reaches 45%. Despite the challenges of the war, the industry demonstrates resilience and contributes to economic stability. A comparison of the share of the digital sector in Ukraine and the EU countries is carried out, which indicates a tendency towards convergence with the European model of digitalisation. The importance of developing the population's digital skills is also emphasised - more than 60% of adult Ukrainians already have basic digital competencies. The conclusions indicate that digitalisation is becoming a system-forming factor in the economic development of Ukraine, combining technological, social and institutional changes. Further strengthening of digital potential, development of human capital and reduction of the "digital divide" are key conditions for Ukraine's integration into the single digital space of the EU.

Introduction

Digitalisation of the economy is rapidly transforming the modern world and is becoming a determining factor in the competitiveness of countries in the global environment. It covers all spheres of public life – from production and trade to

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education, finance and public administration – forming a new paradigm of economic development. The share of the digital economy, that is, economic activity based on the use of information and communication technologies (ICT), is constantly growing [1].

According to international think tanks, in 2023, more than half of the world's gross domestic product will already be created by digitalised enterprises – those that actively implement modern technologies, digital tools and innovative business models in all aspects of their activities [2]. This indicates that the digital economy has turned from a narrow technological segment into a key driver of global economic growth and structural changes in the world economy.

The rapid development of information technologies, the mass distribution of the Internet, mobile devices and digital platforms, as well as the active implementation of innovations – in particular, cloud services, artificial intelligence, big data (Big Data), blockchain technologies and the Internet of Things (IoT) – have ensured an explosive growth in the volume of digital products and services in the structure of global production. These processes have contributed to the formation of new business models, changed the nature of work, communication, consumption and methods of creating economic value.

In the context of digital transformation, the information technology industry (IT sector) is gaining strategic importance for the development of national economies. It is IT companies that create the technological infrastructure of the digital environment – develop software, provide IT services, implement platforms for e-commerce, digital banking, education, healthcare, etc. They provide the technological basis for innovations in all other sectors of the economy, thereby increasing their efficiency and competitiveness.

The growth of the IT industry's share in the gross domestic product is an important indicator of the technological maturity of the economy, the level of development of the digital infrastructure and the country's readiness for the challenges of the digital era. Analysis of the structure of the IT sector in GDP allows us to assess the contribution of high-tech activities to economic growth, determine the dynamics of digital transformation and identify areas that require state support or institutional improvement.

Therefore, the study of the processes of digitalisation of the economy and the role of the IT sector in this process is relevant both from a scientific and a practical point of view. It allows us to more deeply understand the patterns of the formation of the digital economy, its impact on the structure of the national economy and outline the prospects for Ukraine's integration into the global digital space.

Chapter 1. The essence and theoretical foundations of the digitalisation of the economy

In general, the digitalisation of the economy is a complex phenomenon that encompasses the introduction of digital technologies into business processes, production, service provision and everyday life. The scientific literature uses related concepts: “digital economy”, “ICT sector” (information and communication technologies) and “IT industry”.

A significant contribution to the theoretical understanding of these concepts was made in the work of Bukht and Heeks, who define the digital economy as "part of economic production that is fully or predominantly based on digital technologies, digital infrastructure and digital goods and services" [3]. They propose to apply a three-level structure to this concept:

1. digital sector (core digital economy) – production of IT products and services;
2. digitalised economy (digitalised economy) – areas where ICTs are integrated into traditional business models;
3. digital society (digital society) – social effects of digital technologies.

A similar concept was developed in the report "Measuring the Digital Transformation: A Roadmap for the Future", where the digital economy is interpreted as "all economic processes based on digital data as a key production factor" [4]. This definition is the basis for the formation of a statistical framework for assessing digitalisation in international organisations.

In the work of Goldfarb and Tucker [5], digitalisation is viewed as a reduction in five types of transaction costs: searching, copying, transporting, tracking and verifying information. This explains the fundamental mechanism of the impact of digital technologies on productivity, competition and consumption patterns.

While international studies consider digitalisation mainly through its impact on productivity and markets, domestic scientific literature also emphasises the institutional, regulatory and socio-economic aspects of this process. In particular, Dashko and Mykhailichenko [6] consider the digitalisation of the economy as a new reality of economic development, emphasising its institutional prerequisites, the role of state policy and structural barriers in the implementation of digital technologies. A similar topic is continued by Bashlai and Yaremko [7], who emphasise the European integration dimension of Ukraine's digitalisation, defining digital transformation as a key factor in adapting the economy to EU standards and increasing its competitiveness.

In the study [8], digitalisation is considered through the prism of the development of the ICT sector: the author systematises the stages of its formation, sources of investment and the dynamics of the influence of the IT industry on the formation of the digital economy. In the article "Modern Trends in Digitalisation of the Economy: Problems and Development Prospects", the authors highlight the key problems of digital transformation - inequality of access to digital infrastructure, lagging regions and lack of personnel with digital skills, emphasising the need for balanced state policy [9].

Analysing similar trends, Zhekalo emphasises the importance of information and communication technologies for the structural modernisation of the national economy and emphasises the need to form a system of indicators for assessing the level of digitalisation [10]. At the same time, Cherep at al. [11] systematises the positive effects of digital transformation - increased transparency of business processes, expansion of electronic services, digital integration into global markets, and identifies the main risks associated with uneven development and cyber threats. Taken together, these studies form a theoretical and applied basis for understanding the processes of digitalisation in Ukraine, emphasising common features with global trends, but at the

same time demonstrating national specifics, which are determined by institutional, infrastructural and security challenges.

To better understand the meaning of the concept of "digitalisation of the economy", it is advisable to consider its main tools. Digitalisation is not limited to the use of ICT in business but covers a wide range of technological areas that ensure the transition to new models of production, management and data exchange. The generalised structure of the tools is shown in Figure 1.

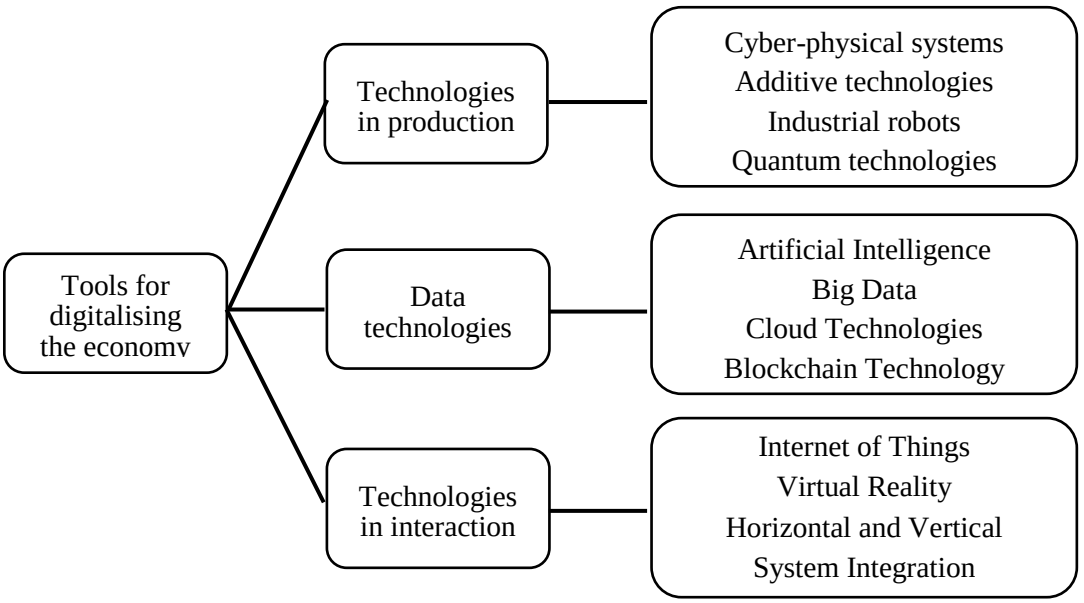


Figure 1. Tools for ensuring the digitalisation of the economy

Source: constructed by the authors based on [12]

As can be seen from Figure 1, digitalisation tools can be grouped into three areas. Their comprehensive implementation provides the technical basis for the digital economy, creating conditions for increasing productivity, forming innovative markets, and deepening integration between sectors.

Thus, the results of these studies confirm that digitalisation has not only a technological and social, but also a clearly expressed economic dimension. It is the growth of the role of information technologies in the structure of a country's GDP that gradually transforms its economy into a digital one, causing the global phenomenon of the digital economy.

This trend is also confirmed by international analytical data. According to the OECD Digital Economy Outlook 2024, the ICT sector has grown significantly faster than the traditional economy over the past decade: the average annual growth rate of the ICT sector in OECD countries was three times higher than the GDP rate in 2013–2023 [13]. This indicates the dynamism and resilience of ICT industries even in conditions of economic shocks.

The generalisation of the above provisions allows us to present the economic dimension of digital transformation as an interconnected system of elements. Digitalisation acts as a complex process that combines institutional and technological

dimensions, forming the basis for the development of the ICT sector, innovative technologies and new digital markets. At the same time, these processes generate new imbalances, in particular the phenomenon of the "digital divide" between countries, sectors and groups of economic agents. The structure of such relationships is shown in Figure 2.

As shown in Figure 2, digitalisation creates a multi-level economic effect. It stimulates the growth of the ICT sector, the development of innovations, as well as the formation of new digital markets and productivity models. The combined effect of these factors leads to the emergence of the global phenomenon of the digital economy, which is becoming the basis of modern economic growth. At the same time, digital transformation is not uniform: differentiation of access to technologies causes a digital divide, which deepens structural differences between countries and sectors of the economy. At the same time, despite the existence of the digital divide, the overall vector of development remains unchanged upward – digital technologies are increasingly penetrating economic processes, forming a new global growth model.

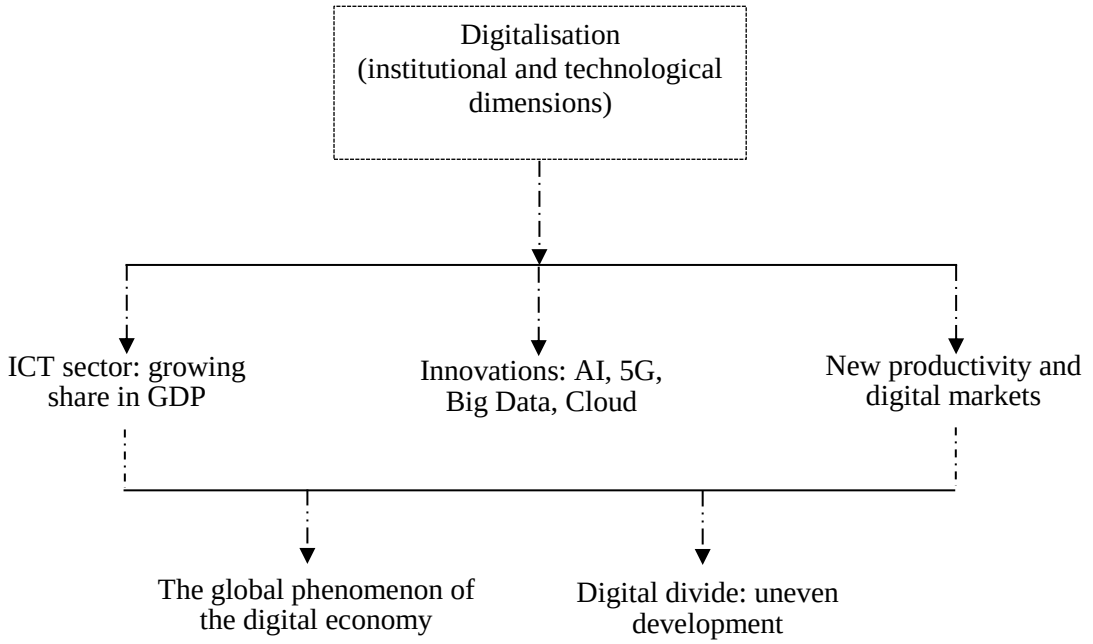


Figure 2. Economic dimension of digital transformation

Source: constructed by the authors based on [13]

Chapter 2. Digitalisation of the Ukrainian economy: structural transformations

The world economy has entered a stage of accelerated digital transformation over the past decade. Global digitalisation trends are evident in all areas – from manufacturing to services, from business to government. One of the key signs is the rapid growth of the digital sector's share in global GDP. According to Statista, the volume of global GDP generated by digitalised enterprises increased from 13.5 trillion USD in 2018 to 53.3 trillion USD in 2023. This means an almost fourfold

increase in five years [14]. Accordingly, the share of the digital economy in nominal global GDP for the first time exceeded 50% in 2023, i.e. more than half of global production now falls on businesses based on ICT and digital technologies. Such shifts indicate the formation of a new model of global development, in which digitalisation is a key factor in increasing productivity, innovation and competitiveness of national economies. However, the speed and scale of digital transformations vary significantly between countries, which leads to the emergence of the so-called "digital divide" between developed and developing countries. In this context, it is important to understand at what stage of digital transformation Ukraine is, how the structure of its economy is changing under the influence of digital processes.

For a more detailed understanding of these trends, it is advisable to consider the distribution of Ukraine's gross domestic product by sectors of economic activity, which allows us to assess the internal dynamics of the economy and identify potential directions for its digital growth.

Figures 3–7 detail the components of Ukraine's GDP, according to the main sectors for 2023.

Figure 3. Primary sector

Source: constructed by the authors based on [15]

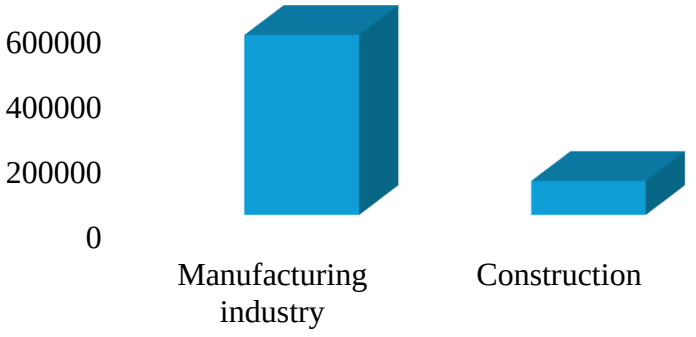


Figure 4. Secondary sector

Source: constructed by the authors based on [15]

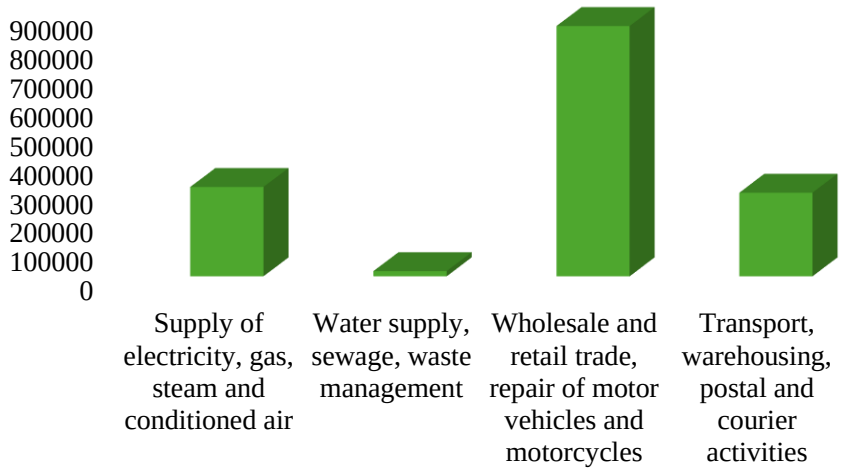


Figure 5. Tertiary sector

Source: constructed by the authors based on [15]

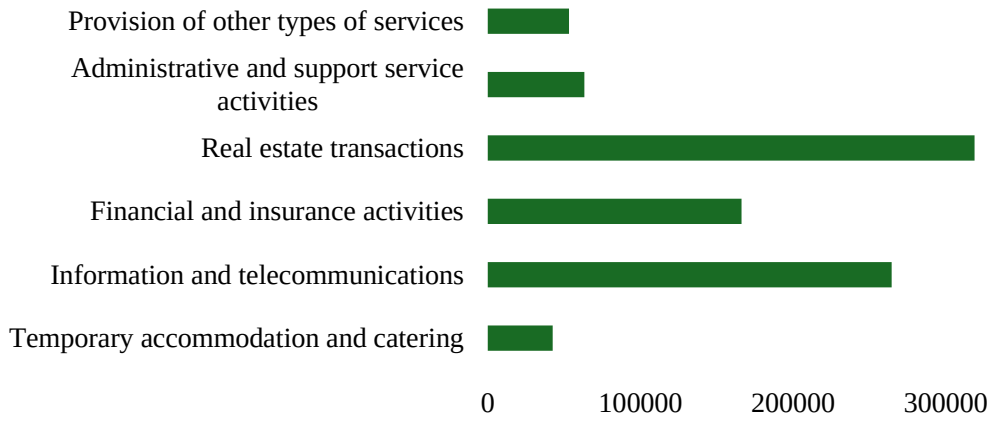


Figure 6. Quaternary sector

Source: constructed by the authors based on [15]

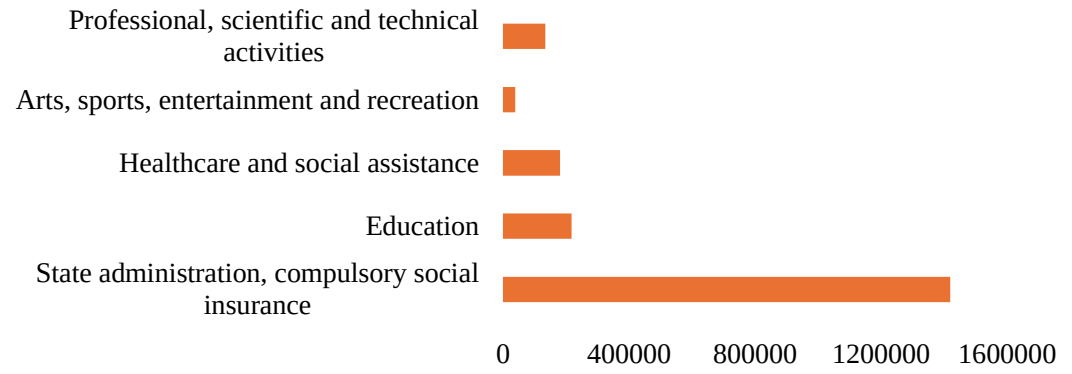


Figure 7. Fifth sector

Source: constructed by the authors based on [15]

As shown in Figures 3–7, the largest contribution to the formation of Ukraine's GDP is provided by the tertiary and quaternary sectors, which combine the services sector, trade, transport, finance, information technology, real estate transactions and administrative services. They form more than two-thirds of the country's gross value added, reflecting the global trend of the dominance of the services sector in the structure of the economy.

The secondary sector (manufacturing and construction) retains its importance as a basic industrial block but is gradually reducing its share in GDP. The primary sector (agriculture, forestry and fisheries, mining) remains important for exports, but its role in creating added value is relatively stable.

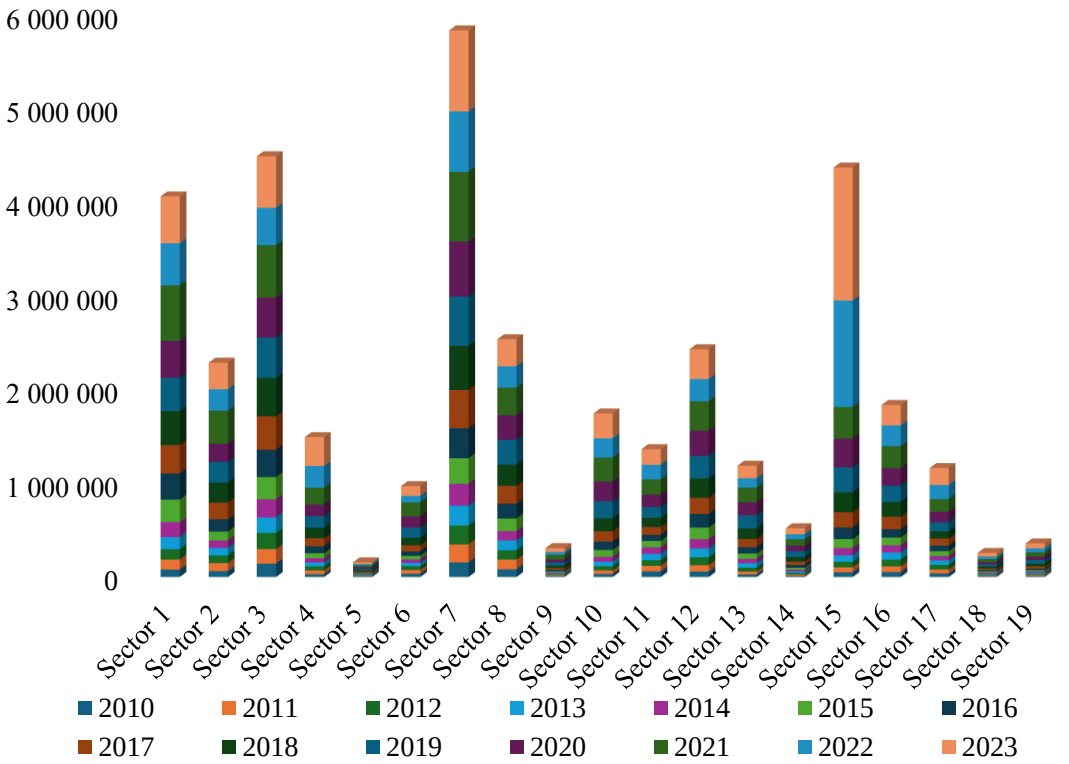
At the same time, the quaternary sector – information and telecommunications, financial, and scientific activities – demonstrates the most dynamic growth, which is a sign of Ukraine's gradual transition to a knowledge economy.

The fifth sector, which includes public administration, education, science, healthcare and social services, provides institutional conditions for the functioning of the entire economic system.

Thus, the structure of the national economy of Ukraine is characterised by the predominance of the service sector, within which information and communication technologies, finance and real estate transactions are developing most dynamically. The share of high-tech activities is gradually increasing, reflecting the processes of digitalisation and transition to a knowledge economy. At the same time, the preservation of a significant role of the industrial and agricultural sectors indicates the mixed nature of the economic system, where traditional and innovative development factors are combined. Such a structure creates the prerequisites for the further integration of digital technologies into all parts of the economic complex of Ukraine.

Analysis of the dynamics of the structure of Ukraine's gross domestic product in 2010–2023 indicates a gradual transformation of the national economy from an industrial-agrarian model to a service-oriented one. Figure 8 shows changes in the volume of gross value added by the main sectors of the economy in actual prices.

During 2010–2021, steady growth was observed in most sectors, reflecting the positive dynamics of domestic demand, exports, and gradual integration into global production chains. The largest share in GDP during the analysed period was occupied by wholesale and retail trade, and repair of motor vehicles, which indicates a high dependence of economic growth on consumer activity of the population. A high contribution to the creation of gross value added was also provided by the processing industry and agriculture, which remained the basic components of the economy, especially in export-oriented sectors. In 2010–2019, the growth rates of these industries were uneven, but generally showed positive dynamics. Starting in 2020, the COVID-19 pandemic led to a temporary reduction in production in industry and transport, while information and communication technologies and services showed increased resilience.



Note: Sector 1: Agriculture, Forestry and Fishing; Sector 2: Mining and Quarrying; Sector 3: Manufacturing; Sector 4: Electricity, Gas, Steam and Air Conditioning Supply; Sector 5: Water Supply; Sewerage, Waste Management and Remediation Activities; Sector 6: Construction; Sector 7: Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles; Sector 8: Transportation, Storage, Postal and Courier Activities; Sector 9: Accommodation and Food Service Activities; Sector 10: Information and Communication; Sector 11: Financial and Insurance Activities; Sector 12: Real Estate Activities; Sector 13: Professional, Scientific and Technical Activities; Sector 14: Administrative and Support Service Activities; Sector 15: Public Administration and Compulsory Social Security; Sector 16: Education; Sector 17: Human Health and Social Work Activities; Sector 18: Arts, Entertainment and Recreation; Sector 19: Other Service Activities

Figure 8. Components of Ukraine's GDP by economic sectors for 2010-2023, in current prices

Source: constructed by the authors based on [16]

Chapter 3. IT industry as a driver of digitalisation of the national economy

2022 became critical for the Ukrainian economy, as a result of Russia's full-scale aggression, there was a sharp drop in production volumes in almost all sectors. The indicators of the processing industry, construction, transport, trade and energy supply decreased the most, which was due to the destruction of infrastructure, the relocation of enterprises and a decrease in business activity. At the same time, the role of public administration, defence, information technologies and telecommunications, which ensured the functioning of critical state systems, increased during this period. In 2023, a partial recovery of economic activity was recorded, especially in the services, construction and IT sectors. The recovery is partly due to the intensification of international assistance, the start of the functioning of enterprises in safe regions and the gradual adaptation of business to wartime conditions. It is noteworthy that the

share of the information and communication sector has further increased, which has become a key factor in the digitalisation of the economy, contributing to increasing its resilience. An important component of this process is the development of foreign economic activity in the ICT sector. The strengthening of its position in global markets reflects not only the industry's internal recovery but also its ability to generate foreign exchange earnings and maintain the economic stability of the state in times of war.

Figure 9 shows the steady growth in the value of ICT services exports and their share in total exports. In 2022, ICT services accounted for 45% of services exports, highlighting their importance to Ukraine’s economy and budget revenues. Since 2014, the growth rate has accelerated, reflecting global demand and Ukraine’s technological development. The ICT sector is the country’s leading service export sector.

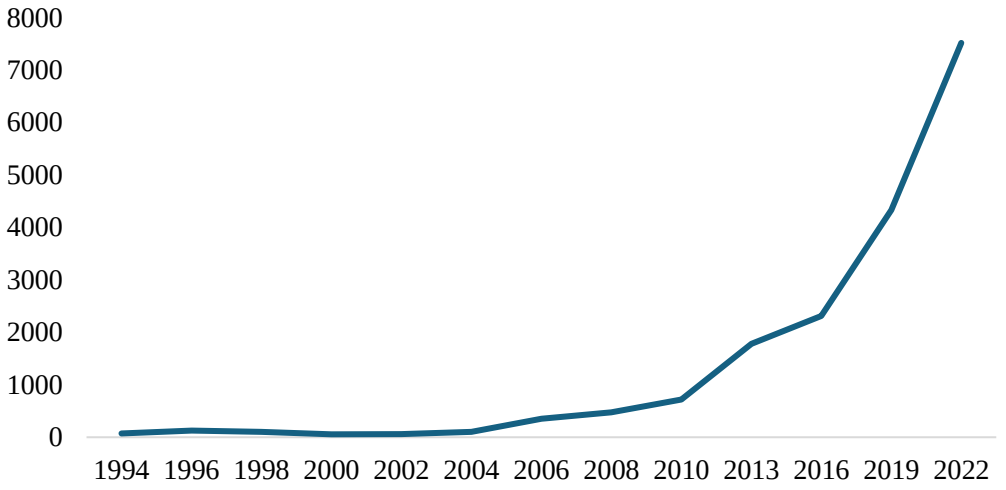


Figure 9. Dynamics of exports of information and communication technology services from Ukraine, million USD

Source: constructed by the authors based on [16]

The Ukrainian IT sector is export-oriented, with the main partner countries in 2023 being the USA, Malta, the UK, Cyprus, Israel, Germany, Poland, Estonia, the Netherlands and Switzerland (Fig. 2.10). Many of these countries also export ICT services, which indicates the popularity of outsourcing in the Ukrainian IT industry, where specialists fulfill orders for foreign brands. With the start of the full-scale invasion in 2023, exports to the USA decreased by 2%, but increased to Poland (+62%), Cyprus (+26%), Malta (+18%) and Estonia (+21%). Exports to Russia fell by 100%.

In addition to exports of ICT services, it is also important to consider the dynamics of imports of relevant services (Figure 11).

The indicator reflects the share of imports of services such as communications, computer, information services and technical support. A decrease in the share of imports of ICT services indicates an increase in the country's ability to meet its own needs, although imports can contribute to the introduction of best practices. After

2000, the share of imports decreased significantly, and this trend continued until 2021, which indicates the development of the domestic ICT sector.

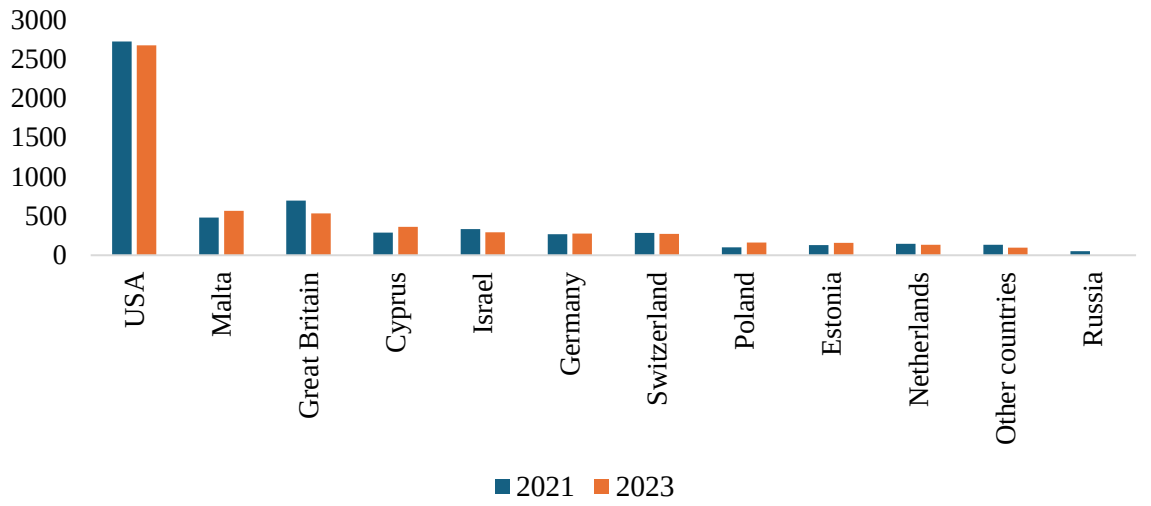


Figure 10. Dynamics of IT services exports by main partner countries, million USD

Source: constructed by the authors based on [16]

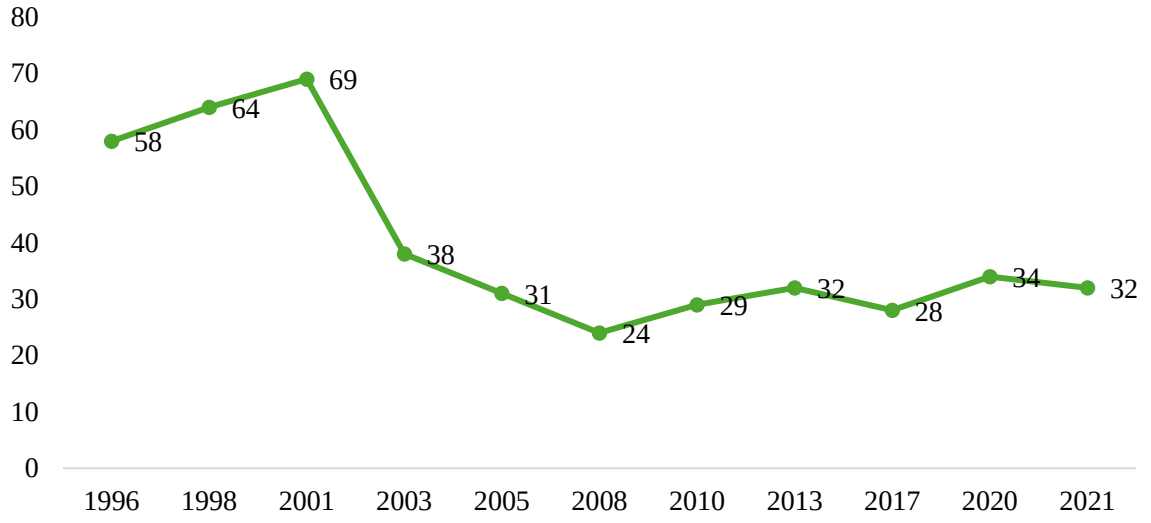


Figure 11. Dynamics of the share of imports of information and communication technology services to total imports of services in Ukraine, %

Source: constructed by the authors based on [16]

Thus, the structure of Ukraine's GDP in the analysed period is characterised by a decrease in the share of material production and an increase in the role of the service sector. Despite the military challenges, Ukraine demonstrates one of the highest rates of development of the IT sector in Eastern Europe, which indicates the presence of powerful human capital and technological potential.

In further research, it is advisable to analyse the relationship between the level of digitalisation and the effectiveness of economic recovery, as well as compare the contribution of Ukraine's digital sector with global indicators of digital GDP. The comparative analysis is presented in Figure 12.

The analysis of the presented data indicates a steady trend of growth of the share of the digital economy in the GDP structure of most European countries over the past decade. The graph shows the dynamics of the digital sector (as a percentage of GDP) in a sample of more than twenty EU countries and the United Kingdom for the period 2011–2022. Almost all countries demonstrate a positive trajectory, consistent with the global processes of digital transformation, automation of production, expansion of the digital services market and e-commerce.

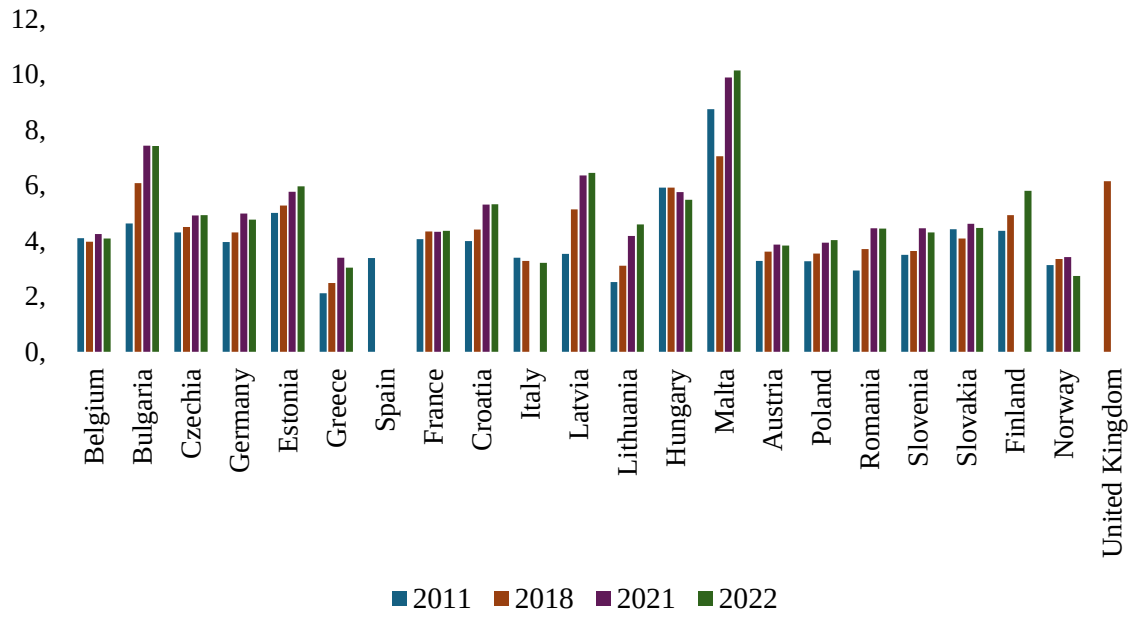


Figure 12. Share of the IT sector in GDP, % of GDP

Source: constructed by the authors based on [17]

In 2011, the share of the digital economy was on average 3–4% of GDP, while by 2022 this figure had doubled in most countries. The largest growth is observed in Austria, Estonia, Norway and Malta, where the digital sector exceeded 8–10% of GDP, which indicates a high level of technological maturity and significant investments in the ICT sector. Particularly illustrative are the examples of Malta and Austria, which, thanks to the development of fintech, e-government and a high share of digital services in GDP, have approached the level of advanced economies of Western Europe.

Scandinavian countries (Norway, Finland) traditionally demonstrate high indicators of digital inclusion, digital infrastructure and the use of technology in the public sector. Their experience confirms the interdependence between digitalisation, innovative activity and labour productivity. At the same time, Central and Eastern European countries (Bulgaria, Romania, Croatia, Hungary, Poland, Slovakia) are

moving towards convergence, gradually reducing the gap thanks to investments in telecommunications infrastructure, the development of IT outsourcing and digital education.

Western European countries (Germany, France, Italy, Spain) demonstrate stable, albeit more moderate, growth of the digital sector. In these countries, digitalisation is mainly driven by industrial modernisation (Industry 4.0), investments in artificial intelligence, cloud services and cybersecurity. For example, in Germany, the share of the digital economy has increased from about 4% in 2011 to almost 6% in 2022, which corresponds to the gradual transition to the "smart industry" model.

Chapter 4. Human capital and digital skills as a factor in the development of the digital economy

The pan-European trend confirms that the digital sector is becoming one of the key drivers of economic growth. It provides increased productivity, creates new jobs in the IT sector, strengthens innovation potential and contributes to the integration of national economies into global digital value chains.

Against this background, Ukraine is gradually integrating into the pan-European digital space. Although the official share of the digital sector in Ukraine's GDP is still lower – estimated at 5–6% in 2023 – its growth rates significantly exceed the European average. The development of IT exports, startup ecosystems, and the introduction of digital government services (Diia, electronic document management, and e-services) create the basis for rapid catch-up development [18]. The Ukrainian IT sector already generates over 4% of GDP and is one of the few that has maintained and even increased its volume during the war period.

Thus, an analysis of the dynamics of the digital economy in European countries shows that Ukraine is in a phase of active convergence with the European model of digitalisation, is characterised by high growth rates of digital services and technological infrastructure, but still needs structural modernisation of the industrial sector and increased digital literacy of the population. Further comparison of digital indicators will allow us to determine how effectively the Ukrainian economy is adapting to the global digital transformation and what policies can accelerate integration into the EU single digital market.

To specify these conclusions at the level of household behaviour, let us turn to indicators of digital participation of the population. They reflect not only the availability of infrastructure, but also the ability of users to integrate digital services into daily practices.

Analysis of the presented graph (Figure 13), which reflects the dynamics of the spread of basic and advanced digital skills among the population of European countries in 2013–2021, allows us to trace profound shifts in the development of human capital as a key element of the digital economy. Digital skills in the context of this indicator are understood as the ability of users to effectively use information and communication technologies for work, study, communication and receiving public services. The level of digital competence determines society's ability to adapt to digital transformation processes, increase labour productivity and create added value in the digital environment.

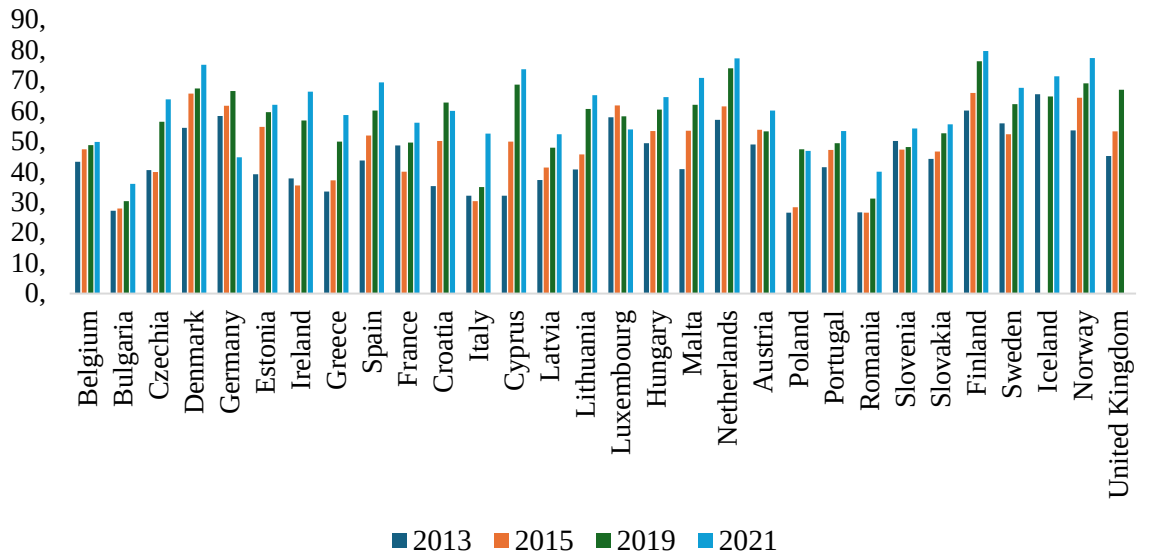


Figure 13. Percentage of Internet banking users, % of users

Source: constructed by the authors based on [13]

The data demonstrate a pan-European trend of sustainable growth in the digital skills of the population, especially after 2015. If the average level of basic digital skills in EU countries fluctuated within 40–50% of the population in 2013, then this indicator exceeded 60% in 2021. The highest results were recorded in the Scandinavian countries – Finland, Sweden, Denmark and Norway, where the share of the population with developed digital competencies is approaching 80–85%. This indicates a systematic approach to the development of digital education, inclusion and wide coverage of ICT in everyday life, education and the public sector.

Western European countries (Germany, the Netherlands, Belgium, France, Austria) demonstrate consistently high results – 60–70% of the population has digital skills at a level sufficient for active participation in the digital economy. These countries implement state digital literacy programs, support lifelong learning, and integrate digital technologies into education, medicine and management.

In contrast, Central and South-Eastern Europe (Romania, Bulgaria, Hungary, Croatia, Poland, Latvia) show lower levels of digital competences – from 30 to 50%, but their growth rates are the highest in Europe. These countries are actively developing digital infrastructure but still face barriers of uneven access to ICT between cities and rural areas, as well as limited opportunities for formal digital education for the older generation.

Conclusions

The growth of the population's digital skills is directly correlated with the expansion of the digital economy's share in GDP, which confirms the data of the previous analysis. In countries with a high level of digital literacy (Finland, Sweden, the Netherlands, Denmark, Austria), the digital sector generates more than 8–10% of GDP, while in countries with a lower level of digital competence, this figure is only 3–5%. Thus, the development of human capital is a determining factor not only for

technological progress but also for sustainable economic growth in general. In this context, Ukraine demonstrates significant progress in increasing the digital literacy of the population, especially in the period 2019–2023, when the national project "Action. Digital Education" and several digital skills training programs for citizens, civil servants and entrepreneurs were implemented [19]. According to the Ministry of Digital Transformation, by 2023, more than 60% of the adult population will have basic digital skills, bringing Ukraine closer to the average European indicators [20]. At the same time, there is a gap in access to digital education between regions and age groups.

A comparison with European trends shows that Ukraine is going through a stage of active digital socialisation, when the key task is technical equipment and the formation of digital culture and competencies. Strengthening human capital in the digital sphere determines the country's potential in innovation, startups, e-government and integration into the EU Single Digital Market. Therefore, the development of the population's digital skills is a critical factor in increasing the competitiveness of the Ukrainian economy and accelerating its transition to a post-industrial model focused on knowledge, technology and information resources.

Thus, the digitalisation of the Ukrainian economy is gradually becoming a system-forming factor in development, combining technological, social and institutional changes. It not only transforms traditional business models, but also forms a new architecture of economic relations, in which data, innovation and human capital act as key resources for growth. Digital technologies have become a catalyst for updating management processes, increasing the transparency of economic operations and creating new market niches, which contribute to the formation of competitive advantages even in conditions of military challenges.

Increasing the digital literacy of the population, developing ICT infrastructure and expanding access to electronic services form the basis for Ukraine's transition to a knowledge economy. This process, however, requires consistent state policy aimed at reducing the digital divide between regions, supporting innovative enterprises, modernising education and stimulating private investment in the technological sphere. Special attention should be paid to the development of human capital - it is he who is the main carrier of digital competencies, without which the effective use of technological advantages is impossible.

In general, digitalisation appears not as a narrow technological phenomenon, but as a strategic transformation of the entire economic system. Its success is determined not only by the availability of technical tools, but also by the ability of the state, business and society to adapt to the new digital paradigm. Ukraine has already made significant progress in this direction, demonstrating an increase in the share of the IT sector in GDP, increased exports of ICT services and an increase in the digital competence of the population. Further deepening of these processes will be the key to Ukraine's integration into the European digital space and increasing its role in the global digital economy.

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