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## CHAPTER 6

# Digital transformation of the national economy in the context of information environment development in Ukraine

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### Abstract

This study is dedicated to defining the conceptual foundations of digital transformation in economic systems and the specifics of digital economy development in Ukraine amid an evolving information environment. It is substantiated that the integration of modern information technologies and digital innovations across all economic sectors lays the groundwork for establishing a new type of economic environment where information becomes a key resource. The study demonstrates that the technological-singularity vector of development, which reflects the increasing importance of information as a critically important productive resource, is the conceptual foundation for the digital transformation of the national economic system. An analysis was conducted on the intensity of digital transformation in the economies of European Union member countries and Ukraine. Based on the obtained data, it is shown that digitalization is a critical condition for global economic competitiveness and stability. This trend emphasizes the importance of investing in the development of information and communication technologies, infrastructure, and digital innovations as key drivers of further economic growth. An analysis of gross value-added formation across types of economic activities in Ukraine reveals an increasing share in sectors fundamental to the digital transformation of the national economy, particularly in the information and telecommunications sectors. The study proves that the digital sector also serves as an essential tool for reducing the shadow economy and corruption risks. The importance of information security in the context of digital economy development is highlighted. The study outlines prospects for the digital transformation of Ukraine's economy amid growing risks and threats in cyberspace.

### **Keywords**

Digitalization, economic system, digital economy, information asymmetry, information security, sectoral structure of the economy, IT sector, business, shadow economy, corruption risks.

## **6.1 Introduction**

Current trends in the development of the information environment are closely linked to the gradual establishment of the digital economy, which defines the vector of economic growth for leading countries around the world. The digital economy has become a key direction of strategic development, contributing to the formation of a digital society and the integration of security aspects into information and economic processes at all levels of management – from macro to micro levels. This approach necessitates the modernization of management systems and the implementation of qualitatively new methods for monitoring and analyzing economic processes to ensure stable growth.

The digital economy is based on the utilization of digital data as a primary production resource, which enhances the efficiency, productivity, and competitiveness of goods and services. The use of data as a resource factor transforms the core processes of economic activity, enabling the creation of new types of services and improving the quality of life for the population. Information and communication technologies, along with artificial intelligence, have become the main drivers of economic development, facilitating the transition to a knowledge economy and increasing the adaptability of society to new conditions.

Digital transformation of the economy encompasses not only the implementation of digital technologies but also changes in the approaches to utilizing information resources across all sectors of activity. From the social sphere to industry and the financial sector, digitalization fosters profound changes in the structure of economic relations and creates prerequisites for building a society with a new quality of life, where technology serves as the foundation for socio-economic development.

The integration of digital tools into the economy enables countries to strengthen their positions amid globalization, ensuring sustainable development and enhancing competitive advantages in the global market.

In light of the above, the relevance of studying the processes of digital transformation of the national economy in the context of the development of the information environment in Ukraine is undeniable.

## 6.2 Conceptual framework for the digital transformation of economic systems

Digitalization encompasses all spheres of economic activity, significantly impacting both the global economy and national economic systems [1]. The effects of implementing information and communication technologies (ICT) at the macro level are manifested through the creation of added value for economic sectors and social spheres, while at the micro level, it results in innovative products and services with enhanced profitability and quality [2]. The introduction of digital technologies not only accelerates the process of developing ideas until the finished product reaches the market but also ensures increased economic efficiency and sustainable competitive advantages for the country on the international stage.

Moreover, digitalization serves not only as a tool for achieving national economic interests but also as a powerful factor in strengthening the economic security of the state. It can create new opportunities for economic development and ensure an adequate level of protection for the country's economic resources. However, digitalization also brings new challenges and threats, such as cybercrime and cyberattacks, which are characterized by rapid growth in contemporary conditions [3]. Their negative impact on economic indicators, infrastructure, and social security aspects is becoming increasingly significant, leading to considerable financial losses in the global economy.

Amid the intensifying processes of digitalization, significant transformational changes have occurred in the structure of the economy and productive forces. Information, which traditionally served as one of the key resources in economic systems, has now evolved into a fundamental productive force, reshaping the way economic activities are conducted and driving innovation across various sectors. In contemporary conditions, information holds a status equal to that of primary factors of production – land, labor, and capital – highlighting its critical importance in fostering new economic opportunities and enhancing productivity. This shift emphasizes the evolving role of information, not merely as a supportive element but as a primary driver of economic growth and competitiveness. In this context, the ability to effectively gather, analyze, and utilize information becomes a key determinant of success in the modern economy.

From an economic perspective, information functions as a dominant production factor that encompasses a wide array of functions beyond simple data exchange. It comprises a complex mix of data, knowledge, and insights that are essential for understanding and managing economic processes. This includes the production, distribution, exchange, and consumption of both tangible and intangible goods. Economic

agents – ranging from small businesses to large corporations – rely on information not only to navigate market dynamics but also to make strategic decisions that optimize production processes, enhance efficiency, and secure competitive advantages.

The ability to harness information effectively allows firms to respond rapidly to changes in market conditions, consumer preferences, and technological advancements. Furthermore, the role of information is crucial in facilitating innovation, as it enables businesses to identify trends, anticipate challenges, and develop new products and services tailored to the evolving needs of the market. In this way, information serves as a catalyst for innovation, driving the development of novel solutions that can lead to increased profitability and market share. The universality of information is evident in its capacity to function simultaneously as both a means and an object of labor. This duality makes information an integral component of every production process, permeating all aspects of resource management and business operations. By integrating information into decision-making processes, organizations can enhance their operational efficiency and improve overall performance [4].

Moreover, the advent of digital technologies has further amplified the significance of information. The proliferation of big data, artificial intelligence, and machine learning enables businesses to analyze vast amounts of information swiftly, leading to more accurate forecasts and informed strategic planning. As a result, companies that can leverage information effectively gain a significant edge over their competitors, positioning themselves as leaders in their respective industries.

In summary, the transformation of information from a mere resource to a pivotal productive force reflects the broader shifts in the economic landscape driven by digitalization. As economies continue to evolve, the ability to effectively manage and utilize information will be paramount for achieving sustainable growth, fostering innovation, and maintaining competitiveness in an increasingly interconnected global marketplace.

The modern economic system, dependent on technological development, increasingly relies on information resources that allow for the rapid processing of large volumes of data, enabling the forecasting of market trends and adaptation to changes in market conditions. Technological progress and the development of integrated information solutions create opportunities for building economic models where information serves as a foundation for strategic management, accelerating the innovation process, and enhancing the overall efficiency of production systems. This requires continuous improvement of information support tools to ensure the relevance, accessibility, and usefulness of information resources.

Information, as an economic factor, possesses unique properties that distinguish it from traditional resources such as labor, land, and capital. It combines

characteristics of both scarcity and abundance, limitation and inexhaustibility, which makes it particularly significant in the context of the modern market [5, 6]. The scarcity of information is determined by its significance and utility to specific categories of consumers; for individual economic entities, possessing certain information can be crucial, providing them with competitive advantages. At the same time, information has the potential for widespread dissemination due to digital technologies, which ensure its accessibility to a broad range of users.

A distinctive property of information lies in its inexhaustibility during repeated use: unlike traditional resources, information does not lose its essence or volume when transmitted or exchanged. It is not subject to physical wear; however, it can lose its economic value if it becomes less relevant, obsolete, or no longer applicable due to changes in market conditions when certain data can no longer be effectively utilized. Therefore, information requires constant updating to remain a valuable resource, and its relevance depends on changes in the external environment and the ability of economic agents to adapt it to new conditions.

Overall, the significance of information in the modern economy is important not only because of its properties as a resource but also due to its strategic role in supporting economic development, achieving efficiency in production systems, and forming competitive advantages for business entities [7, 8].

The increasing significance of information in economic processes has contributed to the development of a new stream of economic theory that focuses on studying the phenomenon of information inequality, or "asymmetric information", and its impact on the functioning of economic systems. This direction contrasts with traditional neoclassical theory, which assumed that economic agents, having access to complete information, are capable of making rational decisions that ensure maximum efficiency in the functioning of the economy [9, 10]. Research within the theory of "asymmetric information", conducted by scholars such as G. Akerlof, M. Spence and J. Stiglitz [11–14], has demonstrated that under modern conditions, economic agents possess varying levels of awareness regarding market conditions, which can lead to significant deviations from optimal behavior and even hinder the development of the economic system.

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The founders of the theory of information asymmetry have developed models of market equilibrium that account for different access to information and emphasize the importance of information in ensuring the sustainable functioning of various markets – from the agricultural sector to financial institutions. These models have shown that economic efficiency largely depends on the level of awareness among economic agents: insufficient or distorted information leads to disruptions in market mechanisms, and asymmetry among participants in economic relations becomes one of the causes of low productivity and the absence of equilibrium in the market.

Researchers argue that by implementing mechanisms that reduce information inequality, it is possible to significantly enhance market self-regulation, which underscores the importance of government intervention [15] in ensuring the availability and accuracy of information. Addressing information asymmetry can lead to improved trust among market participants. When consumers and producers have reliable access to information, it encourages informed decision-making, reducing the likelihood of market failures and promoting a healthier economic climate. This is particularly crucial in sectors where trust is paramount, such as finance and healthcare, where misinformation can have dire consequences. The exploration of information asymmetry not only enriches our understanding of economic behavior but also underscores the vital need for robust information management strategies. By prioritizing the reduction of information inequality, policymakers can create a more equitable and efficient economic landscape, driving sustainable growth and improving overall welfare in society.

In this context, establishing effective information flows that reflect the transfer and exchange of data between economic entities is extremely important. The circulation of information within the economic system creates an information exchange that directly impacts the level of information asymmetry. This issue highlights the necessity of implementing mechanisms to ensure the reliability, accessibility, and integrity of information resources, as well as to protect the information environment from potential risks and threats [16, 17]. Information asymmetry can be reduced through accessible channels for information exchange, which is a task for government policy aimed at supporting the effectiveness of market processes by creating transparent and reliable conditions for communication within the economic system [18].

The integration of modern information technologies and digital innovations into all sectors of the economy lays the foundation for the creation of a new type

of economic environment where information becomes a key resource [19]. This shapes the information environment as an organic component of the economic system, in which production, distribution, and exchange processes increasingly rely on quick access to data, technological solutions, and analytics. This approach leads to the formation of a new structure of the national economy, focused on utilizing knowledge and digital resources to enhance competitiveness and resilience. In the context of the growing importance of information, it serves as a primary factor of production that ensures the dynamism of economic processes and facilitates the transition to a knowledge economy, where innovations and digital solutions become the basis for economic development [20].

The conceptual vision of the national economic system is increasingly based on the techno-singularity vector of its development, reflecting the growing importance of information as a critically important production resource. This not only contributes to an increased share of the information and communication technology sector in GDP but also fosters the formation of a global information space that ensures effective interaction among economic entities at the international level. Information serves as the foundation for developing strategic, tactical, and operational goals for economic development, implementing them at all levels – from macro and meso levels to micro and nano levels.

### **6.3 Development of the information environment and formation of the digital economy in Ukraine**

The digital information environment is a crucial factor in forming competitive advantages, contributing to the innovative development of economic systems in various countries. Currently, the digital economy accounts for a significant share of global GDP – estimated to be between 15.5 % and 17.5 %. Notably, nearly 40 % of the added value generated by the global information and communication technology sector comes from leading economies, such as the USA and China. It is expected that by 2030, the share of the digital economy in the overall GDP of the world's largest economies will reach 50–60 % [21, 22].

The rapid growth of digital economy indicators demonstrates the dynamics of a global transition to an innovative economic model. Specifically, in 2018, the share of global GDP created by digitalized enterprises was valued at 13.5 trillion USD. It is projected that by the end of 2023, this figure could quadruple, reaching approximately 53.3 trillion USD, which would account for over half of the nominal volume of global GDP. This indicates significant changes in the economic environment, where

digitalization is becoming not only an important tool for enhancing business efficiency but also a critical condition for global economic competitiveness and stability [23, 24].

This trend emphasizes the importance of investing in the development of information and communication technologies, infrastructure, and digital innovations as key factors for further economic growth (Fig. 6.1).

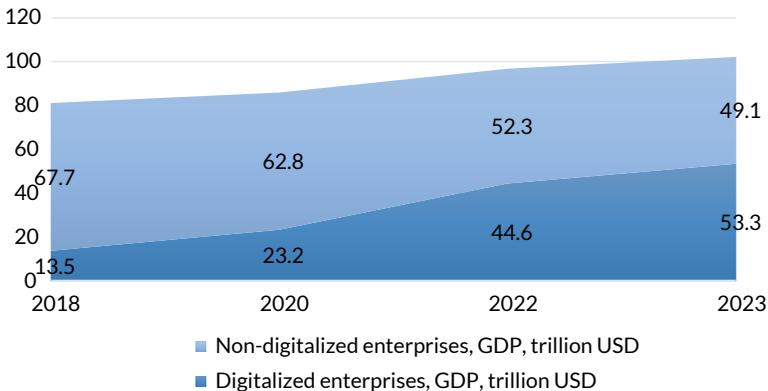


Fig. 6.1 Volume of products from digitalized and non-digitalized enterprises in global GDP  
Source: compiled by the authors based on data [23]

The International Digital Economy and Society Index (I-DESI) is one of the key indicators for assessing the level of digital economy development on the international stage. It is based on an analysis of digital performance indicators for EU member countries and an additional 19 countries worldwide, including Australia, Israel, Japan, the United States, the United Kingdom, South Korea, Canada, Turkey, and others [25]. This index allows tracking countries' progress in digitalization and identifying key areas for digital economy development.

According to the I-DESI results for 2022, five EU countries ranked among the top ten leaders, taking leading positions in the rating. In this context, Denmark became the most digitally developed country in the EU, confirming its leadership as indicated by the internal DESI score for 2021. Among non-EU countries, Iceland topped the ranking, showing high levels of digital readiness and performance. Overall, the average I-DESI scores remain higher for some countries outside the EU, indicating increased global competition in the field of digital economy.

The I-DESI ranking reflects not only the level of digital infrastructure development but also shows how effectively countries implement digital technologies to improve citizens' quality of life, support economic growth, and enhance

competitiveness in the international market. The index serves as an important benchmark for policy development in the field of digital transformation, promoting the exchange of best practices among countries.

At the European Union level, the Digital Economy and Society Index (DESI) is calculated [26], serving as one of the primary tools for assessing digital transformation and competitiveness among EU member states. DESI is a composite index that combines various indicators of digital performance, including the level of digital infrastructure development, access to high-speed internet, digital skills of the population, the degree of digital technology integration in business, and the development of e-government services. This enables not only a comparative analysis of digital readiness across EU countries but also the monitoring of digital economy progress at both national and EU-wide levels.

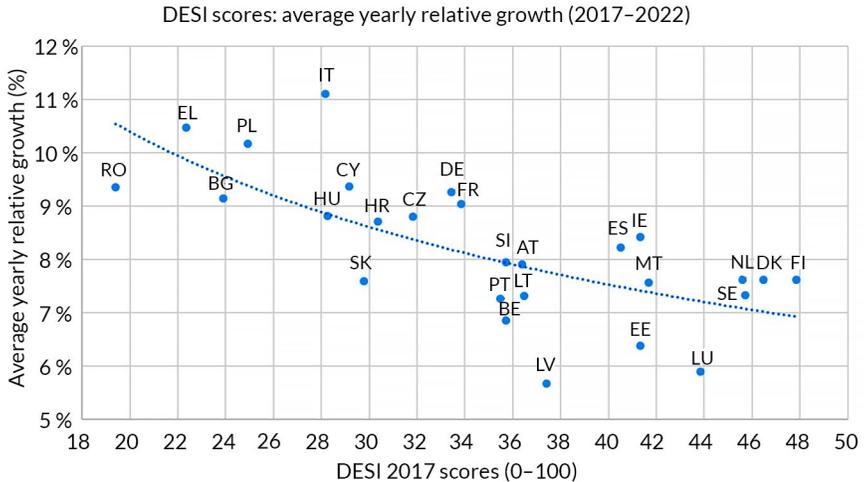
DESI also provides data that allow for an assessment of the strengths and weaknesses of EU member states in digital transformation, identifying areas that require additional investment or reform. For instance, countries with a high level of infrastructure might need to improve the digital skills of their population, while countries that already have a high level of digital competencies among citizens may focus on expanding e-government services. This facilitates the development of national digital transformation strategies aimed at achieving the EU's long-term goals of enhancing its global competitiveness and ensuring sustainable economic growth through innovative technologies [27].

**Fig. 6.2** illustrates the progress of EU member states in the digitalization of the economy and society over the past five years. For each country it shows the relationship between DESI scores for 2017 (horizontal axis) and the average annual growth rate of this index from 2017 to 2022 (vertical axis). Similar to the classical theory of economic growth, a convergence phenomenon can be observed: countries with lower initial levels of digital development exhibit higher growth rates, as represented on the left side of the chart.

The graph clearly illustrates the overall convergence trend among EU countries between 2017 and 2022. The blue line on the graph represents the predicted convergence model, indicating the expected growth rates of countries based on their initial scores. Countries located above the blue line showed growth that exceeded the expected values according to the convergence model, highlighting their substantial progress in the digital sector. Conversely, countries below this line experienced growth lower than the predicted rates, which may indicate a lag in digitalization compared to average expectations.

This analysis not only demonstrates the intensity of digital transformation in individual countries but also reveals the general dynamics that contribute to the con-

vergence of EU member states in the field of digital development, ensuring more equitable opportunities for further economic growth within the European Union.



**Fig. 6.2** Digital economy and society index – member states' relative progress in the period 2017-2022  
 Source: [26]

Given current trends in global development, it is important to note that developed countries have a significant advantage over developing countries in terms of cybersecurity and digital economy indicators. This observation is supported by correlational studies that demonstrate that the security of digital systems, as well as the transparency of digital actors, particularly in the context of data use, play a crucial role in the diffusion of technology in society [28]. For example, e-government, which relies on effective interaction between the state and citizens, requires a high level of trust and information security.

In this context, addressing cybersecurity issues becomes not only important, but also necessary to facilitate the active use of e-participation resources. E-participation is an important component of the democratic process, as it provides citizens with the opportunity to participate in decision-making, which, in turn, increases the level of social awareness and activity [29]. Thus, the successful implementation of e-services directly depends on the state of cybersecurity, which emphasizes the importance of integrating security aspects into all stages of digitalization [30, 31].

In Ukraine, unfortunately, there is a significant shortage of models that could adequately assess the economic impact of information and communication technologies (ICT) on various sectors of the national economy. For example, 2018 data show that the total consumption of ICT equipment and services in Ukraine amounted to approximately 1.5 billion USD, which is significantly lower than in Poland, where it amounted to 6.5 billion USD [32]. This difference in consumption indicates that Ukraine is lagging behind in terms of digitalization, which may be due to a number of factors, including insufficient investment activity, limited access to the latest technologies, and insufficient training.

This low level of consumption of ICT products and services also indicates limited opportunities for the country's modernization, innovation and competitiveness. In the context of the global economy, where digital technologies are becoming the basis for development, Ukraine needs to take urgent measures to increase the consumption of ICT products.

Given the goal of reaching a GDP of 1 trillion USD by 2030, Ukraine needs to significantly increase its consumption of ICT products [33, 34]. This can be realized, in particular, through large-scale national projects in the field of digital transformation, which will include infrastructure development, investment in new technologies, and training of personnel capable of using these technologies effectively. Only by focusing on ICT development will Ukraine be able to increase its productivity, competitiveness, and sustainability in light of the current challenges facing the country's economy (Table 6.1).

**Table 6.1 Projected indicators of economic digitalization in Ukraine**

Indicator	Year							
	2023	2024	2025	2026	2027	2028	2029	2030
Domestic market (ICT consumption), billion USD	3.0	4.5	6.0	8.0	10.0	12.0	14.0	16.0
Growth rate of ICT consumption, %	-	150.0	133.3	133.3	125.0	120.0	116.7	114.3
GDP growth rate due to economic digitalization, %	2.0	3.5	4.5	6.0	7.5	9.0	11.0	14.0
Share of the digital economy in total GDP, %	5.0	8.0	11.0	15.0	20.0	28.0	40.0	52.0

Source: summarized by the authors based on data [20, 35]

In the event of a positive scenario for the development of the digital economy, the share of the digital economy in the overall GDP will demonstrate a steady growth

trend (Fig. 6.3), reflecting the successful adaptation of Ukraine's national economy to the new conditions of the global digital environment. This transformation will not only enhance the competitiveness of the national economy but also contribute to overall economic growth and improve the quality of life for the population.

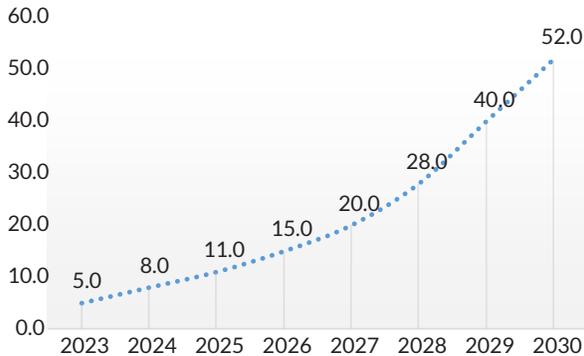


Fig. 6.3 Projected share of the digital economy in total GDP, %  
Source: compiled by the authors based on data [20]

In the modern context of economic development, information has become a key asset that shapes a new paradigm in the functioning of national economies. The informational nature of the national economy reflects significant changes in the ways of conducting business based on knowledge and emphasizes the importance of generating, processing, and effectively utilizing information to ensure competitiveness, enhance the productivity of economic entities, and ensure their financial security [36]. A key role in the informational transformation of the economy is played by the development of artificial intelligence (AI). AI enables the automation of processes for processing and analyzing large volumes of data, which, in turn, allows businesses to make informed decisions more quickly and adapt to changes in the market environment [37]. The use of machine learning algorithms and data analytics helps companies uncover hidden patterns, forecast consumer behavior, and optimize their offerings, thereby enhancing their competitiveness.

Thus, in the rapidly changing global environment, information is regarded not only as a commodity but also as a critically important economic resource. This creates added value not only at the macro level, where it shapes the overall economic potential of the country, but also at the micro level, where each specific product or service can gain increased value through the use of cutting-edge technologies and digital innovations [38].

Therefore, studying the sectoral structure of Ukraine's national economy, particularly the formation of added value in different sectors, is extremely relevant. This allows for the identification of which industries are most sensitive to the implementation of digital technologies, as well as the discovery of potential reserves for improving efficiency and productivity. According to data from the State Statistics Service of Ukraine [39], a detailed analysis can be conducted that will enable important conclusions to be drawn about the relationship between information technologies and added value in various sectors of the economy.

Analyzing the dynamics of added value formation across sectors will enable to assess not only the effectiveness of their operations but also to understand how changes in the information environment impact economic development. Sectors that actively utilize information and communication technologies may demonstrate higher rates of added value growth, indicating significant potential for development [40, 41].

An important aspect of this analysis is considering not only production indicators but also the impact of information technologies on other factors such as innovation, competitiveness, and the adaptive capacity of enterprises. This allows for the formulation of a comprehensive picture that reflects the complex interactions between information, knowledge, and economic outcomes.

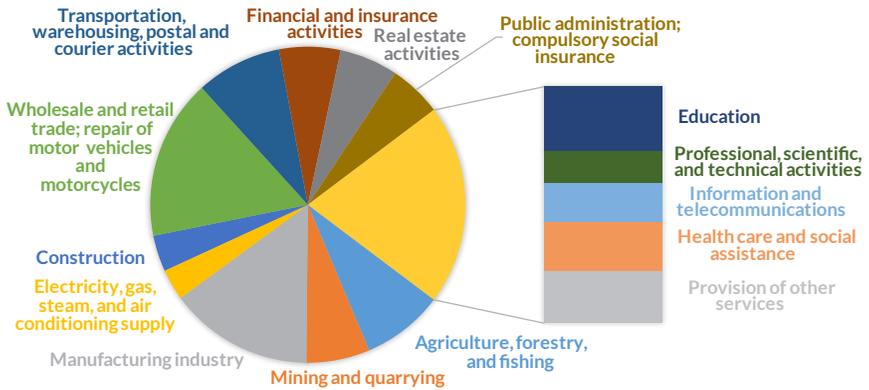
Therefore, studying the formation of added value within the sectoral structure of the Ukrainian economy is a crucial step in determining its development strategy in the context of digitalization. It provides the opportunity to evaluate the current state as well as outline prospects for further growth and development of the national economy, which is becoming increasingly dependent on the effective use of information resources. Examining the data presented in **Fig. 6.4–6.7** will allow for a comprehensive analysis and informed conclusions regarding the observed trends in various sectors of Ukraine's economy.

Structure of gross added value by types of economic activity in 2010 is shown in **Fig. 6.4**.

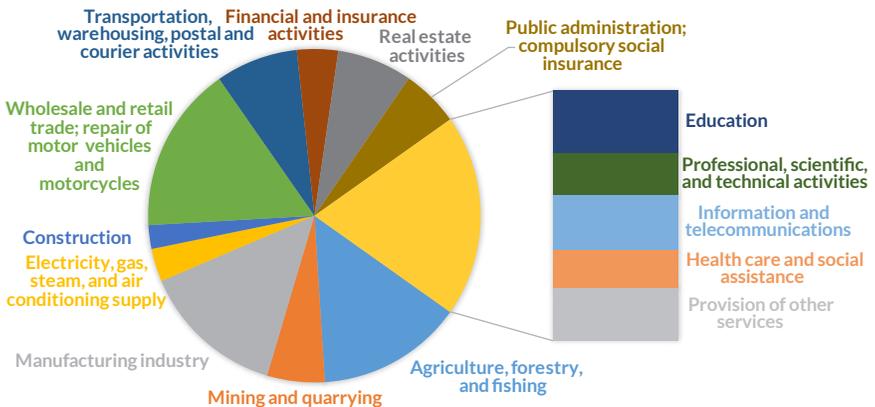
According to the presented results, in 2010 the largest contributions to the formation of gross added value in Ukraine's national economy came from the following types of economic activity: wholesale and retail trade, which accounted for 16.4 % of the total volume; manufacturing industry, which contributed 14.8 %; and transportation, warehousing, postal and courier services, which made up 8.8 %. At the same time, the information and communications sector contributed 3.4 % to the overall structure of gross added value.

Structure of gross added value by types of economic activity in 2015 is shown in **Fig. 6.5**.

## Transformations of national economies under conditions of instability



**Fig. 6.4** Structure of gross added value by types of economic activity (2010, in current prices)  
*Source: constructed by the authors based on data [42]*



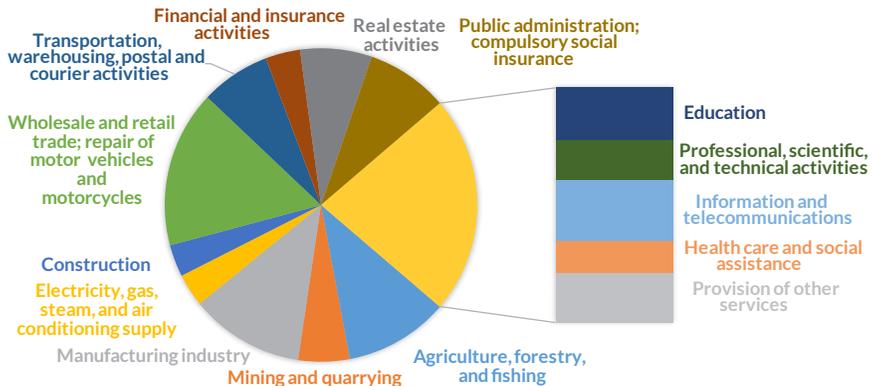
**Fig. 6.5** Structure of gross added value by types of economic activity (2015, in current prices)  
*Source: constructed by the authors based on data [42]*

Over the five years – from 2010 to 2015, there has been a significant change in the share of industries in the national economy within the structure of gross added value. In particular, wholesale and retail trade, which accounted for 16.4 % in 2010, decreased to 16.2 %, while the manufacturing industry saw its contribution drop from 14.8 % to 14.0 %. These decreases indicate certain changes in the economic dynamics of the country and may result from the adaptation of enterprises to new market conditions, as well as the influence of external factors.

At the same time, the contribution of agriculture, forestry, and fishing noticeably increased, rising from 8.4 % to 14.2 %. This can be attributed to the growing demand for agricultural products, particularly in the context of global market globalization, as well as an increase in investments in the agricultural sector. The growth of this sector indicates its potential for further development, especially regarding food security and sustainable development.

Equally important is the positive trend in the information and communications sector, whose contribution to gross added value was 4.3 %. This reflects the increasing significance of information technologies in various areas of the economy, highlighting the trend toward digitalization and the implementation of innovations.

Structure of gross added value by types of economic activity in 2020 is shown in Fig. 6.6.



**Fig. 6.6** Structure of gross added value by types of economic activity (2020, in current prices)  
*Source: constructed by the authors based on data [42]*

In 2020, another important trend emerged: the contribution of intangible capital to the formation of added value exceeded that of tangible capital. This indicates a paradigm shift in economic development, where intellectual property, brands, and technologies are becoming key assets for enterprises. The contribution of the wholesale and retail trade sector continues to lead, maintaining a share of 16.2 % in the structure of gross added value.

There is also a noticeable increase in the share of public administration, which reached 8.5 % compared to 5.6 % in 2015. This indicates a growing role of the state in economic processes and the importance of public administration in ensuring economic efficiency. All of this suggests that the modern economy of Ukraine

is undergoing structural changes that require the adaptation of development strategies to maximize the potential of sectors in light of new challenges and opportunities [43].

These changes in the structure of gross added value in Ukraine reflect the impact of new government initiatives aimed at stimulating the digitalization of the economy, which began to be implemented in 2019. The launch of the EU program "EU4Digital: Support for the Digital Economy and Society in the Eastern Partnership" has been an important step in extending the benefits of the European Union's Single Digital Market to Ukraine and other Eastern Partnership countries [44, 45]. This program aims to stimulate economic growth, create new jobs, improve the quality of life for citizens, and support businesses through the implementation of modern digital solutions.

The state has proven to be a key consumer and active user of innovations, recognizing digital transformation as a priority of national policy. The cultivation of a digital culture and the promotion of education in high-tech fields contribute to the upskilling of the workforce and the creation of a favorable environment for innovation. Important aspects include the implementation of infrastructure projects that ensure access to modern technologies for the population, such as connecting 90 % of Ukrainians to 4G mobile coverage, which significantly improves communication and access to information resources [46].

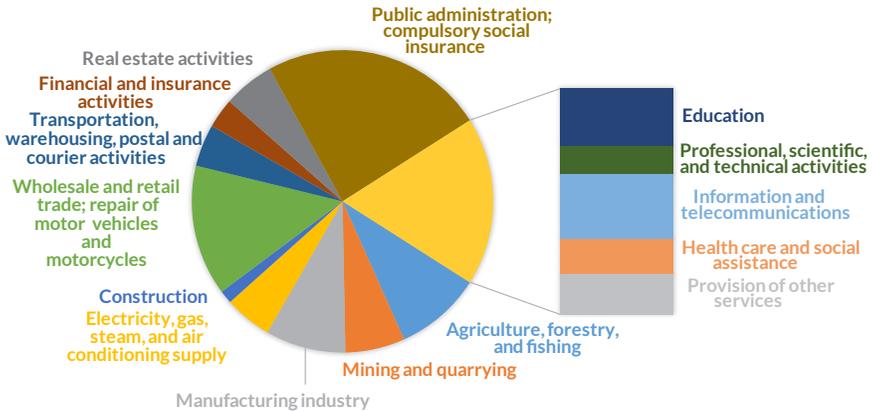
In addition, a number of digital transformation projects have been initiated and implemented, which are already actively being adopted in various sectors of the economy. For example, the "Prozorro" and "e-Health" systems have become key tools for enhancing transparency in public procurement and improving the quality of medical services, respectively, since 2020. The official launch of the "Diia" state services portal has provided citizens with convenient access to a variety of administrative services, which, in turn, contributes to reducing bureaucracy and increasing the efficiency of public administration [47].

These initiatives not only increase the level of digitalization in Ukraine but also contribute to the formation of a modern economy where information and communication technologies become the foundation for the development of various industries [48]. As a result, the country's economy gains new opportunities for innovative growth, which will undoubtedly have a positive impact on its competitiveness on the global stage.

Structure of gross added value by types of economic activity in 2022 is shown in **Fig. 6.7**.

The specifics of the presented results are undoubtedly related to the war of the Russian Federation against Ukraine, which has significantly affected the structure

of gross value added. In 2022, the largest share in this structure was occupied by the public administration and defense sector, accounting for 24 %. This figure is primarily due to the necessity of funding salaries for military personnel, which has become a priority for the state under martial law.



**Fig. 6.7** Structure of gross added value by types of economic activity (2022, in current prices)  
*Source: constructed by the authors based on data [42]*

The agriculture, forestry, and fishing sector also had a noticeable presence in the structure of gross value added, comprising 9.3 %. Although this figure is relatively high compared to similar indicators in European Union countries, it indicates a structural imbalance, as low-value-added products continue to dominate the agricultural sector. With significant competitive advantages in the agricultural field, Ukraine must focus on increasing the added value of products produced in this sector to achieve sustainable economic growth.

An analysis of real estate operations indicates that this sector does not function as a growth driver for the national economy. Despite its potential, it does not demonstrate a significant contribution to the formation of gross value added. In contrast, the information and telecommunications sector, which belongs to the innovation sector, shows steady growth in the structure of gross value added. This indicates that information and communication technologies (ICT) play an increasingly important role in shaping an economy oriented towards knowledge and innovation [49].

According to the analysis conducted, there is a noticeable increase in the share of sectors that form the foundation of a post-industrial economy and serve as the basis for the development of a digital economy. This indicates a transformation of

the national economy towards greater innovation and digitalization. The transition to a post-industrial society requires strategic resource management aimed at ensuring sustainable development through increased productivity, innovation, and the integration of digital technologies into all areas of economic activity. These changes are critically important for the recovery and further development of Ukraine's economy in the face of contemporary challenges.

Despite the full-scale war, the IT sector in Ukraine has become the only industry demonstrating positive export dynamics. Specifically, in 2022 the export revenue from IT services increased by 5.85 %, reaching 7.3 billion USD. This exceeds the figures from the previous year by 406 million USD, indicating the resilience and adaptability of the IT sector amid war and economic instability [50].

The dynamics of changes in IT exports in Ukraine during 2021–2022 underscore the importance of this sector for the national economy. This trend may be attributed to several factors, including the growing demand for Ukrainian IT services in the international market, the high quality of the services provided, and the availability of skilled personnel. The information technology sector, thanks to its flexibility, has managed to quickly adapt to new conditions, continuing to execute projects for foreign clients despite internal challenges.

It is worth noting that the IT sector not only provides stable export income but also plays a crucial role in modernizing other sectors of the economy, contributing to their digitalization and increased efficiency [51]. The trends in the development of IT exports, presented in **Fig. 6.8, 6.9**, demonstrate how this sector, even in times of war, remains a driver of economic growth and innovation in Ukraine. In the long term, supporting and developing the IT sector may become critically important for the recovery of the national economy and its integration into the global market.

As shown in the graph illustrating the quarterly dynamics of exports, the peak of IT activity was recorded just before the Russian invasion in the fourth quarter of 2021, when exports reached 2.1 billion USD. Since then, the average volumes of computer service exports have gradually decreased to 1.7 billion USD, reflecting approximately a 20 % decline in quarterly export revenue in the IT sector.

Although the sector's share in the total exports of goods and services from Ukraine has increased from 8.8 % to 13.4 % over the year and a half of war (**Fig. 6.9**), the current role of the IT sector as a driver of export growth is far from the optimistic expectations that were formed prior to the conflict.

The resilience of the digital sector in times of crisis is an important factor that determines not only the economy's operational response to challenges but also its potential for recovery. The digital economy, in particular, has the capacity to become a key factor in the resilience of the national economy and a reliable source of tax

revenues, as it demonstrates less dependence on physical assets compared to traditional sectors such as industry or agriculture.

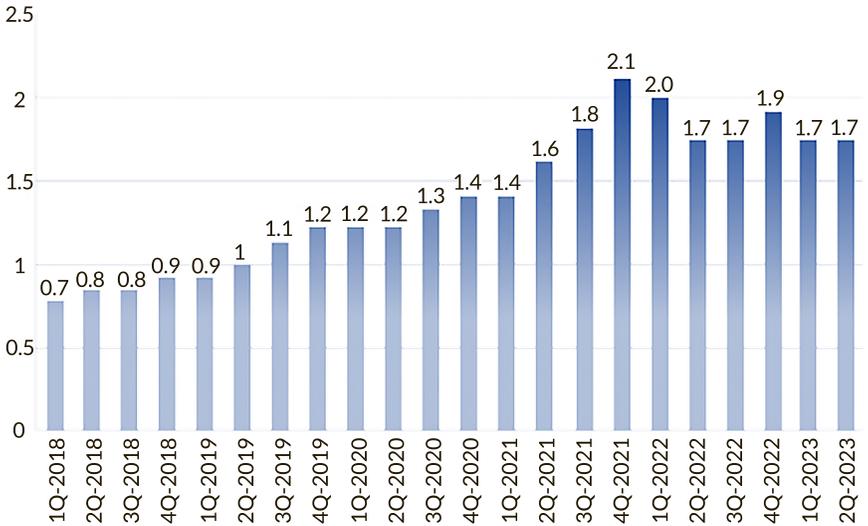


Fig. 6.8 Quarterly dynamics of IT service exports from Ukraine, billion USD  
Source: [42, 52, 53]

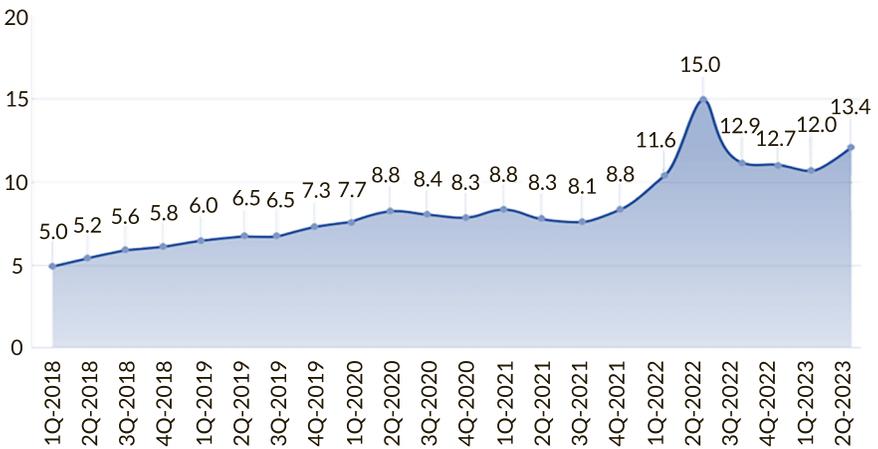
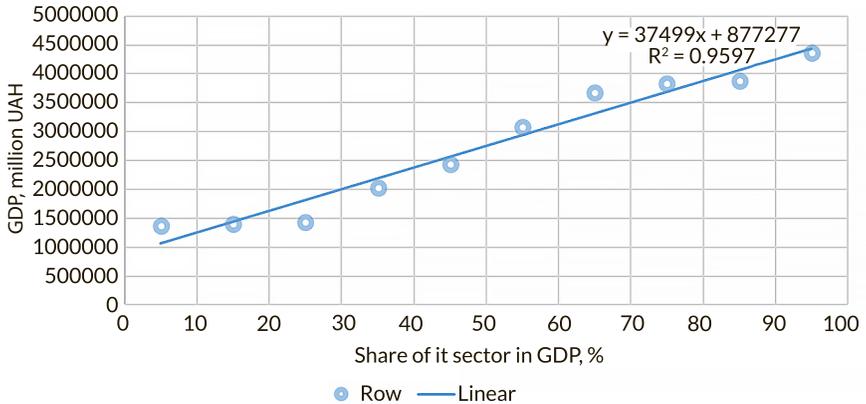


Fig. 6.9 Share of the IT sector in the structure of goods and services exports from Ukraine, %  
Source: [42, 52, 53]

The strategic importance of the IT sector for the national economy is also confirmed by the regression analysis of the relationship between Ukraine's GDP and the share of IT sector in GDP (Fig. 6.10).



**Fig. 6.10** Relationship between Ukraine's GDP and the share of IT sector in GDP  
*Source: constructed by the authors based on data [42]*

The value of the coefficient of determination  $R^2=0.9597$  indicates the high adequacy of the model for analyzing this relationship. The correlation coefficient  $r=0.846$  indicates a strong positive relationship between the share of IT sector in GDP and the overall GDP. This suggests that an increase in the share of IT sector will ensure the growth of the country's economy. The high values of these coefficients confirm the importance of the IT sector for economic development. Given global digitalization trends, investments in the IT sector can serve as a key driver of Ukraine's economic growth in the long term.

In crisis conditions, information technologies become essential for increasing the efficiency and flexibility of economic processes. The development of the IT sector not only contributes to the creation of new jobs but also stimulates innovations in other industries by implementing digital technologies that allow for production optimization, cost reduction, and improved product quality.

In addition, digital solutions can play an important role in the distribution of international aid provided to Ukraine in connection with the war and in monitoring its use. The utilization of technologies such as blockchain or e-governance platforms can reduce corruption risks by ensuring transparency and accountability in budgetary expenditures [54]. Through digitalization, citizens gain access to

information about government decisions, budgets, and expenditures in real time, which contributes to the demystification of government activities and allows society to monitor the actions of officials. The simplification of administrative procedures through digital solutions also reduces opportunities for corruption that often arise in complex bureaucratic systems. The automation of processes minimizes the human factor, which is one of the most vulnerable points for the emergence of corrupt schemes, such as bribery or nepotism. For instance, the use of online platforms for submitting tax declarations, registering businesses, and conducting public procurements eliminates the need for personal meetings, which could be exploited for corrupt agreements.

Furthermore, digital solutions enable the use of data analytics to monitor the activities of government bodies. This creates the possibility of detecting anomalies and patterns that may indicate corruption. The application of predictive analytics, for example, can reveal unusual expenditures or inefficiencies that would warrant further investigations.

E-government platforms provide citizens with direct access to public services, such as permits, licenses, and social services. This reduces dependence on intermediaries who may abuse their positions to gain corrupt benefits. Direct interaction between the government and society fosters a culture of integrity and trust. Additionally, digitalization may include feedback mechanisms that allow citizens to anonymously report cases of corruption or inefficiency. This encourages active citizen participation in governance and ensures a sense of security for those who voice their concerns.

Finally, the implementation of digital solutions in accordance with international standards can enhance the country's authority on the international stage and attract foreign investment. Investors generally prefer governments that demonstrate a commitment to transparency and anti-corruption measures. Therefore, the digitalization of public administration not only optimizes processes but also fundamentally changes the relationship between the government and citizens. By promoting transparency and accountability, it reduces opportunities for corruption and fosters a more reliable and efficient governance system. This transformation is essential for ensuring effective management of the national economy and sustainable societal development.

Thus, the digital economy not only ensures resilience in crisis conditions but can also serve as a foundation for the transformation of the national economy, creating new opportunities for growth and development. In the face of the ongoing challenges posed by the war, it is precisely information technology that can become a catalyst for recovery and stability in the future.

#### **6.4 Prospects for digital transformation of Ukraine's economy amid deepening risks and cyber threats**

Despite the challenges posed by the war, Ukraine is actively developing its digital economy, aiming to integrate into the European Union's Single Digital Market. This process involves removing barriers and establishing common rules for online services in the areas of digital marketing, telecommunications, and e-commerce, as well as enhancing the level of cybersecurity for networks and information systems. According to estimates from leading domestic economists, integration into the EU's Single Digital Market could lead to a GDP growth of up to 12 % for Ukraine, with the export of goods to EU member states increasing by up to 17 % and services by up to 12.2 % [55, 56]. Thus, Ukraine's accession to the EU markets would not only facilitate the eurointegration processes but also bring significant economic advantages, enhancing the competitiveness and innovative potential of the national economy.

However, in the current context of digitalizing the national economy, information can sometimes take on a dangerous significance, as the emergence of new technologies brings about increased risks of information and hybrid threats. This is manifested in the ability of information not only to foster development but also to become a tool for destabilization, particularly during information attacks that can lead to the disorganization of government systems, the collapse of financial structures, technological disasters, and even the outbreak of armed conflicts [57]. For example, the military aggression of the Russian Federation against Ukraine is accompanied by a large-scale information war, which causes significant harm to the national economy and society, often comparable in scale to the damage from combat actions.

In the context of armed confrontation and external aggression, the national economy requires a clear operational strategy based on the principles of information security. This necessitates the creation and maintenance of an information infrastructure capable of withstanding external information attacks and ensuring the continuous operation of key economic and governmental institutions. A critical task becomes the integration of information protection systems into all areas of economic management, which contributes not only to ensuring stability but also to forming a resilient economic system capable of adapting to new challenges.

Consequently, an important condition for successful digital transformation is the provision of cybersecurity at all levels, from government bodies to the private sector. This includes implementing modern information protection systems, training personnel in the fundamentals of cyber hygiene, and developing a national cybersecurity strategy that meets international standards. It is also necessary to develop infrastructure to support digital technologies. This includes expanding access to

high-speed internet, developing e-government platforms, and investing in cutting-edge technologies such as artificial intelligence, blockchain, and big data [58]. These technologies can help optimize business processes and enhance the effectiveness of government management.

Furthermore, the digital transformation of Ukraine's national economy should be accompanied by the active involvement of all participants in the process, including the government, businesses, and society. This will create conditions for forming a culture of digitalization, where information technologies are used to enhance transparency, accountability, and trust among all parties.

On the other hand, Ukraine should take into account international experience and adapt best practices in the fields of digitalization and cybersecurity. Cooperation with international organizations, such as NATO, the European Union, and other entities, can help strengthen national security and improve the country's technological base.

Thus, the digital transformation of Ukraine's economy has enormous potential for creating new opportunities for growth and development; however, it requires a systematic approach to ensuring cybersecurity and effectively managing risks. Only through a comprehensive resolution of these issues can we hope for a successful integration of Ukraine into the global digital economy.

## 6.5 Conclusions

Given that digitalization processes are a key factor in the development of the national economy in current conditions, this section substantiates the conceptual foundations of the digital transformation of economic systems and the features of forming a digital economy in Ukraine. In Ukraine, as in many other countries, digitalization has become not only a catalyst for economic growth but also a crucial factor in enhancing the resilience of the national economy to crises. Observed correlations between the level of digital sector development and the economy's ability to withstand external and internal challenges indicate the high adaptability and efficiency of digital solutions. These solutions ensure economic flexibility, enabling companies to quickly switch to remote work, automate processes, and minimize dependency on physical assets, which is especially valuable during periods of instability.

The conducted research demonstrates current trends and dynamics in the development of the information environment both in Ukraine and globally, highlighting the deep penetration of digital technologies into various sectors of economic activity and their contribution to GDP formation. Analysis of the formation of gross value

added by types of economic activity from 2010 to 2022 confirms that the advent of Industry 4.0 and the adoption of Industry 5.0 principles have fundamentally changed the structure of the national economy. Growth has been observed in sectors that constitute the foundation of a post-industrial economy and are the basis for digital economic development, particularly in the information and telecommunications sectors.

It has been proven that the digital sector also plays an essential role as a tool in reducing the shadow economy and corruption risks. The use of digital platforms and solutions, such as electronic document management, state registries, and expenditure monitoring platforms, significantly limits opportunities for shadow operations, making economic activities more transparent and accountable. The effective integration of digital solutions in public administration and the corporate sector contributes to increased trust in government institutions and fosters a culture of transparency.

It is substantiated that despite the significant advantages of digitalization, Ukraine's national information environment faces new security challenges driven by the active development of technologies and the growing threats in cyberspace. Traditional threats, such as industrial espionage, commercial secrets leaks, and unintentional disclosure of confidential information, are intensified by new types of cyber risks. Improvements in information systems and their expanded accessibility make them potential targets for cyber-attacks, which can have serious consequences for the economy and national security. Specifically, cyber-attacks aimed at disrupting the integrity of databases can lead to the loss of critical data, reduced trust in government structures, and undermining economic stability. This underscores the need for a comprehensive cybersecurity strategy that will include not only protective technological solutions but also the development of early warning systems, increased public awareness, and constant threat monitoring.

Thus, digital transformation requires an approach that simultaneously encompasses economic, informational, and security components to minimize risks and ensure long-term stability. This approach enables not only the strengthening of economic resilience but also creates opportunities to enhance Ukraine's competitiveness on the international stage, where maintaining high cybersecurity standards becomes one of the key factors for integration into global digital markets.

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