1 The dimensions of the digital economy and society

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1.1 Introduction

The Organisation for Economic Co-operation and Development (OECD, 2020) defines the digital economy as an economic structure wherein data is a factor of production. Enterprises in this type of economy rely on digital data and its processing and use in creating value-added services. The development of the digital economy is driven by the transformation of traditional economy and the rise of the information society. Thus, the changes observed at present give reasons to propose a hypothesis about a change to the structure of mature economies where traditional resources and factors of production are being replaced by their digital equivalents (see: Nazarov et al., 2019). The increase in computer usage and the third industrial revolution initiated the production of digital data. Its exponential growth entails the need to have it systematized, stored and processed. It provides a basis for developing digital technologies (such as the Internet of Things), resulting in changes to data archiving models, data protection or broadly to the functioning of various types of organizations.

This chapter is aimed to formulate a conceptual framework for the present book. The framework consists of four aspects of the digital economy, namely, the economic dimension (a change in the nature of resources, factors of production and economic management), the technological dimension (technical progress from a macroeconomic perspective vs. technology innovation from a microeconomic perspective), the regulatory dimension (challenges to regulators) and the social dimension (a change in the functioning of society, in the approach to labour and interpersonal relationships). This chapter presents successively: a brief historical outline of the history of the digital economy with various approaches to its definition (considering its various dimensions), the sphere of influence of digital transformation on the economy and the threats and opportunities created by the digitalization of economic and social processes.

1.2 The emergence of the digital economy

The digital revolution began in the mid-1980s with the emerging mass market for personal computers. The 1990s saw a rapid development of digital

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design tools and robotic manufacturing equipment. As of the turn of the 20th and 21st centuries, digitalization processes are driven by massive growth in outsourcing and offshoring. International coordination and corporate interoperability are being rapidly improved at present. An increasing number of diverse computing devices and computer programs are used in business processes, including services, transportation or precision agriculture (UNCTAD, 2017).

The current state of economic relationships, termed the digital economy, is still considered to be in its emerging phase (Chen & Wang, 2019). The emergence process of the digital economy is described by Katz (2017) by distinguishing its three waves. The first wave is associated with the use and management of information systems aimed at automating data processing. They are applied to monitoring and reporting of business performance. A significant aspect of this wave is the popularization of telecommunication technologies, such as broadband (fixed and mobile) access to the Internet. The second wave entails the diffusion of the Internet and the development of digital platforms (new markets and search engines). The third wave is the key phase for shaping the digital economy. The third wave consists in automating routine tasks and processes at various levels: individual organizations, their networks and public policies.

The Federation of German Industries in its 2015 report identifies four major factors of digital transformation of Europe's economies: (1) digital data, (2) automation, (3) connectivity and (4) the digital customer interface (Table 1.1).

Analysing the contents of Table 1.1, a hypothesis may be proposed about a change to the paradigm of production factors. Digital data in the age of digital economy is equivalent to raw materials for manufacture.

Table 1.1 Levers of digital transformation

	Levers	*Enabling technologies*	*Applications*
Digital transformation	Digital data	• Big data • Wearables • Internet of Things	• Demand forecasts • Data-based routing • Predictive maintenance
	Automation	• Robotics • Additive manufacturing	• Drones • Autonomous vehicles
	Connectivity	• Cloud computing • Broadband Internet	• Smart factory • Pure digital products • Remote maintenance
	Digital customer access	• Social networks • Mobile Internet/ apps	• E-commerce • Infotainment • Fourth-party logistics

Source: Roland Berger, The digital transformation of industry (2015). https://www.rolandberger.com/publications/publication_pdf/roland_berger_digital_transformation_of_industry_20150315.pdf (30.08.2022).

Automated, robotic production lines and digital organizations form a new labour market, and scalable communication networks represent relational, social and structural capital. The increase in computer usage and the third industrial revolution initiated the production of digital data. Exponential growth in data production entails the need to have it systematized and stored. The inventions that initiated the fourth revolution (e.g., the Internet of Things) entail inevitable changes in personal data archiving and protection. Opinions are voiced that personal data protection should be considered a human right. Digital technologies may be perceived as a disruptive innovation that changes the status quo (Kerber, 2016).

1.3 The digital economy as a research subject

The term "digital economy" was first used by Tapscott in 1996. He used it with reference to the age of networked intelligence characterized by a rapid development of the sector of information and communication technology (ICT). Tapscott (1996) argued that the digital economy combines intelligence, knowledge and creativity, thus being capable of creating "the wealth of nations" and supporting their development.

The first publications on the digital economy appeared in the WOS database in 1993 (Figure 1.1). The number of such publications did not exceed 100 papers annually until 2015. As of 2016, the number of publications on

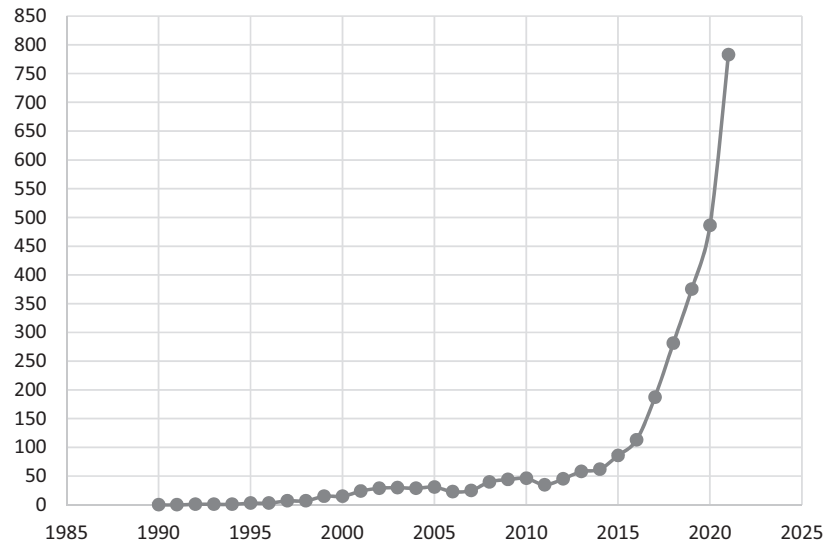

Figure 1.1 Number of publications for "digital economy" query from 1990.
Source: Own calculations based on Web of Science (2022).

this topic has increased by 30%–60% year by year. In 2022, until September of that year, as many as 674 papers on the digital economy were published.

From 1990 to September 2022, the Web of Science database collected 3,950 papers with "digital economy" as their keyword. The largest set includes papers dedicated to the areas of Business and Economics (27%) and Communication (12%). Such research fields are found within the range between 2% and 4% as Government and Law, Environmental Science and Ecology and Sociology and Education. This indicates the interdisciplinary nature of the subject discussed (Figure 1.2).

In the first two decades of research on the digital economy (Figures 1.3 and 1.4), the studies focused mainly on technology topics and the use of the Internet and ICT. Such concepts as e-commerce, e-government or information society were introduced in 2000–2009.

An analysis of keywords occurring jointly in 2010–2019 (Figure 1.5) compared to prior years shows a significant increase in associating the concept of digital economy with other areas of the social system, not limited to its economic aspects. Several fields of research developed in 2010–2019: (1) the digital economy combined with collaborative economy and sharing economy; (2) information society, the use of digital tools in teaching and digital skills; (3) property rights, intellectual property and piracy; (4) social media

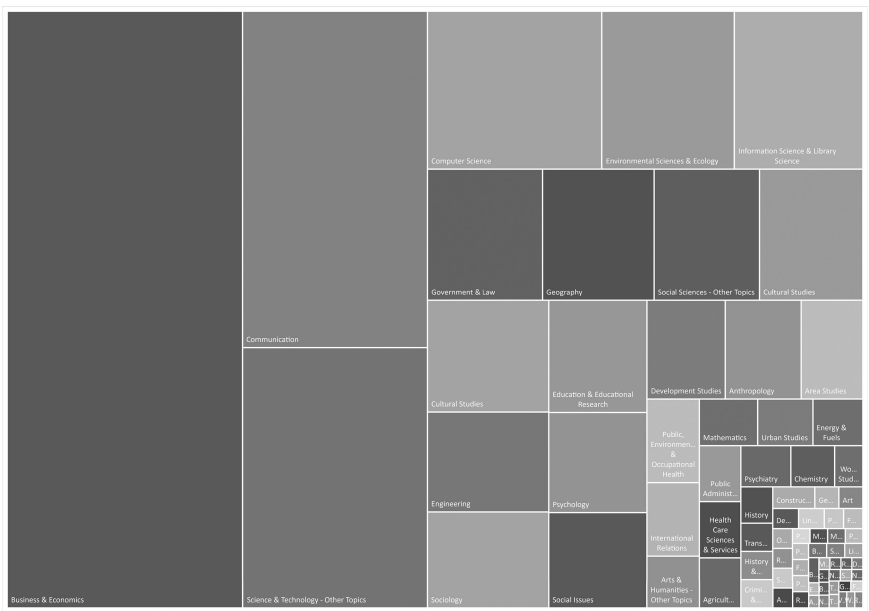

Figure 1.2 Share of research areas represented in the articles for "digital economy" query.

Source: Own calculations based on Web of Science (2022).

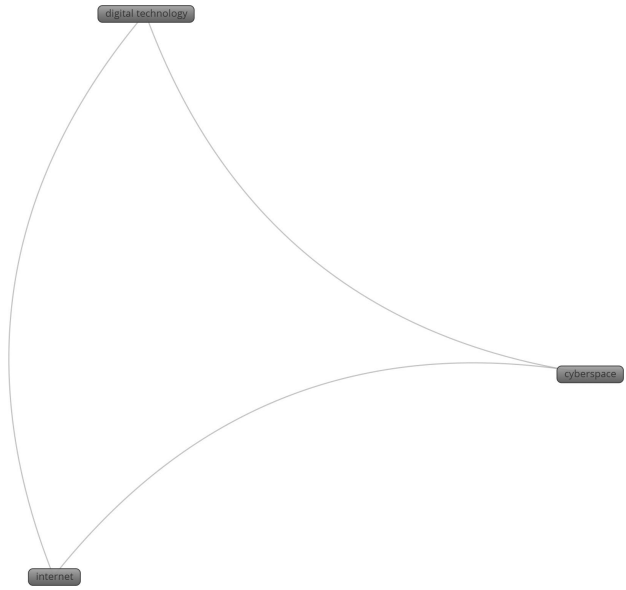

Figure 1.3 Map of the keywords occurrence for "digital economy" query in 1990–1999.

Source: Own elaboration based on Web of Science (2022), prepared in VOSviewer.

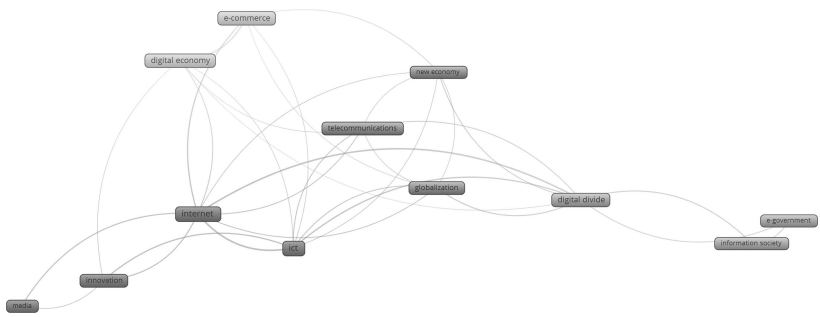

Figure 1.4 Map of the keywords occurrence for "digital economy" query in 2000–2009.

Source: Own elaboration based on Web of Science (2022), prepared in VOSviewer.

and their use in advertising, and the question of personal data protection; and (5) big data and digital tools used in regulation.

The years after 2020 were affected by the COVID-19 pandemic as the virus characteristics limited society's activity in the real world and caused a transfer of numerous tasks into the virtual world. Therefore, many studies on the digital economy also discussed the COVID-19 pandemic

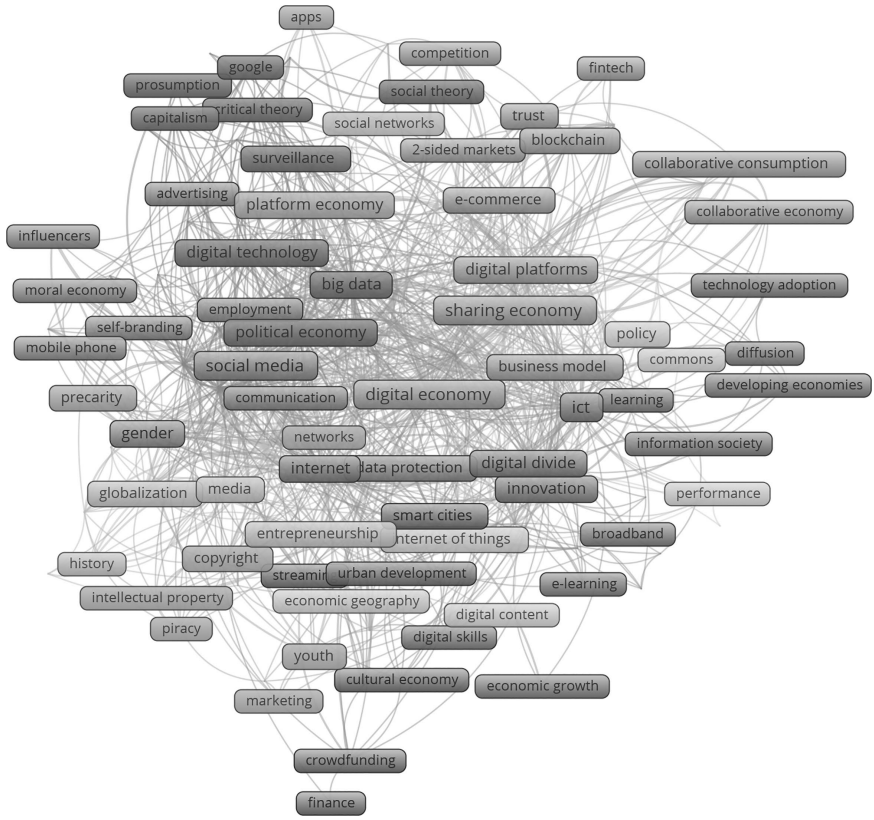

Figure 1.5 Map of the keywords occurrence for "digital economy" query in 2010–2019.

Source: Own elaboration based on Web of Science (2022), prepared in VOSviewer.

(Figure 1.6). The COVID-19 pandemic caused accelerated implementation of numerous digital solutions in the economy, management, finance and education. Other important fields of research appeared in 2020–2022: (1) changes to the labour market – platform economy, gig economy, crowdsourcing and precarity; (2) changes in digital products and services – digital trade, fintech, mobile money, e-government and associated emotions; (3) necessary amendments to legislation on personal data and privacy protection, on algorithm use and on improving security in using Internet applications; (4) the rise of cryptocurrencies; and (5) the development of Economy 4.0 combined with the topics of a circular economy and a sustainable business model.

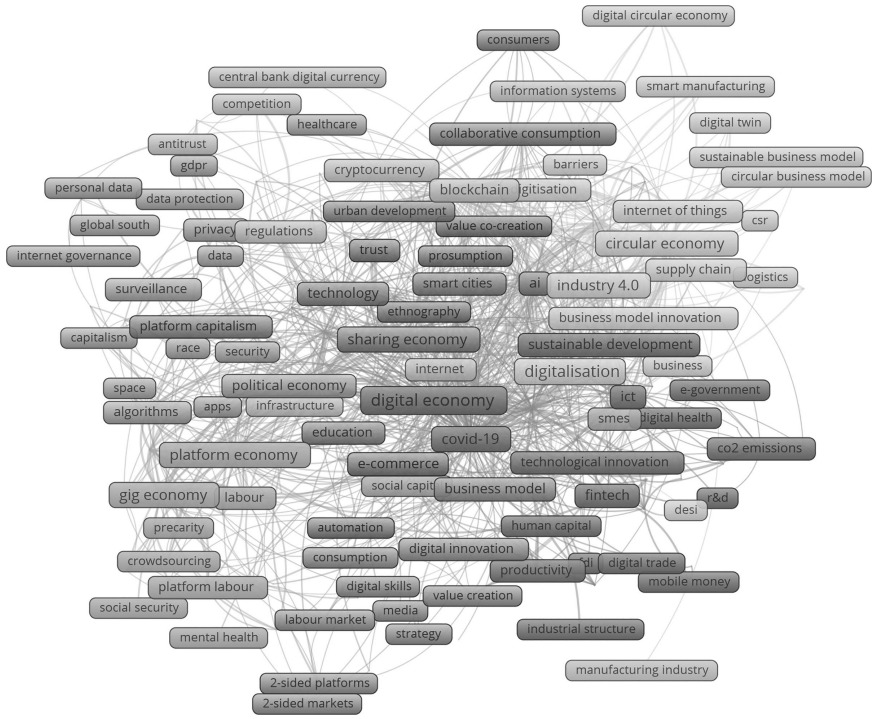

Figure 1.6 Map of the keywords occurrence for "digital economy" query in 2020–2022.

Source: Own elaboration based on Web of Science (2022), prepared in VOSviewer.

1.4 A comparison of approaches to defining the digital economy

The conducted review of the main research topics in the area of digital economy gives its picture as a multi-dimensional and dynamic structure that should be analysed considering its economic, technological, regulatory and social aspects. All those aspects are discussed in the further chapters of the book.

From an economic perspective, the digital economy is founded on a digital form of trade (Teo, 2001). Digital information transfers have dramatically changed the nature of management processes in enterprises (D'Ippolito et al., 2019). Given this observation, Cheon and Kim (2003) define the sphere of digital economy as an economy in which the production, sales, and consumption of goods and services depend on the network of electronic means based on an intermediary information flow. Thus, digital technologies and broadband network access can be identified as the core of the digital economy (Banning, 2016). In this approach, the digital economy is an economic form of production in the digital technology sector. It is driven by the development

of the information and communication industry, which directly translates into growth in electronic commerce (Lane, 1999).

The digital economy can be understood as a kind of umbrella concept describing digital markets, technologies and communication, data processing and e-commerce (Nathan et al., 2013). The growing number of interrelations between the traditional (offline) and the digital economy makes the boundary between them increasingly difficult to define. The difficulty becomes greater as the influence of the digital economy grows beyond business, to include the area of lifestyles in society (e.g., the sharing economy, algorithms and big data) (Capobianco & Nyeso, 2018). The digital economy with its multiple dimensions and internal dynamics requires a flexible approach to its definition (Barefoot et al., 2018). However, an excessively general and easy-to-modify description of the digital economy can present problems in analysis and observation due to the boundaries of the research subject being blurred and changing in time.

The material basis for the digital economy is provided by the processes and products offered by the ICT sector that pervade all areas of the economy and society in a majority of developed countries (Lazanyuk & Revinova, 2019): the banking system – mobile and online banking and electronic payment; trade – auction and sales platforms; energy – coordinating fuel supplies, energy purchase and remote reading of consumption meters; transport – advanced logistics, real-time vehicle tracking and autonomous vehicles; education – remote teaching/learning; health – teleconsultation, teleoperations, surgical robots and patient records (e.g., Internet patient account in health service); offices – online access to data, documents and requests.

The structure of the digital economy can be analysed at its three levels (UNCTAD, 2017). The core refers to the ICT and IT sectors. It includes telecommunications, software development, computer hardware manufacture and offering IT services. This level is considered from the perspective focusing on specific technologies, such as 3D printing, blockchain, 5G or the Internet of Things. The narrow scope includes digital platforms, the sharing economy and digital services (e.g., Facebook and Google). This level employs specific technologies to create innovative processes, new methods of distribution or to change the approach to fundamental concepts in economics, like utility and ownership. The broad scope of the concept of digital economy extends beyond advanced technology industries (e-agriculture, e-administration, e-business and Industry 4.0). It includes the sphere of finance (fintech and open banking), e-commerce and the labour market (gig economy) (Figure 1.7).

The digital economy is distinguished from the traditional economy by Valenduc and Vendramin (2016) as the diminishing role of geographical location, no longer providing a competitive advantage; the key role played by digital platforms; the great importance of network effects; and the use of big data. Digital transformation also initiated the fourth industrial revolution, conceptualized by Klaus Schwab (2017). It is based on digital data, the combination of sensors and data warehouse analysis made by artificial

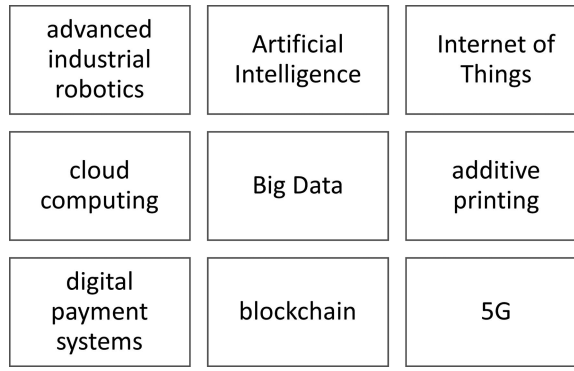

Figure 1.7 Key digital technologies.
Source: UNCTAD (2017).

intelligence (Industry 4.0). Adaptation of digital technologies in production and services causes changes in the production process. The digital economy determines the quality of economic growth and development. Digital transformation of a traditional economy is sufficient to produce desirable effects (Zhao et al., 2020). ICTs provide foundations for the digital economy. Therefore, it is important to identify various types of digital technologies (Nathan et al., 2019), namely, IT hardware (e.g., drones, industrial robots and wearables) and digital content (software, online advertising, design, online media and online business).

The digital economy is now replacing the economy based on natural resources. An enormous challenge is posed by establishing adequate formal institutions (a regulatory infrastructure) designed to lay down rules for market play, a new deal, e.g., for the digital data market. Wiebe (2017) emphasizes the need for regulating the right to trade in industrial data and its protection in the digital age. Considering that big data, which involves collecting and processing large data sets, represents an essential component of the digital economy, immediate decisive actions are indispensable. During the following years, the rise of industrial robots, autonomous vehicles the growing automation of numerous processes will cause an increase in the number of data producers.

The OECD (2020) identifies many areas where digitalization and innovation based on digital data will affect competitiveness. The digital economy was selected as a strategic theme for the OECD Competition Committee, with a focus on four sub-streams (Capobianco & Nyeso, 2018): (1) the relationship between the digital economy, law and innovation; (2) challenges posed to antitrust tools and approaches; (3) practical challenges to competition enforcement; and (4) development and evolution of specific industries.

By using ICT and virtual resources (software and algorithms), businesses can easily expand their operations (this is termed flexible scalability of

activity). This capability is described as a cross-jurisdictional scale without mass. The technology companies actively participate in the economies of numerous countries, influencing social processes and decisions made by people. They ignore constraints imposed by local (national) laws (Śledziewska & Włoch, 2020). This gives reasons for introducing a digital tax payable by the "digital giants" in the member states of the EU. Not waiting for a joint initiative to introduce a "digital tax" and aiming to protect their domestic markets from being monopolized by American and Chinese corporations, Spain imposed a 3% tax on "digital revenue" generated in the Spanish market, and Great Britain imposed a similar 2% tax. Such measures are taken to achieve the community objective of creating a single digital market in the European Economic Area and thus facilitating the free movement of digital goods, increasing productivity and improving access to information.

The solutions used to regulate the digital economy include regulatory test environments known as regulatory sandboxes. Their concept consists of creating special and isolated areas for testing the potential consequences of a new technical solution to be introduced. Such sandboxes facilitate performing an "experiment" in a safe manner, rapid verification by the regulator of the consequences of an innovation, reducing the barriers to entry faced by innovators and accelerating the pace of implementation of a solution.

This is done in the spirit of mitigating risks to consumers of digital services. Currently, regulatory sandboxes are operating in more than 20 countries. A regulatory sandbox has been operated by the Financial Supervision Authority in Poland since 2018. The European leader and pioneer is the British regulatory body the Financial Conduct Authority (FCA) that has improved the regulation process, making Great Britain an inspiring example of fintech development. On average, one-third of the applications for participating in the FCA sandbox are approved and admitted to testing (Marchewka-Bartkowiak, 2019).

The development of the digital economy is also characterized by significant changes in work organization. A new global division of labour across value chains, the new business model of online platforms, reflecting the increasing capacity to extract value from big data, and the digital renewal of the informal economy are fostering new forms of work and employment (Valenduc, 2019, p. 79). There is ICT-based nomadic work with digital nomads characterized by two specific work practices: they make extensive use of computers, smartphones, cloud services and the Internet, and their working time is not spent solely on the premises of the employer (p. 68). Another change is linked to online platforms that have enabled on-demand work. Such work relies on the continued employment relationship with an employer but without continuity of job, pre-defined working hours or level of remuneration. The employer calls on the worker only when needed (p. 70). There is crowd working that refers to work carried out through online

platforms which allow organizations or individuals prepared to solve specific problems or supply specific services or products in exchange for payment (Green et al., 2013); in other words, work is "externalized to the crowd" (Valenduc, 2019, p. 71). And finally prosumers – individuals who both produce and consume digitized information – carry out work by supplying data and services without being paid for it, but for which salaried employers were previously partly responsible (p. 73).

Participation in the digital economy appears to be characterized by social stratification. According to Eichhorn et al. (2020, p. 396), digital inequality research has shown that individuals cannot simply be categorized as users and non-users of online services – or haves and have-nots. Rather, individuals can be distinguished along various dimensions of access. The "digital divide" describes not only the difference between those who are connected to the digital world and those who are not, or those with "digital readiness skills" and those without them, but also widening inequality within groups and places that are connected (Sturgeon, 2021, p. 50). Notwithstanding the elimination of the classic elements of the digital divide, such as barriers to ICT adaptation, use of social media or the uptake of current e-government services, new chasms have appeared, e.g., regarding privacy, cybersecurity or the major challenge of how to deal with fake news and other forms of cyber manipulation (Bánhidi et al., 2020, p. 43).

The idea that the digital economy will advance with great rapidity creates worry about dislocations, especially from rapid reductions in demand for labour-intensive and routine jobs from automation, autonomy and artificial intelligence (Sturgeon, 2021, p. 35). According to Heikki Hiilamo (2022, p. 2), with economic globalization, technological change will have an impact across the globe with potential political repercussions. An increase in precariousness, unemployment and inequality may lead to widespread discontent which is a breeding ground for xenophobia, populism and political violence (Hiilamo, 2022). Thus, the role of policy is crucial. Policy makers have an obligation to shape digital technologies in ways to protect citizens and key institutions from abuse or damage and mitigate market concentration (Sturgeon, 2021, p. 50).

Knowledge, skills and competencies desired in the labour market change over time. Today, the following competencies are indicated as particularly important: collaboration, communication, digital literacy, citizenship, openness, capability of problem solving and critical thinking (Voogt & Roblin, 2012). The development of knowledge society has led to an accelerated growth in the importance of soft skills. However, ITC literacy has become equally essential (Lewin & McNicol, 2015). The ability to effectively function in a technology-rich society has become crucial (Eshet-Alkalai, 2004). Aiming to classify the desired 21st-century skills, Claro et al. (2012) indicate (1) the mastery of ICT applications to solve cognitive tasks at work, (2) skills supporting higher order thinking processes and (3) skills related to cognitive processes favouring continuous learning.

1.5 The sphere of influence of an economy's digital transformation

The fourth industrial revolution was triggered mainly by the development of the Internet. It enabled global and instant communication between people, and between people and machines, using cyber-physical systems. The transformation process of the industry is triggered by social, economic and political changes (Lasi et al., 2014), in particular, by pressure on shortening consecutive phases of the innovation development process. High innovation capability is becoming an essential success factor for many enterprises, enabling them to shorten "time to market". Individualization on demand and a change from a seller's into a buyer's market have been observed for decades, due to market saturation. Buyers wish to define the conditions of transactions, and this requires that individualized products be offered. Flexibility means growing flexibility in product development and manufacturing processes. Decentralization means that organizational structures are reduced to introduce faster decision-making procedures in response to sharp market fluctuations. Resource efficiency (increase in prices for resources) is caused by their shortage. Ecological aspects grow in importance, entailing a transition of manufacturing processes towards a sustainable industrial model.

Digital transformation is based on the development of the Internet and ICT. They enable developing new products in a digital form, their virtual distribution, and the emergence of new enterprise models and industries. ICT, generation by generation, offers an increasing range of functionalities, also reducing the cost of their purchase which leads to their growing accessibility.

The development of the Internet has made it possible to provide services through digital channels (Table 1.2). Automated services can be provided remotely and with a minimum participation of humans. The time of day and geographical location are irrelevant. The Internet, mobile devices (smartphones and tablets) or satellite television are used for the purposes of entertainment (music, films and games), education (remote teaching, websites, magazines and ebooks), communication (video conferencing, chats, forums and social media), physical exercise (online training sessions with a coach) and even telework (call centres and hotlines, consultancy, freelancing and financial services). Investment in advanced distribution networks of digital services became crucial, especially in the times of the COVID-19 pandemic and lockdowns.

The development of ICT in agriculture has led to an improvement in the standard of living in rural areas, more efficient plant growing and animal breeding methods. Due to technological progress, farmers are provided with precise and current information or dedicated services opening opportunities for more profitable digital agriculture (e-agriculture). The term e-agriculture refers to the conceptualization, design, development, evaluation and application of innovative ways to use ICT in rural areas (Mahant et al., 2012). As a result, digital technologies make it possible to conduct precision and

Table 1.2 The most important areas of digital services

Service	*Directions of further development*
E-health	The possibility of remote medical consultation, arranging online a visit to a health centre or receiving an e-prescription
E-work	Using the Internet to conduct remote recruitment of workers, to cooperate, complete projects and access corporate data resources
E-learning	Language courses, professional training, tertiary education, remote classes at schools, private tutoring and electronic textbooks
E-logistics	Services that support the supply chain, coordination of drivers and business partners and real-time tracking on a map of current locations of specific shipments and parcels
E-finance	The possibility of completing all tasks in the areas of finance, banking, investment and insurance with the use of dedicated software and Internet access
E-commerce	Buying and selling products over the Internet, discussed in more detail in a dedicated section below
E-administration	The provision of public services using ICT. This includes the possibility of filing applications with authorities and submitting requests by email, and even of taking popular vote over the Internet
E-culture	Access to scanned paintings and to other works of art in a digital format (also using augmented and virtual reality). This gives people with disabilities or those living in the provinces the opportunity to experience culture

Source: Flis et al. (2009).

computer-aided farming. The data collected (from agricultural machinery, e.g., on machine locations indicated by the Global Positioning System, analysis of weather and soil conditions) facilitate precise planning of soil fertilization and plant protection from pests, storms or droughts. This finally results in getting larger volumes of quality crops while managing the costs of agricultural produce (Gozdowski et al., 2007).

Another industry that has undergone a revolution due to technological progress is finance. Through the digital transformation of financial services, a new sector emerged, known as fintech (a portmanteau of "financial technology"). The term fintech, as regards market players, refers to the entities coming from the technology industry. They possess necessary know-how and technical resources useful in offering innovative financial products. In this narrow definition, the fintech industry includes only new technology companies characterized by a considerable degree of flexibility, innovation and their focus on a competitive advantage over traditional banks, gained from technology. In a broader definition, fintech may also include the digital giants that offer financial services and even the traditional banks that invest in digital solutions (Harasim & Mitręga-Niestrój, 2018).

1.6 Opportunities and threats presented by digitalization

Digital transformation of economies in numerous countries entails heightened expectations for economic growth and an improved standard of living. Simultaneously, fears are voiced of a reduction in the number of jobs, increasing inequalities and threats to information security. However, the digitalization of economies has become a major social objective (Lazanyuk & Revinova, 2019). This process was accelerated by the coronavirus pandemic in 2020–2022. The digital economy offers the following advantages according to the World Bank (2016): a reduction in the cost of information, and thus in transaction costs; promoting innovation; increasing efficiency achieved by faster and more convenient operations and services; a better integration, as the services previously unavailable are now within reach to a greater number of consumers; and job opportunities.

Vatamanescu et al. (2017) argue that the digital economy raises questions regarding the consumer protection mechanisms, the protection of privacy, the intellectual rights and the competition policies. In this respect, the EU authorities express concern about the inconveniences caused by digital transformation and its effect on the consumers and the business environment. Simultaneously, despite a rapid increase in business spending on ICT, the digital economy (understood as mobile technology, the Internet and cloud computing) has not yet generated any visible improvement in productivity (Van Ark, 2016). However, it must be reminded that the digital economy is still in its initial phase. Its effect on productivity may only be assessed from a wider historical perspective.

Technological progress may take place on condition that the development level in the preceding phase is sufficiently high. The convergence effect is observed in the industrial age and in industrial technologies. The digital revolution is the motor of divergence (growing revenues relative to scale), which is not directly observable in national accounts. For example, gross domestic product does not include a fragment of quantitative changes taking place in the age of emerging digital economy. Such spheres as online entertainment, open-source software or freeware are ignored. The digital age cannot be perceived as a simple continuation of the industrial age. The changes are observable, but the challenge lies in their measurement.

1.7 Conclusion

This chapter was aimed at providing a general conceptual framework for the present book. The proposed historical outline of the digital economy with various approaches to its definition, the discussed sphere of influence of digital transformation on the economy, leads to the following conclusions.

First, as of the turn of the 20th and 21st centuries, digitalization processes are driven by massive growth in outsourcing and offshoring. International coordination and corporate interoperability are being rapidly improved at present. Economic processes are determined by the growing diversity of digital

devices and computer programs. However, it must be remembered that the current development phase of the digital economy is still to be regarded as its beginnings (with a relative shortage in software, a huge potential of artificial intelligence for influencing transformation and frequently immature automation of production processes). Second, the digital economy is driven by the development of ICT. Digital technologies and broadband access to the Web form the core of the emerging digital economy. "Digital economy" can be understood as a kind of umbrella concept describing digital markets, technologies and communication, data processing and e-commerce. Third, the characteristics distinguishing the digital economy from the traditional economy include the diminishing role of geographical location, the key role of digital platforms and network effects and the use of big data. The key factor determining future developments is AI. Fourth, the most important challenges for the development of the digital economy in the short run are posed by enforcing the competition law, taxation, data ownership, intellectual property, privacy, profiling and statistical/algorithmic discrimination.

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