



中国—中东欧国家全球伙伴中心
GLOBAL PARTNERSHIP CENTER OF CEECs AND CHINA

Research Project of

China-CEEC Global Partnership Center (GPC)

The Status and Prospects of China-CEECs Digital Economy Cooperation

China Institute of International Studies-CIIS (China)

Institute for Foreign Affairs and Trade-IFAT (Hungary)

Authors:

Wei Min

Senior Research Fellow of China-CEEC Global Partnership
Center (GPC) and China Institute of International Studies (CIIS)

Yang Bowen

Assistant Research Fellow of China-CEEC Global Partnership
Center (GPC) and China Institute of International Studies (CIIS)

Péter Goreczky

Senior Analyst, Manager of Asia-Pacific Research Program at
the Institute for Foreign Affairs and Trade, Hungary

Viktor Eszterhai

senior researcher at the Institute for Foreign Affairs and Trade,
Hungary

The Status and Prospects of China-CEECs Digital Economy Cooperation

1. Introduction

At present, the digital economy represented by new technologies such as the Internet, big data, cloud computing, artificial intelligence, and blockchain is developing rapidly, and is increasingly integrated into the entire process of various economic and social developments. The digital economy is becoming a key force for reorganizing global resource elements, reshaping the global economic structure, and changing the global competition pattern. COVID-19 pandemic has accelerated the development of the digital economy and is a strong digital accelerator. Countries have adopted digital means to prevent and control the pandemic, and many living and work needs have shifted from offline to online. Digital transformation has become an important direction for post-pandemic economic recovery and an important manifestation of a country's core competitiveness. China is striving to strengthen, optimize and expand the digital economy from various aspects, and the digital economy in Central and Eastern European countries is also rapidly developing against the adversity of the pandemic. Although there are some new challenges faced by China and CEECs in conducting and promoting cooperation, digital economic cooperation has become a key area for the improvement and upgrading of China-CEEC cooperation.

The purpose of this report is to analyze the development and cooperation status between China and CEECs in the field of digital economy, and aims to put forward suggestions for strengthening cooperation in the future. The full report consists of four parts. The first part reviews the origin, connotation and definition of the concept of digital economy. The second part introduces the respective digital economy development status of China and Central and Eastern European countries, and categorizes the different levels of development of Central and Eastern European countries in the field of digital economy. The third part provides an overview of China-CEEC digital economic cooperation, specifies China's cooperation practices with the Western Balkan countries and Hungary, and evaluates the current challenges facing China-CEEC digital economy cooperation. Based on the above findings, the fourth part draws the main conclusions and puts forward policy recommendations for China-CEEC cooperation in the field of digital economy.

2. The emergence and definition of the concept of "digital economy"

The term "digital economy" first appeared in the 1990s. At that time, the Internet economy emerged and developed rapidly. In 1997, the world-renowned new economist Don Tapscott published the book "The Digital Economy: Promise and Peril In The Age of Networked Intelligence", which discussed in detail the impact of the Internet on the economy and society. Don Tapscott himself is known as the "Father of

the Digital Economy”. Since then, Manuel Castells’ “Information Age” trilogy, Nicholas Negroponte’s “Being Digital” and other works have come out in succession. The concept of “digital economy” has been widely accepted and was gradually spreading around the world.

At the same time, governments around the world have also started to see the development of the digital economy as an important means to boost economic growth. In 1997, the Japanese Ministry of International Trade and Industry began to use the term “digital economy”. In 1998, the U.S. Department of Commerce released the report “The Emerging Digital Economy”, which described the development trend from the industrial economy to the digital economy driven by the diffusion and penetration of IT technology, and summarized the characteristics of the digital economy as “The Internet is the foundation of the digital economy, the information technology is the leading technology, the information industry is the leading and pillar industry, and e-commerce is the engine of economic growth”. Since then, the US Department of Commerce continued to closely pay attention to new economic phenomena related to Internet technology, and has released a number of annual research results on the theme of the digital economy.

In the 21st century, especially after the outbreak of the international financial crisis in 2008, countries around the world began to formulate digital economy strategies in order to stimulate economic recovery through the development of the digital economy. China also attaches great importance to the role of information and communication technology in promoting the economy and society development, yet in practices, concepts such as a series of “golden project”¹, “information industry”², “informatization”³, and “integration of informatization and industrialization”⁴ are often used. The 2015 “Report on the Work of the Government” first proposed the concept of “Internet +” to accelerate the pace of economic transformation and upgrading by promoting Internet integration and innovation. In 2017, the digital economy appeared in the annual “Report on the Work of the Government” for the first time and was regarded as a new driving force for China’s rapid economic growth.

A unified and clear definition of the digital economy is the primary prerequisite for measuring the digital economy. Effective and accurate measurement of the digital economy is crucial to grasping the growth opportunities and challenges brought about by the digital economy.

In 2019, the United Nations Conference on Trade and Development (UNCTAD) sorted out the main understanding of the digital economy since the 1990s, but did not give a clear definition. In “Digital Economy Report 2019”, the digital economy is

¹ 一系列 “金字工程”

² 信息产业

³ 信息化

⁴ 两化融合（信息化与工业化）

roughly divided into three broad components: The first is Core aspects or foundational aspects of the digital economy, which comprise fundamental innovations (semiconductors, processors), core technologies (computers, telecommunication devices) and enabling infrastructures (Internet and telecoms networks). The second is Digital and information technology (IT) sectors, which produce key products or services that rely on core digital technologies, including digital platforms, mobile applications and payment services. The digital economy is to a high degree affected by innovative services in these sectors. The third is a wider set of digitalizing sector, which includes those where digital products and services are being increasingly used, and include This includes digitally enabled sectors in which new activities or business models have emerged and are being transformed as a result of digital technologies. Examples include finance, media, tourism and transportation. Moreover, digitally literate or skilled workers, consumers, buyers and users are crucial for the growth of the digitalized economy (UNCTAD, 2019).

According to the definition of the Organisation for Economic Cooperation and Development (OECD), The Digital Economy incorporates all economic activity reliant on, or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services and data. It refers to all producers and consumers, including government, that are utilising these digital inputs in their economic activities (OECD, 2020).

G20 first proposed and adopted the definition of the digital economy at the 2016 Hangzhou Summit. Then in 2017, the group formulated the digitalization roadmap during Germany's G20 presidency. In 2018, during the Argentine presidency, a toolbox for measuring the digital economy was formed. In 2020, during the presidency of Saudi Arabia, after consultation with the member states, a unified understanding was formed, which promoted the formation of a common framework for measuring the digital economy. The G20's definition of the digital economy is specified in "A G20 Roadmap toward a Common Framework for Measuring the Digital Economy" released at the G20 Digital Economy Ministers Meeting of July 22, 2020⁵ (G20, 2020). The digital economy mainly includes the upstream and downstream industries of ICT production and services supported by data.

As mentioned above, the U.S. Department of Commerce believes that the digital economy consists of infrastructure, e-commerce, and paid digital services. The European Commission has not clearly defined the digital economy, and mainly measures the digital economy through the index set by the annual released Digital Economy and Society Index (DESI). The index divides digital economic into five categories, and sets second-level and third-level indicators according to specific situations. The final DESI index is formed based on the third-level indicators, after

⁵ "The digital economy incorporates all economic activity reliant on, or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services, and data; it refers to all producers and consumers, including government, that are utilising these digital inputs in their economic activities."

the data of each category is integrated after weighted calculation. The four first-level indicators are human capital, connectivity, integration of digital technology and digital public services (DESI, 2021).

The National Bureau of Statistics of China defines the digital economy as: A series of economic activities with data resources as key production factors, modern information network as an important carrier, and effective use of information and communication technology as an important driving force for efficiency improvement and economic structure optimization. Specifically, it includes five categories: digital product manufacturing, digital service industry, digital technology application industry, digital factor-driven industry, and digital efficiency improvement industry⁶.

The China Academy of Information and Communication Technology (CAICT) defines the digital economy as "with digital knowledge and information as the key production factors, digital technology innovation as the core driving force, modern information network as an important carrier, through the deep integration of digital technology and the real economy, and continuously improve Digitalization and intelligence of traditional industries, accelerating the reconstruction of new economic forms of economic development and government governance models", that is, the framework of the digital economy system is considered to be "four modernizations": digital industrialization, industrial digitization, digital governance and data value-added (CAICT, 2020).

In the 2018 report "The rise of Digital Challengers--How digitization can become the next growth engine for Central and Eastern Europe", McKinsey & Company strikes a balance between the various definitions of "digitization" and sum up to three components: 1. The value of the information and communication technology (ICT) sector; 2. The value of the e-commerce market, measured as online sales of goods; and 3. The value of offline consumer spending on digital equipment. McKinsey & Company chooses this definition for two main reasons. First, it is relatively comprehensive – broader than just the ICT sector, and more concrete than "all activities related to digital data." Second, reliable data is available for each of the three areas it covers and so its total value can be calculated (McKinsey & Company, 2018). This definition is adopted by the 2020 McKinsey & Company report "Digital Challengers in the next normal--Central and Eastern Europe on a path to digitally-led growth" (McKinsey & Company, 2020).

2. Current situation of digital economy development in China and Central and Eastern European countries

2.1. Current Situation of China's digital economy development

China regards the rise and development of the digital economy as an important part of

⁶ 数字产品制造业、数字产品服务业、数字技术应用业、数字要素驱动业、数字化效率提升业。

the unprecedented global changes, and the Chinese government puts a high value on and promotes the healthy development of the digital economy. The Chinese government strives to promote digital applications and services for the benefit of all people, continues to improve domestic laws, regulations and policy norms, integrates into the global emerging digital technology governance framework, actively applies to join high-level digital trade agreements, strengthens global digital economic cooperation, and promotes the joint development of digital silk road, narrow the digital divide, and promote the development of global digital governance in the direction of openness, inclusiveness, mutual benefit and balance.

In March 2021, the National People's Congress adopted the “14th Five-Year Plan (2021-2025) for National Economic and Social Development”, which listed the digital economy as a separate chapter and elaborated the future development plan of China's digital economy. It proposes specific goals in the field of digital economy development such as creating new advantages in the digital economy, accelerating the pace of digital society construction, improving the level of digital government construction, and creating a good digital ecology. In October 2021, the collective study session on promoting the healthy development of the digital economy was held by CPC Central Committee's Political Bureau. General Secretary Xi Jinping pointed out: “The development of the digital economy is a strategic choice to grasp the new opportunities of the new round of scientific and technological revolution and industrial transformation.” The Chinese government and the central committee of CPC have made a lot of arrangement for the development of digital economy. The digital economy has risen to the national strategic level, and its leading position in the national economy has continued to be demonstrated.

1) The scale of China's digital economy ranks second in the world, and its growth rate ranks first in the world. According to the “Global Digital Economy White Paper” released by China Academy of Information and Communications Technology in August 2021, the total scale of the digital economy in 47 countries will reach 32.6 trillion US dollars, accounting for 43.7% of GDP in the year of 2020. The scale of China's digital economy is 5.4 trillion US dollars, preceded only by the United State's 13.6 trillion US dollars, ranking second in the world. Despite the impact of the COVID-19 pandemic, China's digital economy still maintained a rapid growth of 9.7% in 2020, ranking first in the world. The digital economy has played an important role in combating the pandemic and promoting the sustained and stable recovery of China's national economy.

The contribution rate of the digital economy to China's GDP is also increasing year by year, and the status of digital economy is prominent. From 2005 to 2020, the proportion of China's digital economy in GDP increased from 14.2% to 38.6%. The digitalization of China's industries is accelerating. In 2020, the digital economy will account for 40.7%, 21.0% and 8.9% of the industry's added value (that is, the penetration rate of the digital economy) in China's three major industries of services,

agriculture and industry.

2) China is rapidly advancing the speed of digital infrastructure construction, and has become the leading country in 5G network coverage. As of November 2021, China has built more than 1.15 million 5G base stations, accounting for more than 70% of the world's total, making it the world's largest and the most technologically advanced 5G independent network. All urban areas of prefecture-level cities, over 97% urban areas of county-level cities, and 40% of townships in China have achieved 5G network coverage. 5G end users reached 450 million, accounting for more than 80% of the world.

3) The digital literacy of Chinese citizens continues to improve. According to “the 48th China Statistical Report on Internet Development” released by China Internet Network Information Center (CNNIC) in August 2021, as of June 2021, the number of Internet users in China was 1.011 billion, and the number of mobile Internet users was 1.007 billion. China's digital talent pool and demand for ICT professional skills continue to expand, and the future talent gap will be concentrated in emerging fields such as cloud computing, big data, the Internet of Things, and artificial intelligence (CNNIC, 2021).

4) China's Internet applications take the lead in the world. In the first half of 2021, China's personal Internet applications showed a steady growth trend. Among them, the users of online food delivery, online medical treatment and online office have the most significant growth, all of which have a growth rate of more than 10%. Instant messaging, online video, short video, online payment and online shopping are the top five applications most used by netizens. The number of instant messaging users in China reached 983 million, accounting for 97.3% of the total netizens. The online consumption of Chinese residents continued to increase, and the number of online payment users reached 872 million. The pilot work of digital RMB has been carried out successively, with more than 1.32 million pilot scenarios covering all areas of life.

5) China's industrial digitization process is accelerating. The development of China's industrial Internet has begun to take shape, helping to upgrade the manufacturing industry, and it is becoming a new way for China's industrial digital transformation. The "comprehensive + characteristic + professional" industrial Internet platform system has basically been formed. There are more than 100 industrial Internet platforms with certain industry and regional influence, the number of connected devices exceeds 70 million units (sets), and there are more than 590,000 industrial APPs. Investment and financing play an important role in supporting the continuous innovation and development of the industrial Internet industry. Some fast-growing industrial Internet entrepreneurial and innovative enterprises have received financial support and their competitiveness is being formed.

6) China continues to improve its digital governance capabilities. The Chinese

government regards the improvement of digital governance capabilities as an important driving force for the modernization of the national governance system, and comprehensively promotes the digitalization and intelligence of government operation methods, business processes and service models. During the COVID-19 pandemic, the national integrated government service platform launched more than 700 high-frequency service services such as return to work, online recruitment, enterprise registration, project approval, and online taxation, providing "contactless" online services for 3.3 billion people.

7) China actively participates in international digital economy cooperation.

China is working with other countries to promote the healthy development of the digital economy, fostering new impetus and opening up new space for world economic growth. In November 2016, President Xi Jinping called on all countries to join hands to build a community with a shared future in cyberspace at the 3rd World Internet Conference. In September 2020, China proposed "Global Initiative on Data Security" (全球数据安全倡议) to contribute Chinese wisdom to maintaining data security, promoting digital development and cooperation, and advancing global digital governance. In November 2021, China formally applied to join the Digital Economy Partnership Agreement (DEPA), reflecting China's firm determination to participate in international exchanges and cooperation in the digital economy.

The development of China's digital economy also faces prominent shortcomings and challenges. In the field of digital industrialization, the technological gap with developed Western countries is still relatively prominent. In the field of industrial digitalization, China's consumer Internet has developed rapidly, and has advantages in the fields in mobile payment and e-commerce scale. However, there are still many challenges in the development of the industrial Internet, especially the industrial Internet. In terms of data governance, data openness still needs to be further strengthened, and rights confirmation process and transactions of data elements have not yet formed an effective scale. Data security challenges also need to be strengthened (Tian, 2021).

2.2 Current Situation of digital economy development in Central and Eastern European countries

Economic growth of CEE has been traditionally driven by a few key industries, exports, foreign direct investments, labour cost advantages and cohesion funds provided by the European Union. However, some of these traditional growth engines are about to exhaust. Prior to the Covid-crisis, the Visegrad countries (Hungary, Poland, Czech Republic, Slovakia) were already facing a labour shortage, while high dependence on a narrow group of export markets and industries, like automotive also highlighted the limitations of the growth trajectory of the past few decades. Most of the Baltic states and the V4 countries are making considerable efforts to move up in the global value chain which also underlines the necessity of new development strategies. Digitization is the new lever for these countries to maintain economic

growth. In 2018, global consultant firm McKinsey suggested in its *The rise of digital challengers* report that by 2025, the Baltic and the V4 states, Croatia, Slovenia, Romania and Bulgaria could gain significant economic benefits from digitalisation, primarily due to productivity gains. According to calculations of the report, closing the gap to Western and Northern Europe had the potential to add EUR 200 billion in additional GDP. However, the level of development of the CEE countries in the field of digital economy is uneven.

1) Baltic countries and Slovenia are the "leaders" of the digital economy in Central and Eastern Europe. The Digital Economy and Society Index (DESI, 2021) of Estonia and Slovenia is higher than the EU average, and Latvia is basically on par with the EU average. The above-mentioned countries have relatively perfect digital infrastructure and digital transformation environment, favorable policy environment, and have advantages in advanced technology fields such as big data, artificial intelligence, and laser.

Estonia's DESI index ranks first among Central and Eastern European countries and seventh in the European Union. As the EU's first "digital state", Estonia has performed well in the digitization of public services and the creation of "digital residents". Digital public services of Estonia rank first in the EU, with almost 99% of government services available online. However, Estonia's digital infrastructure indicators are relatively low, and 5G frequency band allocation and application have not yet begun.

Slovenia's DESI index ranks 13th in the EU, higher than the EU average level. Digital infrastructure and the integration of digital technology in businesses are its distinct advantages. In terms of digital infrastructure, Slovenia's 5G network spectrum allocation ratio has reached 98%, significantly higher than the EU average of 51%, ranking first in Central and Eastern Europe. Slovenia has formulated a series of 5G development plans and the "Digital Slovenia" strategy, but the actual commercial use of 5G has not yet started.

Latvia's DESI index ranks 17th among EU-27 and 4th in Central and Eastern European countries. The main advantage is that it has a relatively developed digital infrastructure and a high level of digital public services. The proportion of citizens and enterprises using digital services and the number of e-government users are higher than the EU average. The relative disadvantage is that the digital application and digital penetration rate are relatively low, and the relative lack of talents makes it still at a relatively low level in big data, AI, cloud computing and other aspects.

2) The digital economy level of the Czech Republic, Croatia, Slovakia, Hungary and Poland is in the middle and relatively low level in EU and the middle position in Central and Eastern Europe. These countries have their own strengths in one or some aspects of the digital economy, and the overall level is slightly lower

than that of EU member states.

The DESI index of Czech Republic ranks 15th among the EU-27, with outstanding performance in the field of artificial intelligence and e-commerce. The Czech Republic ranks first in the EU in the proportion of companies using artificial intelligence technology (40%). According to the World Robotics Association, the Czech Republic is the 15th largest market for industrial robots in the world (IFR, 2020).

Croatia ranks 19th in the EU-27 on the DESI index. The digital infrastructure is relatively developed, with a high-speed network deployment ratio is 86% and its ratio in rural areas of 39% is relatively high. It is also comparable to the EU in terms of talent training and proportion of professional talents, and higher than the EU average in terms of digital application. In terms of big data and cloud computing, Croatia also has strong technical advantages, but artificial intelligence is slightly lower than the EU level. There are clearer gaps in the field of public digital services.

Slovakia's DESI index ranks 22nd in the EU. The gap with the EU is relatively small in terms of digital skills and digital public services, but the gap is relatively large in terms of infrastructure and digital technology applications, especially advanced technologies such as artificial intelligence, big data and cloud computing. The gap in digital capabilities is relatively prominent in the field of education. Schools lack sufficient digital professional course teachers, and their digital infrastructure is still lacking, especially in the context of the pandemic. The gap between Slovakia and the EU in the field of business digitalization and high-tech is also increasing year by year.

Hungary's DESI index ranks 23rd among EU member states. With relatively developed digital infrastructure (complete 4G and early 5G coverage), and a higher share of IT professionals in the labour market, the digital economy has become the main source of economic growth in Hungary in recent decades. But Hungary is not in a favorable position when it comes to human capital indicators, with over half of the population lacks basic digital skills and software skills (DESI, 2021). Compared with other countries in Central and Eastern European countries, Hungary ranks 25th and 26th respectively among the EU-27 in terms of digital public services and integration of digital technology dimension.

Poland's DESI index ranks 21st in the EU, with digital public services and connectivity performing better. As the largest economy in Central and Eastern Europe, although Poland is not ranked highly in terms of digital commercialization and digital professional skills, the absolute number of digital economies is considerable, and it has advantages in the number of talents and the game industry. With the investment of Microsoft and other companies, the improvement of domestic infrastructure and the improvement of talent training plans, Poland's digital economy still has huge development space and opportunities. Open government data is one of Poland's

strengths. In the 2020 EU "Open Data Maturity" ranking, Poland has risen from the third level "Fast-tracker" to the highest "Trend-setter".

3) The development level of the digital economy in Greece, Bulgaria, and Romania is at the end of the EU member states, and the digital economy has obvious shortcomings, only outstanding in some aspects. These countries have strong digital infrastructure or digital skills development needs, but the overall level of high-tech industry development is relatively weak, and they face the obvious problem of "brain drain".

Greece's DESI index ranks 25th in the EU-27. Its shortcomings in digital infrastructure are obvious, especially in terms of fixed broadband deployment and usage, which is far below the EU average. However, the AI industry in Greece has comparative advantages and is significantly higher than the EU average.

Bulgaria's DESI index ranks 26th in the EU, and there are obvious shortcomings in terms of people's digital skills, digital professionals, digital infrastructure, emerging digital technologies and business digitalization, which are far below the EU average. Only in terms of digital public services, it is close to the EU level, mainly due to the high score of digital services for businesses, but the level of digital public services for citizens is still relatively low.

Romania's overall DESI index ranks at the bottom of the EU, but its connectivity (high-speed network coverage) exceeds the EU average, and 5G deployment ranks among the top countries in Central and Eastern Europe. It has advantages in the fields of artificial intelligence and high-performance computers, and its ICT graduates rank fourth in the EU. However, due to brain drain, imperfect digital policy environment, and lack of digital public services, it is difficult for talent advantages to effectively promote the development of the digital economy industry. Romania has a relatively low level of digital commercialization and e-government.

4) There are still significant gaps in connectivity and digital skills between the Western Balkans and EU countries. In terms of broadband connection speeds, the Western Balkans, with the exception of Kosovo, lag behind the EU average. Countries that have massively deployed infrastructure in recent years, such as Montenegro and Serbia, are approaching the EU average for fast broadband subscriptions.

The Western Balkans performed better on communication-related indicators, above or very close to the EU average, and the average score for the use of internet for video calls and social networks in the Western Balkans is higher than in the European Union. The Western Balkans generally lag behind EU member states when it comes to advanced digital skills, while Serbia is closest to the EU average, which is a potential reason for long-term constraints on the region's digital economy boom.

In terms of business technology integration, i.e. business digitization and expansion of online sales channels, the Western Balkans performed relatively well, but to varying degrees. Most data are available for Serbia and Montenegro, both countries outperforming the EU average in most categories of business technology integration. However, North Macedonia and Kosovo are far behind the EU average in terms of e-commerce and online cross-border sales of SMEs. In terms of digital public services and e-government, the Western Balkans lag behind the EU average.

In 2018, the European Commission launched Digital Agenda for the Western Balkans, which aims to support the region's transition to a digital economy and enjoy the benefits of digital transformation, such as faster economic growth, more jobs and better services. The Agenda supports Western Balkan countries to invest more in broadband connectivity, strengthening cybersecurity, trust and industry digitization, strengthening digital economy and society, and research and innovation. In 2019, the Balkans Digital Highway Initiative, funded by the EU-Western Balkans Investment Framework (WBIF), aims to address digital infrastructure deficits and facilitate the sharing of infrastructure opportunities between the region and neighbouring economies.

3. Opportunities and challenges for China-CEECs digital economy cooperation

3.1. Basic situation of China-CEECs digital economy cooperation

It is relatively early for China and the EU to carry out digital economy dialogue and cooperation. In 2015, under the framework of high-level economic and trade dialogue, China and the EU established a China-EU digital economy and cybersecurity expert working group to conduct consultations on data privacy protection and digital transformation; in 2016, the Cyberspace Administration of China and the European Commission established dialogue and cooperation platform to cooperate on issues such as cyber security.

In terms of Central and Eastern Europe, in August 2019, the China-CEEC Blockchain Center of Excellence was established in Beijing and held a high-end digital dialogue. The main goal is to apply new technologies such as blockchain to energy, finance, aerospace and other industries, and to promote cutting-edge technologies Development and upgrading of the digital economy. In the same month, the China-CEEC Digital Economy Development Conference was held in Chengdu. The conference focused on 5G and related applications, with e-commerce platforms as the main application form. The digital economy cooperation between China and Central and Eastern European countries has the following characteristics:

1) The basis for cooperation is good. Chinese enterprises have generally participated in the construction of 4G networks in Central and Eastern European countries, and based on this, they have promoted the layout of new technologies such as 5G. Huawei

occupies a dominant position in the communication equipment manufacturing and communication service markets in Central and Eastern European countries, and has established R&D centers in Poland, Hungary and other countries to promote industry-university-research cooperation. TP-LINK established a subsidiary in Prague to engage in the trade of network and communication terminal equipment. IntreTech and Hungary Wick Group invested in the construction of an industrial park in Hungary, introducing the world's most advanced intelligent manufacturing technology and R&D capabilities into Hungary (Hua, 2020).

2) E-commerce trade is the main form of cooperation. Trade and investment are the main content of cooperation between China and Central and Eastern European countries, and bilateral digital economic cooperation also focuses on promoting trade growth. Among them, Central and Eastern European enterprises not only participate in the "CIIE", "China-CEEC Investment and Trade Expo", etc., but also actively enter the Chinese e-commerce platform. In this way, Central and Eastern European countries have found new channels to explore the Chinese market under the pandemic. As the main declaration place for cross-border e-commerce in Central and Eastern European countries, Ningbo cross-border e-commerce import transaction volume from Central and Eastern European countries has reached 720 million yuan. The China-CEEC Dialogue Mechanism on E-commerce Cooperation was also officially launched in June 2021.

3) The field of cooperation has gradually expanded to emerging industries such as big data and blockchain. In addition to 5G and e-commerce, China and Central and Eastern European countries have also leveraged their respective advantages to promote technological cooperation and trade in high value-added ICT technology research and development, big data, and blockchain. Among the Central and Eastern European countries, Poland, Estonia, Hungary, the Czech Republic, and Serbia have signed the "Digital Silk Road" agreement or MoU with China, and carried out cooperation in the fields of information industry, electronics and game industries. In recent years, the two sides have also promoted cooperation in the application of ICT technology in high-tech fields, including new energy, aerospace, medical and health care, etc., and promoted the establishment of smart city centers and blockchain centers led by Romania and Slovakia to promote industrial upgrading.

3.2. The practice of digital technology cooperation between China, Western Balkan countries and Hungary

Under the current situation, the Western Balkans urgently needs to strengthen their competitiveness in the field of digital economy. As mentioned above, the European Union has launched the "The Digital Agenda for the Western Balkans". Chinese technology companies have also made some footprints in the Western Balkans that point in the direction of developing the digital economy, nevertheless the level of cooperation is still uneven and needs to be improved.

Serbia can be considered the absolute frontrunner. The two countries signed a memorandum of understanding on Strengthening the Development of Information Silk Road for Information Connectivity in 2017. As a consequence of either the good political relationship or their corporate expansion strategy, the activity of Chinese tech companies increased substantially in the country. The list of such Chinese technology projects provides a good overview of possible forms of cooperation in developing the digital economy in the Western Balkans. Some of these projects targeted the upgrading of the telecommunication infrastructure which is the base for moving towards a digital economy. In 2016 Serbia's state-owned telecom giant Telekom Srbija and Chinese Huawei launched an EUR 150 million three-year ALL-IP transformation project to develop the landline network in Serbia. The Chinese company was also the partner of Telenor in establishing the country's first 5G base station in the Science-Technology Park, Belgrade. Huawei and HIKvision participated in smart and safe city initiatives in several Serbian cities, while the former also opened an Innovations and Development Centre in Belgrade in 2020, which will have a role in ecosystem building. Moreover, Huawei was a partner in establishing a city and a state data centre in Serbia. The city data centre in Kragujevac is a result of a USD 2 million investment from China. Serbia's government has also signed an MoU with Huawei for the development of an artificial intelligence (AI) platform that will serve the implementation of state-of-the-art e-government services. The EUR 11.7 million project is financed by the Chinese International Cooperation Development Agency. Serbia also cooperates with Chinese tech company NetDragon in using advanced technologies such as cloud computing and AI to build a national management and service system for smart education.

Other WB countries lag far behind Serbia in cooperating with Chinese companies on building the foundations of a digital economy. Bosnia and Herzegovina has concluded a technology partnership with Huawei in the framework of which the Chinese company would provide technical support to smart city and safe city projects in the country. Montenegro's state-owned telecom company signed a deal in 2011 with Huawei for the deployment of new technologies and the upgrade of its network. But state-owned Montenegro Telekom stated that it would use the Ericsson and Nokia equipment in the first phase of the 5G rollout. Huawei technologies have been a part of Albania's existing 4G network infrastructure. However, due to US pressure Albania selected Ericsson as the supplier of 5G equipment. Huawei has operations in North Macedonia. However North Macedonia may limit future partnerships with China in this field.

Sino-Hungarian cooperation. Hungary was traditionally China's most important partner in digital technology cooperation before the COVID-19 pandemic. Huawei Technology Hungary Kft. was established in 2005 as a subsidiary of Huawei. In 2009, Huawei located its European Supply Centre in Hungary. In 2013, Huawei opened an enlarged logistics centre in Biatorbágy, and in 2020 a research and development (R&D) centre was established in Budapest. Huawei has become a major investor in

the Hungarian economy because of its total investment of USD 1.5 billion over the past 15 years and either directly or indirectly created approximately 2,400 jobs in Hungary (Huawei, 2020). ZTE established a representative office in Budapest in 2005 and a subsidiary five years later. ZTE began to operate a new European regional network operation centre (NOC) and a call centre in Budapest in 2012. Huawei and ZTE are major players in Hungary's information and communication technology (ICT) field and also play a key role in the rollout of 5G networks in Hungary.

Two other areas where Chinese companies can be considered as major players are security information system and smart logistics. In 2015, Hungary experienced a significant wave of migration, which led the Hungarian government to decide to protect the Serbian-Hungarian border with the help of a temporary technical barrier. The Chinese Zhejiang Dahua Technology Co. provided a video surveillance system for the fence. Dahua Technology Hungary Kft, the Hungarian branch of Zhejiang Dahua Technology Co., is a world-leading video-centric smart IoT solution and service provider which opened its Hungarian office in 2016. Hikvision Hungary Kft. was established in Hungary in 2017 as a subsidiary of Hangzhou Hikvision Digital Technology Co. (Völgyi, 2021).

A breakthrough in the field of smart manufacturing was the strategic cooperation agreement between Wanhua and Huawei in 2016, under which Wanhua decided to establish its European info-communication centre in Hungary to raise the quality level of manufacturing technologies and improve operations. The cooperation between the two Chinese companies was introducing cutting-edge manufacturing technology based on big data, cloud technology and machine-to-machine communication, generally known as the "fourth industrial revolution" (IT Business, 2016).

3.3. The pandemic has accelerated the development of China-CEEC cooperation in digital economy

In the post-pandemic era, the new industrial revolution and the digitalization of the economy will be one of the main drivers of global value chain transformation, while those companies will emerge stronger from the crisis that apply the new digital technologies in value creation. Through digital supply chain technologies companies may respond 25% faster to sudden shocks which increase their resilience substantially in case of disruptive events like the Covid-19 pandemic. All these trends affect substantially the CEE economies as well.

In October 2020, consultant firm McKinsey reported the acceleration of the digital economy in the CEE during the first months of the Covid-19 lockdowns and estimated that it had captured 78%, or EUR 5.3 billion of the increase seen in the whole of 2019 in just five months. The 14.2% growth rate from January to May 2020 was almost twice as high as the year-on-year change observed in 2017–2019 (7.8%) (McKinsey & Company, 2020b). As the McKinsey Covid-19 Digital Sentiment Insights survey shows, almost 12 million new users of online services appeared in

CEE—more than the population of Slovakia, Croatia and Slovenia put together (McKinsey & Company, 2020c).

The education system has shown rapid adjustment and adaptability. Despite the massive setback caused by the pandemic, at the Western Balkans Digital Summit 2021, the region's education systems have shown the ability to rise to the challenge and quickly adapt and adjust to ensure continuity of learning but equity and quality gaps persist. Accelerating digital education and skills in the Western Balkan region is thus a key step towards ensuring resilience, recovery and future economic growth in line with the region's ambitions for EU accession.

The COVID-19 crisis and emerging megatrends mark a global inflection point for future trends of FDI flows and global value chains, which provide a unique opportunity for the Western Balkans region to undertake reforms to ensure it benefits from the shifting global context. The region can leverage its proximity to the EU to attract more FDI, but digitalization is needed in case of every WB country to take advantage of these FDI trends and to close the gap with best performing EU member states (World Bank Group, 2021).

In the post-pandemic period, Sino-Hungarian cooperation in the field of digitalization is particularly visible in the area of smart logistics. Vodafone Hungary and Huawei Technologies Hungary are installing a private 5G network at the East-West Gate railway intermodal combi-terminal at Fényeslitke, which aims to become the regional logistics hub for container rail cargo in the CEE region (HVG, 2021). In 2021, Cainiao, a Chinese logistics company belonging to Alibaba Group, announced the launch of its first direct cargo flight between Zhengzhou in China and Budapest in Hungary. Cainiao is planning to speed up the delivery of orders of Hungarian customers on the AliExpress global sales platform (SupplyChain, 2021).

In recent years, Chinese companies have not only entered the Hungarian market in the field of infrastructure construction and the provision of high-tech equipment, but also made breakthroughs in the field of research. Chinese Fudan University has opened a campus in Hungary and the research centres of the highest technological standard are expected to be established at the future university campus. This would attract other high-tech investments from China and promote cooperation in digitalization (Okosipar, 2021).

3.4. The main challenges in China-CEEC digital economy cooperation

1) The United States put pressure on Central and Eastern European countries to prevent them from conducting digital technology cooperation with Chinese companies. Relations between China and the United States were strained in 2019. In order to contain China's rise, the United States has begun to suppress China's high-tech enterprises on a global scale. Washington started accusing the Chinese

telecommunications company Huawei of spying for the Chinese state, and has repeatedly called for the CEE countries to act as military allies of the USA against Huawei. Yet the Hungarian government has so far resisted USA pressure. It has identified good cooperation with Huawei as a “national economic and strategic interest” and sees it as a key player in the roll-out of the 5G network as a partner for telecom companies operating in Hungary (Hungary Today, 2021). Although Hungary has come under considerable pressure as a member of the EU, NATO, and the Three Seas Initiative, the country is the only EU member state that has not formally committed to the principles of The Clean Network and has not made any gesture towards the USA government on this issue. In the Western Balkans, Huawei is a major player in the telecom sector and is therefore also sensitive to the US action against Huawei. Many of WB countries have been willing to cooperate with the US on the Clean Network. The growing Chinese role in the development of digital infrastructure in WB countries, such as the “Digital Silk Road” projects, is also a cause for concern within the EU and the US.

2) EU-specific cybersecurity standards will challenge China-CEEC digital technology cooperation. The issue of cybersecurity is of growing importance within the EU. In January 2020, the European Commission published the Toolbox on 5G Cybersecurity for EU member states. The Toolbox recommends nineteen strategic and technical measures member states can implement to strengthen the security of their 5G networks (Toolbox, 2020). The joint implementation of the Toolbox is greatly weakened by the fact that it is happening at national levels and on a voluntary basis. However, the implementation is supported by the fact that the Toolbox measures comply with the European Electronic Communications Code (EECC), that member states are supposed to implement by December 2020. Articles 40 and 41 of the EECC regulate security requirements for all member states, including Hungary (European Electronic Communications Code, 2018). The European Cybersecurity Agency, ENISA also issued two documents on 10 December 2021 for member states' national regulatory agencies to help them implement these provisions: the Guideline on Security Measures Under the EECC (Guideline, 2021) and a 5G Supplement to this Guideline (5G Supplement, 2021). As for WB countries, these frameworks are not binding. However, as potential candidates for the EU, it is very likely that the EU will propose the implementation of the Toolbox.

3) The EU's legislative norms in the digital field also restrict the participation of non-EU countries in digital cooperation. From 2020 to 2021, EU digital legislation gradually matured, forming legislative norms in all fields, in which the “European digital sovereignty” was stressed. In February 2020, the European Commission released the package of "Shaping Europe's Digital Future", "European Data Strategy", "White Paper on Artificial Intelligence: a European approach to excellence and trust", and in December 2020 proposed “Digital Services Act” and “Digital Markets Act”, thus forming a legal system for the whole process of digital economy from ICT manufacturing, ICT application to data protection.

In addition to focusing on the protection of user rights and the regulation of platforms in the upstream, midstream and downstream of the digital economy, EU laws and regulations also emphasize the protection of small and medium-sized enterprises and information security (especially data security). The EU requires that data shall be processed in Europe and governed only by EU law. At the practical level, Gaia-X, led by France and Germany, is committed to safeguarding "European digital sovereignty", and mainly promotes European data protection and cloud computing security through associations, national hubs and communities, including data localization content. Its participants include Estonia, Greece, Lithuania, Poland, Slovakia and Slovenia 6 Central and Eastern European countries (Gaia-X). The above-mentioned legislation and practices have led to discussions on the possible negative impact of data flow restrictions and platform restrictions. How to promote open cooperation, promote the free flow of data while ensuring security, and maintain the competitiveness of digital enterprises are still issues that need to be further explored (POLITICO EU, 2021).

4) Public opinion in Central and Eastern European countries has increased concerns about cooperation with China. With rising tensions between the USA and China, relations with China have increasingly become a domestic political issue, which is exacerbated by the COVID-19 pandemic. The main concern is that Chinese companies may obtain sensitive data in the field of digital cooperation. Since 2015, the risks of cooperating with Chinese companies in the deployment of mobile networks have been raised in parliamentary debates in Hungary, and the establishment of Fudan University campus in Hungary has sparked intense political debate in Hungary in 2021 (Licskay, 2021). Cybersecurity is less of a publicly discussed issue in WB countries than in the EU member states, posing fewer risks for digital cooperation with China.

4. Conclusions and recommendations

China-CEEC digital economic cooperation is carried out under the general framework of China-CEEC cooperation mechanism, which is bound to be influenced by the overall cooperation atmosphere, and is also closely related to the influence of the United States, the European Union and major EU countries in the region. At the same time, due to their own economic development levels and different attitudes towards major powers, the Central and Eastern European countries have uneven levels of digital cooperation with China. Nonetheless, the basis and conditions for digital transformation are the same. A resilient economy, a strong talent pool, high-quality digital infrastructure and a vibrant technology ecosystem are vital to Central and Eastern European countries, and digital cooperation with China should also focus on these factors.

The directions and suggestions for China-CEEC digital economy cooperation are as follows:

1) Helping Central and Eastern European countries address the challenges of talent pool shortages and the creation of tech ecosystem. One of CEE's strongest assets is its people, however migration of the educated workforce has been a major problem of the region in the past decades. A shortage of IT professionals means that CEE countries have to face an even stronger competition to retain their talents. Creating a lively ecosystem of innovative digital enterprises is also hindered by the lack of experienced entrepreneurs, underdeveloped professional contact network and difficulties in validating business ideas globally. As Sasa Popovic, CEO and co-founder of Vega IT Solutions, based in the tech hub of Novi Sad (Serbia) explained: "We believe that the two most important things for our country to prosper in the future are education and entrepreneurship". Cooperation between the region and China in the digital economy will be very valuable if this partnership addressed these challenges. Central and Eastern European countries want China to share best practices in building a tech ecosystem could also contribute to the long-term competitiveness of the region. Specific proposals include co-organizing regular events related to the digital economy, such as North Macedonia's annual e-commerce conference, which can boost local entrepreneurship. It is recommended that China can participate in mentor programmes for start-ups in the region, which will help CEE countries build a vibrant business ecosystem. Helping Central and Eastern European countries to innovate business ideas, which could help the region in moving up the value chain of the digital economy.

2) Facilitate green transformation and digital collaboration in telemedicine. The EU regards green and digital transformation as the main approach of post-pandemic recovery and long-term development. Central and Eastern European countries are also under pressure to eliminate outdated production capacity and drive growth with digital technology and digital industries. The two sides can cooperate on the green digital transformation of traditional energy and new precision energy-saving equipment; they can also promote the green digital transformation of ICT infrastructure and equipment manufacturing.

The epidemic has highlighted the fragility of the traditional medical industry. China and the Central and Eastern European countries have advantages in hardware and software of medical equipment respectively. The two sides can combine their respective advantages to jointly promote the research and development of high-quality telemedicine equipment in the whole process.

3) Bring digital economic cooperation into the local cooperation between China and Central and Eastern European countries. At present, China-CEEC digital economic cooperation mostly focuses on e-commerce platforms and bilateral and multilateral high-tech industrial cooperation, but lacks attention to local differences. In fact, both China and Central and Eastern European countries have unbalanced regional digital economic development. All parties should be encouraged to adapt to

local conditions, establish digital economic platforms with counterpart regions, and share development experience through platform effects to drive the development of relatively backward regions in the digital economy, and promote the regional balance between digital development and digital skills.

4) Weakening the current political constraints on cooperation. Under the current situation, digital economic cooperation between China and Central and Eastern European countries will still face the risk of being highly politicized. Although both sides are open to cooperation, alleviating political resistance is a real issue that both sides should consider. To this end, transparency and communication with the public should be strengthened in the actual cooperation process, so as to gain wider support and understanding. It is also possible to consider carrying out tripartite cooperation with some Western European countries to achieve benefit sharing and mutual benefit.

5) Launch the China-CEEC Digital Economic Cooperation Year as soon as possible. Share practices and experiences in digital epidemic prevention and digital applications, and discuss data security protection and digital economy governance rules. The two sides should focus on digital economic cooperation, build consensus, and inject new momentum into the all-round cooperation between China and Central and Eastern European countries.