Digital CAREC

Analysis of the Regional Digital Gap

PHASE 1

March 2022

IsDB البنك الإسلامي للتنمية Islamic Development Bank

CAREC INSTITUTE

Digital CAREC:
Analysis of the Regional Digital Gap
Phase 1

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March 2022

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List of Abbreviations

ADB	Asian Development Bank
AI	artificial intelligence
CAREC	Central Asia Regional Economic Cooperation
CDDI	Composite Digital Divide Index
CI	CAREC Institute
EaP	Eastern Partnership
EU	European Union
FDI	foreign direct investment
GDP	gross domestic product
GNI	gross national income
ICT	information and communication technology
IDB	Inter-American Development Bank
IsDB	Islamic Development Bank
LDC	least developed country
LLDC	landlocked developing country
MB	mobile broadband
MSME	micro, small and medium-size enterprise
OEC	Observatory of Economic Complexity
OECD	Organization for Economic Cooperation and Development
PCA	principal component analysis
SDG	sustainable development goal
SIDS	small island developing state
SME	small and medium-size enterprise
TORs	terms of reference
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UPU	Universal Postal Union
WEF	World Economic Forum

List of Tables

List of Figures

Table of Contents

Executive Summary

In the recent era of digitalization, the digital gap (divide) is the key hindrance faced by developing countries today, which yields income inequality, causing social conflict and loss of competitiveness, and polarizing people within/across countries, leading to digital hegemony and threatening sustainable growth. Likewise, the CAREC region has not fully benefited from the digital economy transformation. Therefore, it is imperative to analyze digital performance across the CAREC economies and devise policies to narrow the prevailing digital gaps. However, measuring the digital divide is a complex phenomenon owing to the multifaceted nature of the digital economy. Hence, the key objective of this report is to examine the digital gap between CAREC economies based on multiple factors of the digital economy.

Primarily, this report contains five sections. The first section gives a brief introduction and country profiles, while the second summarizes existing reports and literature. The third section offers methodologies to estimate and analyze the digital divide. It contains two subsections that expose both primary and secondary data analysis. The first segment explores detailed attributes of the digital divide in terms of *Digital Infrastructure, Digital Payments, E-commerce, and Internet Access* using questionnaire-based data collected from six CAREC economies: Afghanistan, Azerbaijan, Kyrgyzstan, Pakistan, Tajikistan, and Uzbekistan. Based on the average results, it is revealed that digital infrastructure and internet access are top performing indicators of digital development in the CAREC region, while digital payments and e-commerce report the lowest average score. Notably, a lower indicator score indicates a higher digital divide and vice versa. Overall, Azerbaijan (59.9) and Uzbekistan (57.8) are relatively less digitally divided economies compared to Kyrgyzstan (53.2), Pakistan (50.4), Tajikistan (45.6), and Afghanistan (39.0). Nevertheless, there is substantial heterogeneity across sub indicators.

In the second segment, the study employs principal component analysis (PCA) to construct a cumulative digital divide index (CDDI) using secondary data from 2016 to 2020. CDDI integrates multidimensional aspects of the digital gap considering *Cost and Affordability, Access and Infrastructure, Internet Quality, Digital Security, Regulations, Digital FDI, and ICT output.* For CDDI, this study includes eight CAREC economies: Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, and Uzbekistan, while Afghanistan, Turkmenistan, and China were dropped owing to data limitations. Notably, a lower CDDI score specifies a higher digital divide and vice versa. The average CDDI score exhibits that Kazakhstan and Georgia are the least digitally divided countries in the selected CAREC region with cumulative average scores of 0.868 and 0.798, respectively, while Azerbaijan and Mongolia are moderately divided in the digital spectrum with average scores of 0.562 and 0.480, respectively. Uzbekistan (0.306), Kyrgyzstan (0.276), Pakistan (0.196), and Tajikistan (0.078) are the least performing economies in CDDI, confirming a higher digital divide. Although Kazakhstan and Georgia secured the highest score in the selected CAREC region, they demonstrated a substantial digital divide compared with other developed regions such as the European Union or China.

Overall, both methodologies produce different features of the same phenomena, which indicates that the digital divide exists not only in the digital infrastructure, but also in socioeconomic and regulatory factors. The differences in ranking and country scores in CDDI emerged mainly owing to the use of distinctive indicators and integration of time trends compared to questionnaire-based output. These results help us identify absolute and relative digital backwardness in multiple domains and their respective solutions and policy recommendations.

Keywords: digital divide, digital gap, principal component analysis, CAREC economies

1. Introduction

The advent of the 'fourth industrial revolution' has brought advanced digitalization into the global economy, with increasing access to information and connectivity. This revolution plays a crucial role in achieving sustainable development goals (SDGs). However, 50 percent of the world's population remains unconnected, posing a danger to the groups being left behind. The gap between and within countries needs to be addressed to ensure equitable gains from digitalization. The importance of this endeavor was made apparent when the United Nations designated access to the internet and information and communication technology (ICT) as a target of SDG 9c in 2015.

Among other digitally divided regions, there is the challenge and opportunity of developing the Central Asia Regional Economic Cooperation (CAREC) economies to harness the commitment of digital transformation by reducing the digital divide gap. Currently, the COVID-19 pandemic has reiterated the importance of the digital economy and connectivity. It entails examining challenges and impeding factors to provide sound data driven and research-based policies to tighten the digital gap.

Manifestly, the CAREC region—particularly Central Asia, a landlocked part of the Asian region—still lacks connectivity infrastructure. It is located far from the world's main fiber optic routes under the sea and oceans. Kyrgyzstan, Tajikistan, and double-landlocked Uzbekistan are more complicated as their mountainous geography complicates the provision of broadband connectivity (World Bank, 2020). Afghanistan (ITU, 2018) and Pakistan (Baloch and Musyani, 2020) have a similar geographic challenge that hinders digital inclusiveness. Similarly, Azerbaijan is another landlocked country in the CAREC region embodied with lower digital penetration. The telecom industry mostly dominates the ICT sector, and a value-added level is relatively low across all countries (ADB, 2019).

Almost half the population in Central Asia (Uzbekistan 55 percent, Kyrgyzstan 38 percent, and Tajikistan 22 percent) is not digitally connected, and less than 20 percent of Afghanistan (13.5 percent) and Pakistan's (15.51 percent) population utilizes the internet. In addition, many disconnected individuals live in remote rural areas (UN DESA, 2020). Notably, five out of six selected CAREC economies are below the global average in terms of the number of individuals using the internet. Only Azerbaijan (79.8 percent) demonstrates a higher number of individuals using the internet compared with the global average.

Specifically, over the last few years, most CAREC economies have made headway in creating the infrastructure required for the digital economy, particularly e-commerce. However, the digital economies have progressed at a different rate. Different infrastructure components have not always evolved at the same rate, resulting in some countries being ahead in certain sectors while falling behind in others (CAREC, 2021). It creates a digital gap not only in the countries themselves but within the region. In a recent study of CAREC and ADB, it is suggested that the CAREC economies are required to coordinate their efforts to harmonize their laws closely with the global consensus. It facilitates closing the digital gap and developing e-commerce in the region (CAREC and ADB, 2021).

Moreover, to consolidate the collective efforts to achieve the UN Agenda 2030 and digital inclusion, the International Telecommunications Union (ITU) introduced a common strategy—Connect 2030—where goal 2 is 'inclusiveness: bridge the digital divide and provide broadband access for all' (ITU, 2020). Similar objectives are considered in the upcoming Digital CAREC Strategy 2030. Following this vision of bringing digital inclusiveness and promoting sustainable development in CAREC economies has great relevance.

1.1 Study Objectives

The main objective of the research project is to examine the digital gap of six CAREC economies (Afghanistan, Azerbaijan, Kyrgyzstan, Pakistan, Tajikistan, and Uzbekistan) for the digitalization of their economies. This research provides a gap analysis report to identify the digital divide between the member countries based on foreign direct investment (FDI), including investment in digital infrastructure, internet access, digital payment, and digital trade or e-commerce. Additionally, this study also constructed a cumulative digital divide index using a panel of eight CAREC countries: Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, and Uzbekistan. The proposed index integrates multidimensional aspects of the digital gap considering cost and affordability, access and infrastructure, internet quality, digital security, regulations, digital FDI, and ICT output.

The specific objectives of the study are:

- To provide a comparative analysis of the current situation of the digital economy with the potential in selected CAREC economies and to identify gaps for development and action.
- To analyze the 'digital divide' among the selected CAREC economies and to provide a comparison with the rest of the CAREC economies and other regions.
- To identify major gap areas and opportunities for bridging the digital gap in the region.

1.2 Country Profiles of Digital Development

The digitalization of the economy and the building of a digital economy are closely related to establishing a stable and secure digital infrastructure. Without a constant and secure digital infrastructure, digitalization of the economy is impossible. For example, the use of ICT in economic relations and the production of digital products based on digital technologies are core fundamentals of this phenomenon. The rapidly developing internet of things (IoT), 5G technologies, big data, cloud computing, robotization, cyber security, and the introduction of artificial intelligence (AI) worldwide also require the construction and updating of the corresponding backbone infrastructure. Without a stable fixed infrastructure, it is impossible to ensure the provision of both international and domestic communication services at the level of advanced standards. Nowadays, communication services are rapidly developing all over the world, the number of users and devices connected to the internet is growing. Telecommunication operators receive new foreign and domestic infrastructure investments every year.

Abecassis et al. (2018) state that since 2014 telecommunication companies have invested more than USD300 billion in digital infrastructure. The research shows that there will be an increase in the number of devices connected to the internet. Moreover, according to the GSM Association (GSMA) report 'The Mobile Economy 2019' (GSMA, 2019), the number of IoT connections will triple and reach 25 billion in the world for the period 2018-2025. During the same period, income from IoT will grow four times to reach USD1.1 trillion. Digitalization and infrastructure development will lead to an increase in the number and users of mobile internet. This report also projects 5 billion internet users based on the benchmark of 3.6 billion in 2018. On the other hand, new statistics of the recent GSMA (2021) report suggest that the COVID-19 pandemic impacts IoT sales in various industries, including connected vehicles, smart cities, and smart buildings. The forecast for 2025 has been lowered to 20 percent, and global revenues for IoT will account for USD900 billion.

Moreover, the digital economy's data consumption is putting a strain on existing IT infrastructure. Data lines, internet exchanges, data centers, cloud computing, and hosting businesses are part of the digital

infrastructure. The digital economy has produced an entirely new supply chain owing to this rising demand: the digital supply chain. Data transportation, storage, and processing are all part of this chain. Data centers, which can house hundreds of servers and facilitate various forms of data storage and processing from storing secure data to facilitating online shopping or analyzing data with advanced AI algorithms, are another essential part of the digital infrastructure ecosystem (Baker McKenzie, 2021).

1.2.1 Afghanistan

Afghanistan is a low-income country in the neighborhood of Central Asia, and its economy is mainly driven by the export of raw materials. The population of Afghanistan is around 38.9 million people and this figure is increasing rapidly, particularly in recent decades (World Bank, 2020). Afghanistan presents enormous connectivity issues as a landlocked and mountainous country in terms of the digital economy. Only 11 percent of the population uses the internet (World Bank 2017), and around 75 percent of the population live in rural and often remote places (World Bank 2019). The cost of using the internet is also a continuing concern. Owing to its landlocked status and lack of submarine cables, Afghanistan has been subjected to transaction fees from its neighbors, Pakistan, Iran, and Turkmenistan (ITU, 2018). Table 1 presents country ranking based on existing digital development indices by different organizations and multidevelopment partners.

Table 1: Main Digital Development Indicators of Afghanistan

UNCTAD B2C e-commerce rank (2020)	143/152
ICT Development Index (IDI)—ITU (2017)	159/176
UNPAN E-Government Development Index (2020)	169/193
Inclusive Internet Index (3i)—EIU (2021)	N/A
Network Readiness Index (NRI) (2020)	N/A
Proportion of internet users who shop online, in percent (2019)	3
UPU reliability score (2020)	14.21 (+3.24)

Source: UNCTAD (2019; 2020), ITU (2017), UN DESA (2020), UPU (2020)

On the other hand, digital governance has long been seen as a crucial component of the government's development plan (Government of Afghanistan, 2008). The Ministry of Communications and Information Technology (MCIT) stated its intention for ICT to be widely used within government to increase public sector efficiency and deliver better social services in its information and communications (ICT) policy document, which was first published in 2003 (OECD, 2019). Furthermore, the government underlined its ambition for a digital transformation of the public sector in the 2018-2022 ICT Policy for Afghanistan, building on past work on digital government in Afghanistan (Government of Afghanistan, 2018).

1.2.2 Azerbaijan

The issue of establishing a sustainable ICT infrastructure in Azerbaijan is also brought up by digitalization and the development of a digital economy. Modernizing the fixed technological foundation and building a new digital infrastructure are essential for improving the digital economy and increasing the number of internet users. Geographically, Azerbaijan connects Europe and Central Asia and comprises 800 kilometers from the Black Sea to the Caspian Sea. Azerbaijan inhabits 10.11 million people (World Bank 2020). Economically speaking, Azerbaijan is an upper middle-income economy, and the extraction of fossil fuels

drives its economy. Oil production accounts for over 90 percent of Azerbaijan's exports, and the oil and gas industry accounts for 33 percent to 50 percent of Azerbaijan's GDP, depending on oil prices (OECD, 2019). Thus, Azerbaijan has vast oil resources that are the main driving force of the economy.

On the other hand, the Government of Azerbaijan supports and puts effort into the development of the digital economy. This idea is at the heart of the 'Azerbaijan Digital HUB' program, which has begun to be implemented to turn Azerbaijan into a regional digital center. Among the state bodies of Azerbaijan, the State Agency for Public Service and Social Innovations under the President of the Republic of Azerbaijan plays an important role in promoting digital transformation in the country. The agency created the Center for the Development of Electronic Government to support the digitalization of the public sector and the Center for Incubation and Acceleration INNOLAND, which supports the development of startups in the ICT field (UNESCAP, 2020). The 'ASAN Xidmət' was introduced by the Government of Azerbaijan, successfully implementing and reaching various milestones in providing digital public services. Through 15 ASAN centers around the nation, run by ASAN Xidmət, the public can access 315 services from 11 government departments and private organizations and businesses. Some services have been moved to online, and mobile services are now also accessible. ASAN is being implemented in collaboration with the commercial sector, responsible for developing software and earning profit through transaction fees. In 2015, ASAN received a United Nations public service award for public service delivery (Yoon, 2019).

Another important project to promote e-governance in Azerbaijan is 'Digital Azerbaijan,' which is a digital information center covering portals that provide digital services in Azerbaijan, information on digital services and their use, information on events in this area, and surveys for civil thought about services. The portal is operated by the E-Gov Development Center. By creating the country's digital platform, the center plays an important role in safeguarding citizens' living standards and access to government services and promoting these services among the population. The center also operates the myGov portal where the citizens can easily obtain information in real time based on information exchange from the electronic systems of relevant government agencies.

Regarding the B2C E-commerce Index of Azerbaijan (UNCTAD, 2020), the country's rank was changed from 63 to 65, with an index value of 60 in 2020. Azerbaijanian internet shoppers comprised 2 percent of a share of internet users and a 1 percent share of the total population in 2020 (UNCTAD, 2019). This shows there is still space to develop the digital economy of Azerbaijan. At the end of the fourth quarter of 2020 (Trend, 2021), compared with the same period of the previous year, the volume of cashless transactions of digital payments increased by 34 percent in Azerbaijan, contactless payments by 5.2 times, and the volume of payments via the internet and mobile banking by 65 percent and 90 percent, respectively. Table 2 offers country ranking based on existing digital development indices, suggesting a lower rank than other developing Asian countries.

Table 2: Main Digital Development Indicators of Azerbaijan

UNCTAD B2C e-commerce rank (2020)	65/152
ICT Development Index (IDI)—ITU (2017)	65/176
UNPAN E-Government Development Index (2020)	70/193
Inclusive Internet Index (3i)—EIU (2021)	52/120
Network Readiness Index (NRI)—(2020)	66/134
Proportion of internet users who shop online, in percent (2019)	2
UPU reliability score (2020)	44.66 (-2.33)

Source: UNCTAD (2019; 2020), ITU (2017), UN DESA (2020), UPU (2020)

Therefore, the government of Azerbaijan set goals for digital transformation of the economy by implementing the State Program on the Implementation of the National Strategy for the Development of Information Society in Azerbaijan for 2016-2020[1] with 52 measures toward this goal. Additionally, since 2016, the Strategic Roadmap for Development of Telecommunications and Information Technologies in Azerbaijan has been realized (Government of Azerbaijan, 2016). Currently, the government is drafting a new Digital Transformation Concept to be accepted in the coming months.

1.2.3 Kyrgyzstan

Kyrgyzstan is a lower middle-income country, one of the poorest countries in Central Asia with Tajikistan, and the second least urbanized country in the region (World Bank, 2020). Remittances account for 33.2 percent of the country's GDP. The economy is extremely vulnerable to fluctuations in commodity prices, as gold and mining account for 63.5 percent of total exports and absorb 80 percent of FDI (OECD, 2019). Consumption/e-commerce, development investment, public administration, and export–import operations are the key components of Kyrgyzstan's digital economy nowadays. Consumption as a kind of virtual commerce accounts for most of the entire volume of the digital economy. This is in line with the percentage increase over the previous year. Domestic appliances and electronics, apparel and footwear, furniture, and household products are the most popular areas for digital commerce. In Kyrgyzstan, these categories account for 80 percent of the e-commerce market. Table 3 describes the country's ranking based on existing reports, suggesting a much lower rank globally.

Table 3: Main Digital Development Indicators of Kyrgyzstan

UNCTAD B2C e-commerce rank (2020)	97/152
ICT Development Index (IDI)—ITU (2017)	109/176
UNPAN E-Government Development Index (2020)	83/193
Inclusive Internet Index (3i)—EIU (2021)	N/A
Network Readiness Index (NRI)—(2020)	94/134
Proportion of internet users who shop online, in percent (2019)	5
UPU reliability score (2020)	25,19 (+1,58)

Source: UNCTAD (2019; 2020), ITU (2017), UN DESA (2020), UPU (2020)

The National Development Strategy of Kyrgyzstan for 2018-2040 was approved in Kyrgyzstan by decree of the President of Kyrgyzstan on 31 October 2018, one of the strategic foundations of which was the 'Taza Koom' (translated as 'Smart Society') National Digital Transformation Program (Institute for Statistical Research and Professional Development of the Kyrgyz Republic, 2020). Accordingly, to develop

[1] http://www.e-qanun.az/framework/33717

and provide support in the implementation of digitalization and e-government development, the Ministry of Digital Development was established by the merger of the State Digital Development Service under the Government of the Kyrgyz Republic and the State Registration Service under the Ministry of Justice of the Kyrgyz Republic.

This merge was carried out to pool resources for digital transformation, assuring Kyrgyzstan's long term growth in the digital age (Ministry of Digital Development of The Kyrgyz Republic, 2021). The current national strategy focuses on the implementation of modern technologies—in particular, in the customs, education, and banking services. The Taza Koom program is considered a key component of the national sustainable development strategy until 2040 and envisions the advance of digital public services, smart cities and villages, infrastructure, and human capital in Kyrgyzstan.

1.2.4 Pakistan

Pakistan has the largest population count among selected CAREC countries, with 220.89 million citizens (World Bank, 2020). Pakistan borders Afghanistan, China, India, and Iran by land and Oman by sea. Most of Pakistan's export share comes from the textile industry and rice. The top export destinations are the United States (14.4 percent), China (7.75 percent), Germany (6.71 percent), the United Kingdom (6.13 percent), and Afghanistan (4.44 percent) (OEC, 2021). Pakistan had over 173 million mobile connections in January 2021, according to Data Reportal's (2021) research, an online platform that aggregates digital insights from around the world. Between January 2020 and January 2021, the number of mobile connections in the country climbed by 6.9 million (a 4.2 percent rise). Table 4 shows that the country's ranking is based on prevailing digital development indicators and confirms that Pakistan lags behind its potential and falls in the lower quartiles of digital development.

Table 4: Main Digital Development Indicators of Pakistan

UNCTAD B2C e-commerce rank (2020)	116 (114 in 2019)
ICT Development Index (IDI)—ITU (2017)	148/176
UNPAN E-Government Development Index (2020)	153/193
Inclusive Internet Index (3i)—EIU (2021)	90/120
Network Readiness Index (NRI)—(2020)	111/134
Proportion of internet users who shop online, in percent (2019)	5
UPU reliability score (2020)	39.36 (-0.05)

Source: UNCTAD (2019; 2020), ITU (2017), UN DESA (2020), UPU (2020)

The Ministry of Information Technology and Telecommunication (MOITT) was preparing to launch the Digital Pakistan Policy (DPP) 2021, in line with the government's goal. The DPP 2021 was developed after a thorough consultation process involving all four provinces and two regions, including Gilgit-Baltistan, Azad Jammu, and Kashmir. Creating a digital ecosystem in Pakistan with infrastructure and institutional frameworks for the quick delivery of innovative digital services, apps, and content is a primary goal of the Digital Pakistan Policy. This policy indicates a move from a piecemeal approach to a comprehensive technology strategy that emphasizes the digital economy as a broad enabler of socioeconomic development in various sectors of Pakistan's economy (Ministry of IT and Telecom of Pakistan, 2018).

1.2.5 Tajikistan

Tajikistan is the only former Soviet Union country classified by the World Bank as a low income country (2020). The Tajik population is mainly rural, and characterized by the lowest level of urbanization in Central Asia with a 27 percent rate. The government has a 15 year plan to provide appropriate infrastructure and job opportunities for more than 45 percent of the population under 20 in 2015. Agriculture is still a large part of the economy, accounting for 21 percent of GDP, but climate change poses severe dangers to the sector (OECD, 2019). The People's Republic of China and the Russian Federation are the two primary sources of FDI in Tajikistan, accounting for 22 percent and 21 percent of total FDI inflow, respectively (Chamber of Commerce and Industry of the Republic of Tajikistan) (n.d.). Kazakhstan (8 percent), the United Kingdom (7 percent), the United States (6 percent), and the Philippines (6 percent) are also key sources of FDI (5 percent).

Tajikistan has already reaped the benefits of having a well developed ICT sector. From 2000 to 2015, it was one of the fastest growing sectors in the country, contributing to socioeconomic development and state budget revenue (Olters, 2021). Table 5 reports the country's global ranking, indicating a lower rank worldwide.

Table 5: Main Digital Development Indicators of Tajikistan

UNCTAD B2C e-commerce rank (2020)	121 (130 in 2019)
ICT Development Index (IDI)—ITU (2017)	N/A
UNPAN E-Government Development Index (2020)	133/193
Inclusive Internet Index (3i)—EIU (2021)	N/A
Network Readiness Index (NRI)—(2020)	109/134
Proportion of internet users who shop online, in percent (2019)	27
UPU reliability score (2020)	7,37 (no change)

Source: UNCTAD (2019; 2020), ITU (2017), UN DESA (2020), UPU (2020)

Political priorities and measures for the digital transformation of the economy and society of Tajikistan are enshrined in the National Development Strategy of the country for the period up to 2030 (Government of Tajikistan, 2016) and the Concept of Digital Economy in Tajikistan (Government of Tajikistan, 2019). Within the framework of this program, Tajikistan seeks to improve the quality of the legal and institutional framework for the development of technology industries and an innovative economy. Both two documents state that the digital transformation of the economy in Tajikistan should be based on more effective institutional development and improved e-governance, and aimed at strengthening the network of national technology parks and diversifying the economy through the development of knowledge intensive industrial sectors.

1.2.6 Uzbekistan

Uzbekistan is the most populous and low middle income country in Central Asia. Its economy relies primarily on gold, petroleum, and cotton exports. Switzerland (primarily as a market for its gold exports), the People's Republic of China (the first country of origin for imports and the second country of destination for exports), and the Russian Federation are Uzbekistan's prime commercial partners (OEC, 2021). Despite the government's history of protectionist trade policies, greater trade openness has become a key component of the economic reform plan since 2017. One of the country's key priorities is economic diversification and the transition to the creation of high tech industries with higher added value (Center of Development Strategy, 2020). The strategy 'Digital Uzbekistan 2030,' adopted by presidential decree

on 5 October 2020, calls for over 280 initiatives for regional digital transformation and sectors of the country's economy over the following two years (Kutbitdinov and Ismailov, 2021).

In addition, a comprehensive program—'Digital Tashkent'—is being implemented, which provides the launch of a geoportal integrated with more than 40 information systems (Government of Uzbekistan, 2020). In 2021, it was planned to increase digitalization in the healthcare sector, and complete the implementation of electronic polyclinic and telemedicine systems in the regions based on the experience of fighting the pandemic. The banking sector's digital revolution, which includes automated management systems and financial technology, will continue. More than USD600 million will be invested in agriculture's digitization to bring contemporary agricultural technology and creative solutions (Kutbitdinov and Ismailov, 2021). Table 6 reports the country's ranking based on existing reports, signifying a lower ranking in the global spectrum.

Table 6: Main Digital Development Indicators of Uzbekistan

UNCTAD B2C e-commerce rank (2020)	107 (94 in 2019)
ICT Development Index (IDI)—ITU (2017)	95/176
UNPAN E-Government Development Index (2020)	87/193
Inclusive Internet Index (3i)—EIU (2021)	76/120
Network Readiness Index (NRI)—(2020)	N/A
Proportion of internet users who shop online, in percent (2019)	6
UPU reliability score (2020)	19.67 (-8.39)

Source: UNCTAD (2019; 2020); WEF (2019); WIPO (2021); UPU (2020).

1.3 Overview of CAREC Digital Strategy 2030

CAREC member countries developed the CAREC Digital Strategy 2030 in 2021. The strategy serves as a vision, plan, and stimulus for regional cooperation in digital transformation. Its goal is to serve as a mechanism for fostering policy dialog and design, capacity building, information exchange, and the implementation of initiatives and programs that use and promote digital technology to address social and economic concerns in the region (CAREC, 2021). The current study adhered to the objectives and scope of the CAREC Digital Strategy.

2. Literature Review

2.1 Definition of Key Constructs

2.1.1 Digital Divide

The Organization for Economic Cooperation and Development (OECD) broadly defines the digital divide as: 'The gap between individuals, households, businesses, and geographic areas at different socioeconomic levels with regard both to their opportunities to access ICTs and to their use of the internet for a wide variety of activities' (OECD, 2001). The digital divide is usually considered the lack of access to information and communication technology (ICT) (Brock, 2014).

Some scholars also include the lack of digital infrastructure, affordability, knowledge, and skills as one of the main components of the digital divide (Ben et al., 2017). Moreover, Chakravorti (2021) states that one of the major solutions to bridge the digital gap in the United States is a majorly digital investment.

Currently, the shifting digital landscape since the last great global tragedy, the 2008/2009 financial crisis, is shown in a new UNCTAD (2020) study. It examines how a technologically equipped environment benefits certain people more than others. According to the study, the coronavirus outbreak has expedited the use of digital solutions, tools, and services, hastening the worldwide shift to a digital economy.

In addition, the new IMF study (García-Escribano, 2020) shows that the speed of the internet defines the digital gap not only within the country but between countries. Despite being world leaders in mobile money transactions, countries in Sub-Saharan Africa, followed by several emerging and growing economies in Asia, have some of the lowest internet connectivity. There is also a significant difference in internet access among businesses in Sub-Saharan Africa—only approximately 60 percent of organizations use email for business in Sub-Saharan Africa, compared with roughly 85 percent in Europe and Central Asia.

Comparatively speaking, even within LDCs, there remains a digital gap. There are significant disparities in per capita income, geography, and population size among LDCs. This variation is also seen in digital development levels, with some nation features clustering together. For example, most Asian LDCs are at the forefront of digital growth, all SIDS are in the middle stage, and many African LLDCs are at the bottom (ITU, 2021). Another study on the digital divide in the EU has found some differences in access, usage, and benefits that exist across Europe and explicitly in East EU member states (Ragnedda and Kreitem, 2018).

2.1.2 Digital Infrastructure

ITU (2020) defines digital infrastructure as a vital component of a country's economy, easing the movement of products, permitting exports, and guaranteeing that citizens receive governmental services. Digital infrastructure is the foundation of the digital economy, which is formed by various digital objects. The development of high-tech digital infrastructure provides competitiveness within the digital economy (Nosova et al., 2019). Digital infrastructure has become important to provide digital connectivity while maintaining societal resilience and business continuity. Especially during the COVID-19 crisis, digital infrastructure providers worldwide faced challenges and a higher demand for connectivity as most citizens were ordering goods and services online because of lockdown and/or working from home (Strusani and Houngbonon, 2020). Thus, there are opportunities for digital infrastructure providers to increase the value of connectivity via higher demand. The WBG Digital Economy for Africa (DE4A) flagship initiative tool defined that digital infrastructure includes mobile internet, fixed broadband internet, complementing infrastructure computer, tablets, smartphones, servers, and all related and peripheral hardware (World Bank, 2020).

2.1.3 Internet Access

Internet infrastructure is a crucial part of digital infrastructure and provides an essential tool to realize e-commerce. The Digital Economy and Society Index study included connectivity and the use of internet services dimensions as fundamental to measuring the digital economy level and identifying the gaps (European Commission, 2020). Moreover, OECD (2019) and IDB (Zaballos et al., 2020) both concluded that increasing investment in connectivity and increasing efficiency of investments in digital infrastructure would benefit future technologies and achieve sustainable development goals.

2.1.4 Digital Payments

The adoption and utilization of fintech solutions are commonly accepted as a tool for the rationale to achieve broader sustainable development goals such as gender equity and poverty reduction (Lewis et al., 2017). UNCTAD (2019; p. 127) recommends governments of LDCs to support mobile payments and other cashless solutions and digital financial literacy among MSMEs. Also, the governments were advised to promote various e-banking solutions, intra-bank transactions, and other digital banking innovations. Research on Chinese digital finance (Jiang et al., 2021) demonstrated that the development of fintech had stimulated the easing of regional entrepreneurship, which in turn promoted economic growth. In Indonesia, digital payment start-ups disrupted the banking sector; however, P2P fintech does not substantially disrupt the banks, primarily because the users focus more on security reasons (Siek and Sutanto, 2019).

2.1.5 E-Commerce

According to the OECD definition of e-commerce, 'The sale or purchase of goods or services, conducted over computer networks by methods specifically designed to receive or place orders. Those methods order the goods or services, but the payment and the ultimate delivery of the goods or services do not have to be conducted online. An e-commerce transaction can be between enterprises, households, individuals, governments, and other public or private organizations. To be included are orders made over the web, extranet, or electronic data charge. The type is defined by the method of placing the order. To be excluded are orders made by telephone calls, facsimile, or manually typed email.' (Dhaundiyal, 2021).

Attracting FDI to expand the digital economy (also known as 'digital FDI') is one way to boost capacity and competitiveness, particularly for small and medium-sized businesses (SMEs) (Stephenson et al., 2021). Digital FDI contributes to financial flow and increases embedded digital knowledge and technology, resulting in job creation and increased productivity (World Bank, 2016). UN ESCAP's (2021) study emphasizes the role of multinational enterprises (MNEs) in the development of the digital economy as they are considered the primary drivers of digital FDI. The digital FDI investors reflect high quality digital connection and digital skills and a robust and stable regulatory framework that attract high end experts from across the world as the most crucial factors in financing the host country. Moreover, data security, data privacy, content monitoring, data localization requirements, copyright, contract, consumer protection laws, and laws governing e-agreements are all crucial.

A previous CAREC report highlighted the role of e-commerce in creating opportunities for vulnerable groups such as women, people with disabilities, and those living in rural areas (CAREC Institute, 2021). Similarly, an OECD report emphasizes that measuring e-commerce helps establish relevant policies for taxation, consumer policy, cross border trade, and the environment (OECD, 2019). Therefore, it is important to look at e-commerce aspects in this study. Lastly, as stated earlier, during the COVID-19 crisis, the digital economy provided a safer platform for interaction between people and organizations and the flow of goods and services. Governments are increasingly setting digitalization at the front and center of policy agendas, including in the CAREC countries. Hence, it is important to support their research and policy recommendation efforts. Finally, in addition to the CAREC Institute (2021) report, further studies should be conducted to explore the role of digital infrastructure, digital FDI, digital payment systems, and government policies on e-commerce.

EU4Digital has launched its e-commerce pilot, establishing national virtual warehouses in Azerbaijan and Georgia to support retailers, marketplaces, delivery operators, and customs to place products for sale

abroad and facilitate cross border delivery. The e-commerce pilot aims to strengthen the e-commerce ecosystem and increase e-commerce volumes, increase awareness and support to prepare for the 2021 e-commerce VAT package introduced in the EU, and address existing cross border challenges in e-commerce trade. Within the pilot, the companies from Azerbaijan (a seller of handcrafted wooden accessories) and Georgia (two women-led businesses, producing children's clothing and eco-friendly housewarming gifts) successfully sold their products to Germany through the virtual warehouse (the case study is given in Appendix 3)

2.1.6 E-Governance

UNPAN (2011) defines e-governance as 'the application of ICT tools in (1) the interaction between government and citizens and businesses, and (2) in internal government operations to simplify and improve democratic governance.' While UNESCO (2011) provided a broader definition stating that e-governance is 'the public sector's use of information and communication technologies to improve information and service delivery, encouraging citizen participation in the decision-making process and making government more accountable, transparent, and effective.'

Many studies emphasize the role of governments in developing digital services and e-government (Jarrar, 2017; World Bank, n.a.; Hanna, 2018). Moreover, quality of life is directly correlated with the level of e-government services and ICT related opportunities, as demonstrated in a recent survey conducted in Europe by the United Nations Subgroup C7 E-Government for Sustainable Development and the Institute for Management and Sustainable Development. The greatest barrier to adopting e-services, according to the respondents, is the reluctance to change, and they believe that individual cohesive strategy and public policy in the e-government area should be connected to worldwide standards. This highlights the critical role of e-governance in closing the digital gap and fostering a citizen centered, egalitarian digital society (Stoiciu, 2021). Furthermore, governments at all levels—national, regional, and local—may benefit from a well-designed digital infrastructure (World Bank, n.a.). This is a clear message that digital infrastructure development should go hand in hand with digital government development.

2.2 Summary of Literature Review

The key studies conducted in the CAREC region on the digital gap are primarily focused on infrastructure (CAREC Institute, 2021), financial inclusion aspects (Khalid, 2021), laws and policies (ADB and CAREC Institute, 2021), e-commerce intensity and postal usage (OECD, 2019; UNCTAD, 2019), and e-government development (UN DESA, 2020). These reports are mainly descriptive in nature and did not compare cross country gap analysis. Table 7 offers a summary of existing reports for the sake of brevity. The summary will help to identify the current study's contribution and further enhance the research analysis.

Moreover, researchers on cross regional and cross-country analysis of the digital divide use digital infrastructure elements, income levels, capital investments, usage, digital services, and legal framework quality as variables to measure the existing gap (Doong and Ho, 2012; Mardikyan et al., 2015; Lewis et al., 2017; Ben et al., 2017; Braesemann and Stephany, 2020; Farooqi et al., 2020; Vimalkumar et al., 2021; and Mushtaq et al., 2021). Notably, some studies include regional integration as one of the main indicators of the study. Economic unions or membership of various regional organizations can provide a more accessible environment for cross border trade and continually improve the digital economy (Duval, 2020). A large extent of existing literature implemented qualitative or descriptive analysis to measure the different attributes of the digital economy such as e-commerce, digital infrastructure, digital financial inclusion, and e-governance; however, little is known regarding a cumulative digital divide using national

level indicators. Tables 7 and 8 represent the summary of relevant research articles and published reports on the digital divide. This brief summary assists us in identifying the research gap and strengthening the study's key contribution. Only a few studies, such as Majid et al. (2021), estimate the digital divide using digital infrastructure and internet quality using selected Asian and Oceania country data. Another recent working paper by UN (ESCAP) proposed a comprehensive theoretical framework to estimate the digital divide based on infrastructure and non-infrastructure factors. We have extended the same and proposed an inclusive digital divide index based on multiple dimensions.

Table 7: Summary of Reports on Digital Divide

Report	Author(s)	Data	Main Indicators
Developing E-Commerce in CAREC Countries: Current State and Challenges in Infrastructure Development (2021)	CAREC Institute	Secondary data from various sources	-Internet infrastructure -Payments -Logistics -E-commerce market
Financial Inclusion and Fintech in CAREC: Constraints and Prospects (2021)	CAREC Institute by Khalid Umar	Secondary data from various sources	**Financial Inclusion:** -Account ownership -Bank account by gender, income, and age group **Financial Adoption:** -Using and accessing account -Purpose of using the account -Online purchasing
E-commerce in CAREC Countries: Laws and Policies (2021)	ADB and CAREC Institute	Secondary data from various sources	-E-commerce use -Internet infrastructure -International connectivity modes and network technologies -Internet download speeds -Internet access and usage -Subscriptions to mobile cellular telephones and broadband internet -Electronic payment capacity and use -Postal and logistics performance indexes
Asia-Pacific Regional Cooperation and Integration Index (2021)	ADB	Primary data	-Trade and investment integration -Money and finance integration -Regional value chain -Infrastructure and connectivity -People and social integration -Institutional arrangements -Technology and digital connectivity -Environmental cooperation
Unpacking E-Commerce: Business Models, Trends, and Policies (2019)	OECD	Secondary data from various sources	-Value of e-commerce in the US and EU28 by sector, 2016 -E-commerce intensity by sector, 2017 -Firm participation in e-commerce by size, 2017 -E-commerce intensity, 2017 -E-commerce engagement in web sales and EDI by firm size, 2010-2017 -Sales channels and B2C sales by sector, 2012-2017

Report	Author(s)	Data	Main Indicators
UNCTAD B2C E-Commerce Index 2019	UNCTAD	Secondary data from various sources	- Account ownership at a financial institution or with a mobile money service provider (percent of population ages 15+) - Individuals using the internet (percent of population) - Postal reliability index - Secure internet servers (per 1 million people)
Measuring the Digital Divide in the Asia-Pacific Region for the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) (2019)	UN ESCAP	Secondary data from various sources	- Affordability - Availability - Digital education - Digital security - Environment - Resilience
E-Government Survey 2020: Digital Government in the Decade of Action for Sustainable Development (2020)	UN DESA	Primary data (Survey)	- The E-Government Development Index (EGDI) - The Online Service Index (OSI) - The Telecommunication Infrastructure Index (TII) - The Human Capital Index (HCI) - E-Participation Index
EU4Digital: Supporting Digital Economy and Society in the Eastern Partnership E-Commerce Report Recommendations Proposed for E-Commerce Environment Harmonization in the EaP Countries: Republic of Azerbaijan (2021)	EU4Digital	Comparative gap analysis	- E-commerce ecosystem - E-commerce legislation - And standards
On the Harmonization of the Digital Markets in the Eastern Partnership: E-Trade, E-Logistics, and Digital Transport Corridors (2018)	HDM	Comparative gap analysis	- National framework for paperless trade - Buying products and services - Export procedures - Import procedures - Payment procedures
Study on the Harmonization of the Digital Markets (HDM) in the Eastern Partnership (2015)	HDM	Comparative gap analysis	- Network, information and cyber security - Electronic identification (e-ID) and electronic trust services (eIDAS) - E-customs - E-commerce for SMEs - Digital skills - Telecom rules

Table 8: Summary of Articles on Digital Divide

Report	Author(s)	Data	Methodology	Main Indicators
Examining the Global Digital Divide: A Cross-Country Analysis (2015)	Sona Mardikyan, Endam Ayçiçek Yıldız, Mehmet Derya Ordu, and Burcu Şimşek	The cross-sectional data is collected for 145 countries in the world, for 2011	One way ANOVA and regression analysis	-ITU ICT key indicators -Development levels -Income levels -OECD membership -Continental differences
The Impact of ICT Development on the Global Digital Divide (2012)	Shing H Doong, Shu-Chun Ho	Secondary data for 136 countries from 2000 to 2008	1. The first principal component (FPC) score is initially used as a composite index approach 2. The cluster scores approach 3. Panel data analysis is used to assess whether there is a causal relationship between national wealth and ICT development status	-GNI -Mobile penetration -Internet user penetration -Capital investment in telecom -Total telecom revenue
Measuring Digital Development with Online Data Digital Economies in Eastern Europe and Central Asia (2020)	Braesemann, Fabian Stephany, Fabian	Online generated datasets are analyzed to demonstrate that visualization tools can be a complement to traditional statistics	Comparative study	-E-services -Online labor markets -Online knowledge -Creation and access to online knowledge
Exploring the Multilevel Digital Divide in Mobile Phone Adoption: A Comparison of Developing Nations (2021)	M Vimalkumar, Jang Bahadur Singh, and Sujeet Kumar Sharma	This study utilizes individual level survey data collected by the Financial Inclusion Insights (FII) Tracker Survey	Multinomial Logistic Regression	-Basic demographics -Household characteristics -Access to and use of mobile devices -Formal financial services -Financial literacy, preparedness, and other general financial behavior.

Report	Author(s)	Data	Methodology	Main Indicators
A Multivariate Statistical Analysis on Digital Divide across Asia and Oceania Countries (2021)	Majid Mushtaqa, Yuosre FM Badirb, Bomi Songc, Moon-Soo Kim	The variables chosen for the research are all compatible with the recommendations from the OECD. Out of 10 indicators, 9 have been obtained from the 'Measuring the Information Society Report 2017' (International Telecommunication Union, 2017) pertaining to 2016. 1 indicator, that plays a vital role in defining the digital development of a country, Secure Internet Servers, was taken from World Bank's website pertaining to 2016.	Matrix correlation, PCA (factor and cluster analysis) multivariate techniques	-Fixed telephone subscriptions per 100 inhabitants -Fixed broadband subscriptions per 100 inhabitants -Mobile cellular prices (percent GNI pc) -Fixed broadband prices (percent GNI pc) -Mobile broadband prices 500MB (percent GNI pc) -Percentage of households with a computer -Percentage of households with internet access -Percentage of individuals using the internet -Secure internet servers (per 1 million people) -Active mobile broadband subscriptions per 100 inhabitants
Brookings financial and digital inclusion project: Building a Secure and Inclusive Global Financial Ecosystem (2017)	Robin J Lewis, John D Villasenor, and Darrell M West	Primary data was collected from government officials, industry leaders, international finance institution representatives, and other key stakeholders	Country summaries and score carding method	Four 'dimensions' of financial inclusion: -Country commitment -Mobile capacity -Regulatory environment, -Adoption of traditional and digital financial services
Impact analysis of fintech on banking industry (2019)	Siek, M and Sutanto, A	Data collection using convenience random sampling through questionnaire created in Google forms.	The data analysis methods include linear regression analysis, reliability	-Promotion -Ease of use -Convenience -Faster transaction

Report	Author(s)	Data	Methodology	Main Indicators
			analysis, validity analysis, correlation analysis.	-Wide range of merchant -Safety
The Nexus between Digital Finance and Economic Development: Evidence from China (2021)	Jiang, X; Wang, X; Ren, J; Xie, Z	Secondary data based on big data on trading accounts on digital inclusive finance from Ant Financial Services	A panel econometric model, mediating effect model, and instrumental variable method were employed to evaluate yearly data from 30 provinces of China from 2011 to 2018	Independent variables -Economic growth -Digital finance -Coverage breadth -Usage depth -Digitization level Mediator Variable -Entrepreneurship Control Variables -Capital input -Labor input -Government intervention -Urbanization rate -Industrial structure -Physical infrastructure

Note: Compiled by the authors

3. Methodology, Results, and Discussion

This chapter primarily contains two sections that used both primary (questionnaire based) and secondary data analysis. The first segment includes a questionnaire, which explores detailed digital divide attributes in terms of the subjective and objective features of the digital economy. The second section proposes the construction of a composite digital divide index and its comparison with ICT leading economies using recent macro level indicators from 2016 to 2020.

Unlike previous studies, this report complements existing qualitative studies by offering new insights into digital infrastructure, digital payments, e-commerce, and internet access. Moving one step further, this study offers an inclusive picture of the digital divide based on cost and affordability, internet quality, digital security, regulations, digital FDI, and ICT output. It also produces year-on-year trends from 2016 to 2020 and comparisons across indicators and countries. To the best of our knowledge, this is a pioneering study that scientifically estimates the cumulative digital divide index across CAREC countries. This framework can be expanded for other countries to include other indicators.

3.1 Primary Analysis of Digital Divide

In the first section, primary data collection includes quantitative measurement of the current situation in the digital economy within a given country. For this purpose, a questionnaire is compiled to examine the digital gap of selected CAREC economies to digitalize the economies. The filled questionnaires are analyzed to see the results on the digital divide in the selected countries. Based on the retrieved score, gaps are identified with respective recommendations.

3.1.1 Construction and Definition of Questionnaires

The questionnaire was divided into four main sections and subsections using the following TORs:

- Digital infrastructure
    - Digital public services
    - Integration of digital technology
    - Access to digital financial services
- Digital payments
- E-commerce
    - E-commerce ecosystem
    - Trust, security, and privacy
- Internet access
    - Use of internet

The questionnaire is designed by analyzing the main indicators used in similar surveys previously held within the World Bank, EU (HDM, DESI), CAREC Institute, ADB, and IsDB projects and annual reports of ITU, UN, and WEF. Some additional questions apart from those used in the reports mentioned above were added to the questionnaire to obtain more information and identify deeper gaps in the digital economy. The questions cover such necessary information as available international payment systems, amount of DFDI, 4G coverage, financial tools/policies, state programs, incentives, and projects implemented in the selected countries to develop the mentioned areas of study.

The questions cover available legislation, programs and strategies, logistics and supply chain (availability of world known logistics/delivery companies), e-commerce platforms in the country, payment methods and e-payment platforms, development programs, projects, and other relevant data that will be useful for identification of the digital divide between the member countries. The opinion of field experts available in the selected countries was also taken into consideration. The questionnaires were filled in by a number of interviewees. For some specific questions that interviewees did not answer, field experts were interviewed.

3.1.2 Interviewees

During the study, data collection and analysis were undertaken on the various aspects of the digital economy in the selected CAREC countries. The proposed interviewees were selected considering their previous experience conducting similar surveys in the Eastern Partnership (EaP) countries. Table 9 reports the detailed information of relevant state authorities and other stakeholders interviewed during this study.

3.1.3 Collection and Presentation of Data

The study evaluates the level of the digital economy focusing on four priority digital economy areas:

- Digital infrastructure
- Digital payment
- Internet access
- E-commerce

Two types of questionnaires were designed—a comprehensive version and a short version with the most important indicators. The comprehensive version was filled in all six countries, while the short version was filled with the assistance of CAREC local coordinators in two CAREC economies (Uzbekistan and Azerbaijan). Several indicators were defined for each of the four priority areas of the digital economy. The indicators characterize the most important aspects, such as economic, technical, and political perspectives. The filled questionnaires (short and comprehensive versions are given in Appendix 4 and 5, respectively). During data collection and processing, descriptive statistical methods were used. The collected data was analyzed and used to draft the current situation in the areas surveyed, identify gaps, prepare country profiles, and form recommendations to narrow the gaps. The representatives of interviewees shown in 3.1.2 were interviewed on the questions indicated in the questionnaire. Local field experts were interviewed for some specific questions/indicators that were not answered by interviewees. Moreover, e-commerce platforms in selected countries were also analyzed on local and cross border trade possibilities.

3.1.4 Visualization of Results

The analysed results are grouped into several graphs, radars, and charts describing each indicator by country, the average of each indicator in six countries, country data on each indicator, and data for each country on all the subindicators. The indicators by country show the average rate for each country on each indicator. Country data shows the data of the country on each indicator. The radars of each country on indicators and average in six countries show the country's position among six countries. The table with main subindicators taken into consideration during the assessment and used for data calculations on four areas is also presented. Tables 11 to 15 provide detailed information on all the main subindicators, while other relevant graphs including radar charts are given in Figures 1 to 6.

Table 9: List of Interviewed Organizations

Organization name	Description	Key functions in relation to digital economy
Ministry of Information Technologies (MIT)	Central executive body, which formulates and implements state policy, secures the legal normative regulation in the areas of communications (telecommunication, post), high technology (information technology, microelectronics, space, nano, bio, and other innovative knowledge based technology).	Electronic certificates provider for e-signature, state register of information resources and systems, regulator in ICT sector.
Statistical authority	State body that promotes and safeguards the production and publication of official statistics that serve the public good.	Produces the data relevant to the indicators of the digital economy components (areas).
National postal operator	The governmental authority is responsible for postal matters. Postal operations involve the execution of domestic and international postal services to include the receipt, transportation, and delivery of authorized classes of mail, specialized mailing services, the operation of postal facilities, and the sale of postage, philatelic materials, and mailing supplies.	Possess the data on indicators of e-commerce (cross border trade, regulations).
Customs authority (agency)	Customs is an authority or agency responsible for collecting tariffs and controlling the flow of goods, including animals, transports, personal effects, and hazardous items, into and out of a country. Customs is the fiscal subject that charges customs duties (tariffs) and other import/export taxes. It is also responsible for trade facilitation.	Possess the data on indicators of e-commerce (cross border trade, regulations).
Tax/fiscal ministry or corresponding divisions of the Ministry of Finance	Government agency responsible for the intake of government revenue, including taxes and sometimes non-tax revenue, also charged with tax collection, investigation of tax evasion, or carrying out audits.	Data on investments, banking sector, financial services, and other relevant data on digital payments and e-commerce.

Organization name	Description	Key functions in relation to digital economy
Ministry of Economy (Trade)	Central executive body implementing the state policy and regulation in the formation of the economic policy of the country, preparation of macroeconomic forecasts, creation of favorable conditions for economic development and economic growth, trade development (including e-trade operations), providing the promotion of investment activity, development of entrepreneurship and industry, regulation of the licensing and authorization system, prevention of monopoly, elimination of unfair competition, protection of consumer rights, purchase of goods (works and services) at the expense of the state funds, management, and privatization of state property.	E-trade and SME relations indicators.
National (Central) Bank	Central or national bank of the country that establishes and implements the country's monetary and foreign exchange policy, sets and announces an official exchange rate of the national currency, develops a reporting balance of payments, develops the country's consolidated foreign debt statistics, and international investment balance.	Data on investments, banking sector, cashless payments, and other relevant data on digital payments.
Cyber security authorities	State authority provides coordination of the activity of the entities of information infrastructure, awareness about existing cyber threats on a country level, education of population, private entities, and other organizations in the field of cyber security.	Data on trust, cyber security, and privacy issues.
Local parcel delivery services	Parcel delivery companies engaged in the delivery of goods within the country borders (locally only).	Information on e-commerce operations, delivery and return of goods.
Marketplaces available in selected countries selling cross border	A platform that provides information about products of national origin and becomes the beneficial platform for their sale in foreign and domestic markets.	E-commerce related information.

3.1.5 Description of Results

Assessment of the digital economy indicators in the selected CAREC economies defines the overall state of play of the digital economy areas in this country. The most important indicators in each of the four areas of study were selected or grouped into one general subindicator for assessment. Benchmarks are defined for each of the four priority areas of the digital economy and then grouped into indicators. All the indicators are given in a single unit of measurement—percentage—and assessed in percentage. The percentage scale is divided into five parts: 0, 25, 50, 75, and 100. Scoring is done by selecting from 'not available' as to 'fully available' for each indicator on a scale of 0 percent to 100 percent. At the same time, 100 percent is taken as the maximum level (baseline) of the indicator (the definition of China as a baseline is not possible owing to the lack of required data for adequate data comparison).

Table 10: Assessment Criterion for Indicators

0	25	50	75	100
The weakest indicator	Weak indicators	Medium indicator	Good indicator	The best indicator

The result of 'fully available' (the best indicator) means that the country meets the maximum level and thus receives 100 percent of the milestones. The answer 'not available' means that the country does not meet the corresponding indicator; therefore, it has 0 percent. Based on the assessment of subindicators, an average indicator on each area is defined for each country. Scores of indicators are also calculated as an average of the six selected countries. Scores are presented in different graphical charts. Table 11 describes the scores across different indicators and countries, indicating a significant heterogeneity among CAREC economies in different indicators of the digital economy. It can be observed that digital payments and e-commerce (digital infrastructure) are key indicators where the digital divide is more (in case of digital payments) and less (in case of e-commerce) pronounced across all CAREC countries. The average score revealed that Azerbaijan (59.9), Uzbekistan (57.8), and Kyrgyzstan (53.2) are relatively less divided economies across the CAREC region compared to Pakistan (50.4), Tajikistan (45.6), and Afghanistan (39.0). Notably, the average score of Afghanistan, Tajikistan, and Pakistan is less than the CAREC average score (51.0), and most of the subindicators are visualized in red, implying a higher digital divide.

Table 11: Assessment of Countries Based on Indicators

Indicators	Afghanistan	Azerbaijan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan	Average score (indicators)
Digital infrastructure	50.0	75.0	71.4	71.4	60.7	67.9	66.1
Digital payments	45.8	50.0	50.0	54.2	50.0	54.2	50.7
E-commerce	31.3	43.8	37.5	34.4	34.4	34.4	35.9
Internet access	29.2	70.8	54.2	41.7	37.5	75.0	51.4
Average digital economy score	39.0	59.9	53.2	50.4	45.6	57.8	51.0
Country rank on average score	6	1	3	4	5	2	N/A

3.1.6 Key Findings and Summary of Results

This section presents key findings and results on each area studied. The table of results on digital infrastructure indicators for the selected countries and the chart on the average result on digital infrastructure indicators for all countries, and more detailed results of the selected countries on each subindicator assessed are given below.

a) Digital Infrastructure

Table 12 reports the findings of digital infrastructure, which indicates that subindicators are substantially varied across sample countries and fall within the range of 50 percent to 75 percent (the average for the selected six countries is 67.3 percent). The best progress has been achieved in the field of 'national framework/availability of any specific national strategies for digital infrastructure development' and 'country coverage with 4G network.' The weakest indicator among all six countries is 'citizens using online public services.' The highest score was obtained by Azerbaijan, Kyrgyzstan, and Pakistan, while Afghanistan shows the lowest score. The remaining countries demonstrate more or less similar levels in digital infrastructure. Figure 1 reports subindicators of digital infrastructure for each country, while Figure 1a shows the average indicator score across all countries, suggesting the highest gap in Afghanistan and Tajikistan.

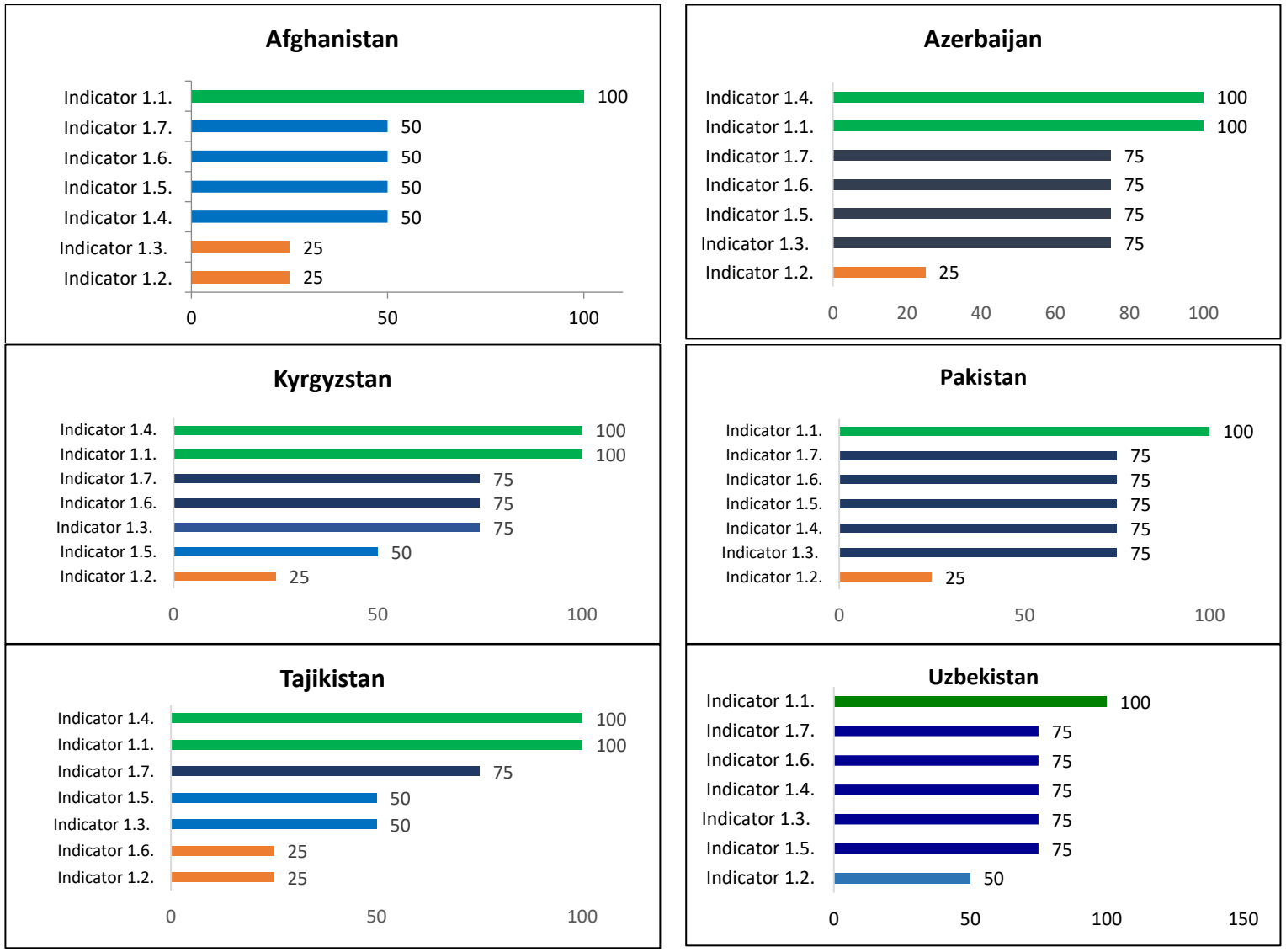
Table 12: Country Results of Each Subindicator of Digital Infrastructure

Indicators	Afghanistan	Azerbaijan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan	Countries' average
1.1. National framework/availability of any specific national strategies for digital infrastructure development	100	100	100	100	100	100	100.0
1.2. Citizens using online public services	25	25	25	25	25	25	25.0
1.3. Amount of FDI in digital infrastructure	25	75	75	75	50	75	62.5
1.4. Country coverage with 4G network	50	100	100	75	100	75	83.3
1.5. Usage of new technologies in digital infrastructure	50	75	50	75	50	50	58.3
1.6. Availability of micro, small, and medium-size enterprise (MSME) innovation and digitalization hubs (techno parks, SEZs)	50	75	75	75	25	75	62.5
1.7. Availability of any e-health methods	50	75	75	75	75	75	70.8
Average indicators	50	75	71.4	71.4	60.7	67.9	66.1

b) Digital Payments

From Table 13, the countries demonstrate closer results in most subindicators of digital payments within the range of 45 percent to 54 percent (the average for the selected six countries is 50.7 percent) except for the 'volume of cashless payments,' which is the weakest point (33.3). The best performing countries among the six countries are Pakistan and Uzbekistan, while the others have similar results. The best indicator is digital banking services provided to process financial transactions and activities. The weakest

Figure 1: Average Country Results of Digital Infrastructure Subindicators



part is the inability to perform a transaction (receipt and payments) using international payment systems (such as PayPal), which is considered a major gap in the development of e-commerce in the CAREC region. Figure 2 displays subindicators of digital payment for each country. And Figure 2a shows the average indicator score across all countries, suggesting that the highest gaps are in Afghanistan, Azerbaijan, Kyrgyzstan, and Tajikistan.

Table 13: Country Results of Each Subindicator of Digital Payments

Area/indicator	Afghanistan	Azerbaijan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan	Countries' average
2.1. Volume of cashless payments	25	25	25	50	25	50	33.3
2.2. Digital financial products offered by financial service providers	50	50	50	50	50	50	50.0
2.3. Programs for increasing the volume of cashless payments	50	50	50	50	50	50	50.0
2.4. Availability of major payment methods used worldwide to sell and pay for goods on the major marketplaces	50	50	50	50	50	50	50.0
2.5. Digital banking services that help to process financial transactions and activities	50	75	75	75	75	75	70.8
2.6. Availability of specific programs or policies aimed at increasing the cashless payment volume	50	50	50	50	50	50	50.0
Average indicators	45.8	50.0	50.0	54.2	50.0	54.2	50.7

c) E-Commerce

From Table 14, the average indicator in e-commerce (36 percent) is the lowest among other areas of the digital economy. The main challenge that hinders e-commerce development in these countries is that none of the selected countries can register directly on international marketplaces to sell abroad. There are only e-commerce platforms for selling locally. Only the Azerbaijan platform allows local exporters to sell abroad, but there is no possibility of the opposite happening. Although since May 2021, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan have gained an opportunity to sell on Amazon; the real registration has not yet occurred owing to restrictions on the use of international payment systems such as PayPal in the specified countries. The highest indicator among countries is the usage of advanced technologies in online trade such as single window platforms, 'green transport corridor' approach, electronic pre-arrival declaration procedure. Azerbaijan shows the highest score (43.8) while the rest of the countries demonstrate indicators that are relatively close to each other (31.3 to 37.5). Notwithstanding, Azerbaijan uses the e-signature for cross border operations with Belarus. Figure 3 demonstrates subindicators of e-commerce for each country, and Figure 3a displays the average indicator score across all countries, suggesting the highest gap in all sample countries.

Figure 2: Average Country Results of Digital Payment Subindicators

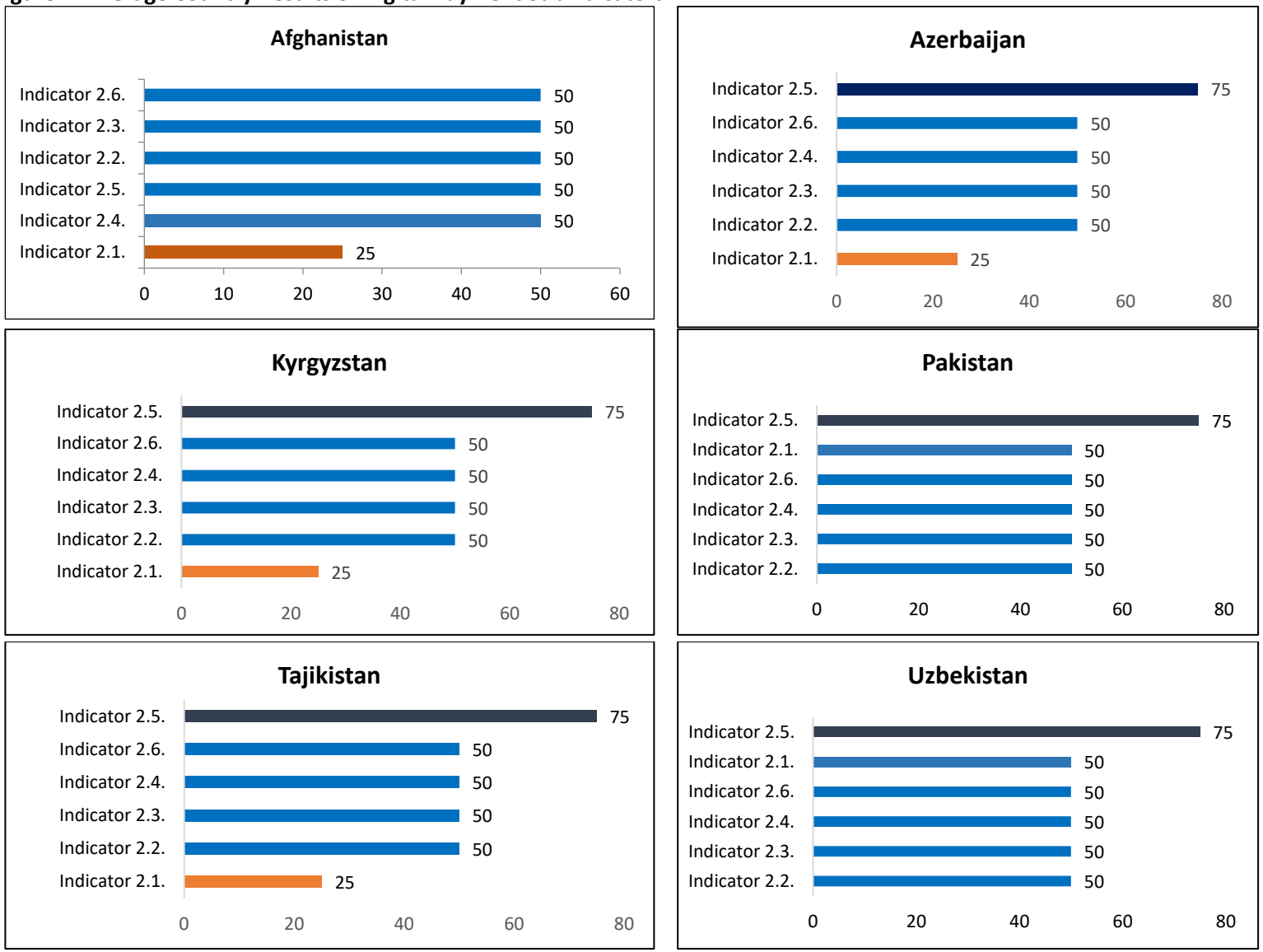


Table 14: Country Results of Each Subindicator of E-Commerce

Area/indicator	Afghanistan	Azerbaijan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan	Countries' average
3.1. Enterprises having a website with e-commerce functions	25	50	25	25	25	50	33.3
3.2. Can SMEs as companies directly register on international marketplaces—such as Amazon or Alibaba—to sell abroad?	0	0	0	0	0	0	0
3.3. Key marketplaces in the country that enable cross border buying and selling	25	50	50	25	25	25	33.3
3.4. Individuals purchasing goods, services, or content over the internet	25	25	25	25	25	25	25.0
3.5. Usage of advanced technologies in online sales (single window platforms, 'green transport corridor' approach, electronic pre-arrival declaration procedure)	50	75	75	75	75	50	66.7
3.6. Legal framework for cross border electronic data exchange between customs	50	50	50	50	50	50	50.0
3.7. What are the most common parcel delivery services used for cross border and local parcels?	75	75	75	75	75	75	75.0
3.8. Usage of e-signature for cross border operations	0	25	0	0	0	0	25.0
Average indicators	31.3	43.8	37.5	34.4	34.4	34.4	35.9

d) Internet Access

Table 15 exposes the highest score in internet access in 'share of enterprises with internet access as a percentage of all enterprises.' In contrast, the lowest score is observed in 'individuals using the internet for selling goods and services,' implying bottlenecks for smooth e-commerce operations. Moreover, Uzbekistan and Azerbaijan demonstrate the highest score, while Afghanistan achieved the lowest score among the six countries. Figure 4 includes subindicators of internet access for each country, while Figure 4a visualizes the average indicator score across all countries, suggesting a moderate gap in all countries except Afghanistan. Moreover, Figure 5 visualizes the average indicator score of the digital economy.

Table 15: Country Results of Each Subindicator of Internet Access

Area/indicator	Afghanistan	Azerbaijan	Kyrgyzstan	Pakistan	Tajikistan	Uzbekistan	Countries' average
4.1. Households using a fixed broadband internet connection at home	0	100	75	50	25	100	58.3
4.2. Individuals using mobile devices to access the internet away from home or work	50	75	50	50	50	75	58.3
4.3. Schools with internet access (e-skills)	25	100	75	25	25	100	58.3
4.4. Share of enterprises with internet access in total number of all enterprises	50	100	75	75	75	100	79.2
4.5. Individuals using the internet for internet banking.	25	25	25	25	25	50	29.2
4.6. Individuals using the internet for selling goods or services.	25	25	25	25	25	25	25.0
Average indicators	29.2	70.8	54.2	41.7	37.5	75.0	51.4

The overall result in the digital economy, taking into account the indicators of all four areas is shown in Figure 5. As can be seen, three of the six countries are above the average (51.0) of the region. Afghanistan, Pakistan, and Tajikistan have to improve their infrastructure, especially for e-commerce and internet access.

3.1.7 Identified Gaps in CAREC Economies

Based on the questionnaire responses and taking into account the opinion of field experts during the interviews, and the gaps indicated in the previous reports of CI and EU, the following gaps are identified and grouped into four parts of the digital economy.

1. **Digital Infrastructure**
   - Lack of e-skills and cultural issues for low level use of online services
   - Low level of public confidence in digital documents and services
   - Security concerns and internet shutdowns
   - Most rural and remote areas do not have access to digital infrastructure
   - No precise data on the amount of FDI on different sectors/areas (Each country is presented on the average annual number of total investments in the range of USD200 million. But this is a general figure that does not specify the amount of FDI in each area of the digital economy). The amount of FDI in Afghanistan is lower than in other CAREC countries.
   - Low level use of digital technologies in the social sphere

2. **Digital Payments**
   - Lack of awareness on the use of cashless payment methods
   - Lack of trust in online payments and low level of cashless transactions
   - Limited digital banking services
   - Rapidly growing services require investment in infrastructure and legislative support
   - High restrictions on the transfer of money abroad, high threshold of the minimum service fee (minimum 25 euros for any amount)
   - Impossible to register on international payment systems (such as PayPal) for receiving payments

Figure 3: Average Country Results of E-Commerce Subindicators

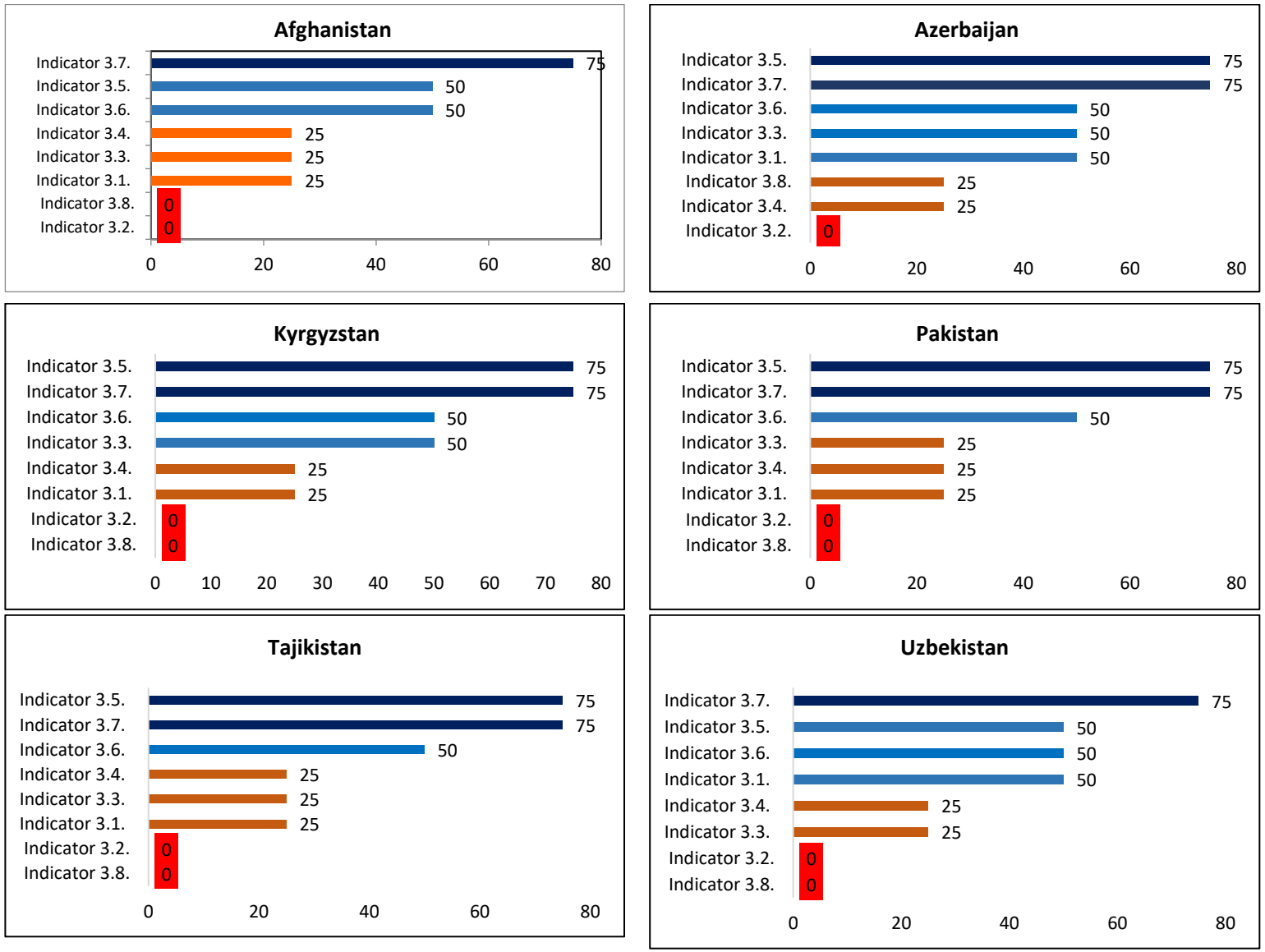


Figure 4: Average Country Results of Internet Access Subindicators

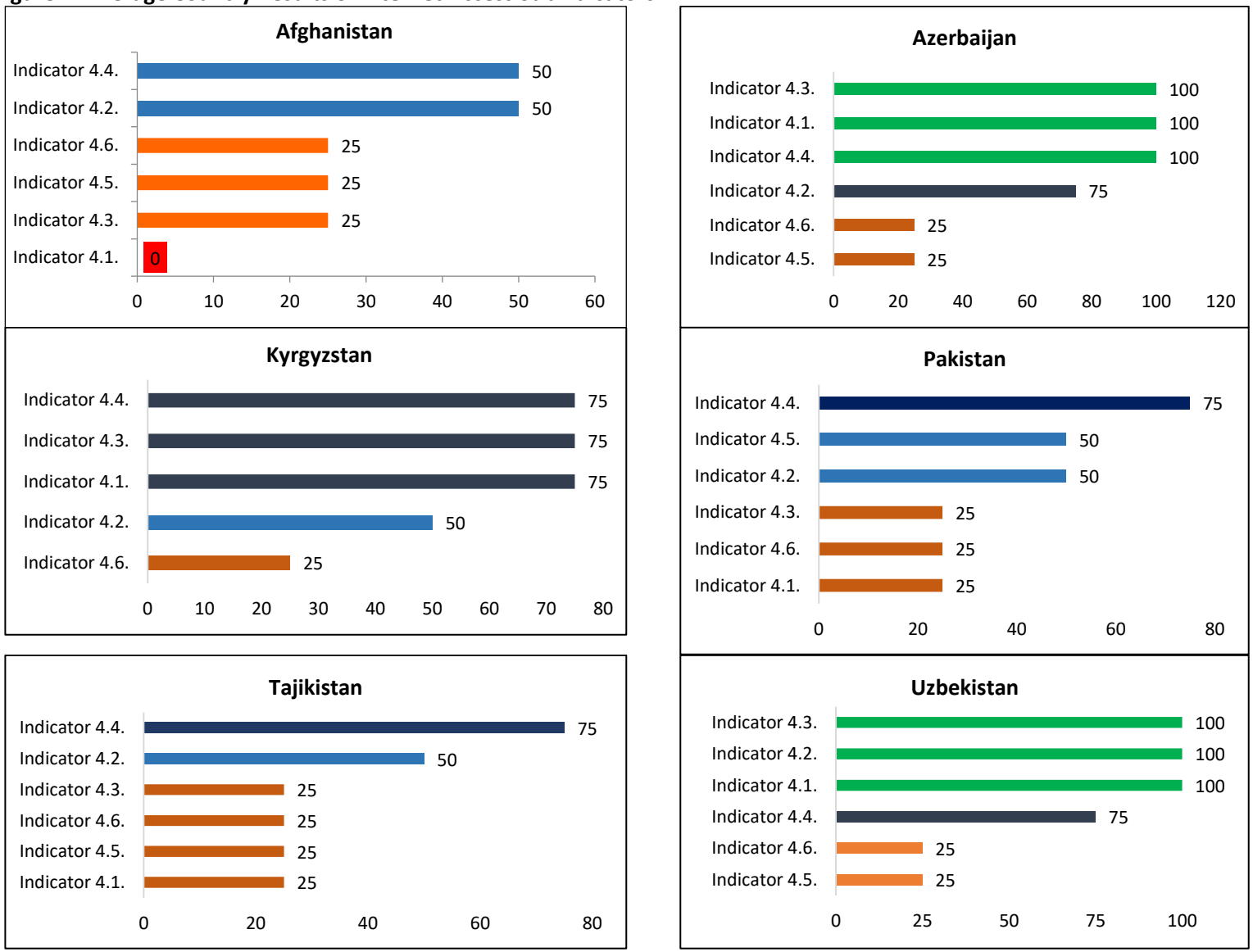


Figure 1a: Average Indicators by Country on Digital Infrastructure

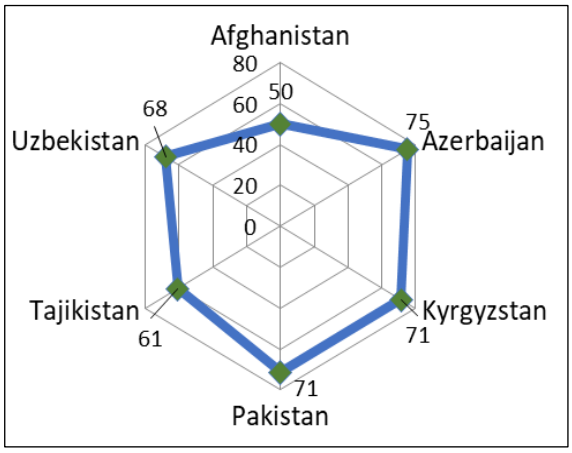


Figure 2a: Average Indicators by Country on Digital Payments

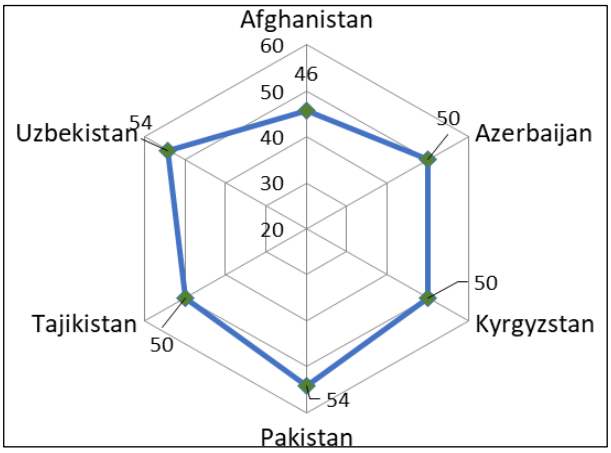


Figure 3a: Average Indicators by Country on E-Commerce

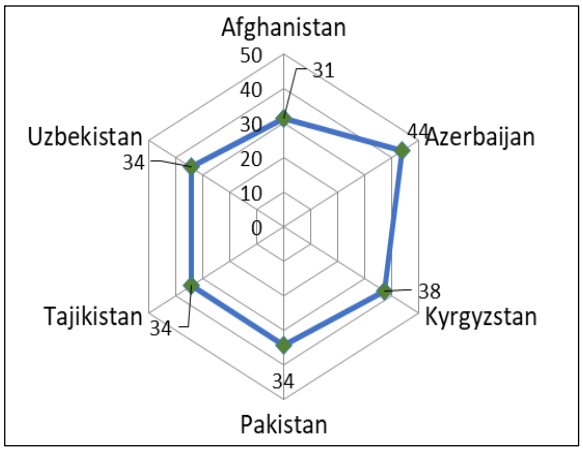


Figure 4a: Average Indicators by Country on Internet Access

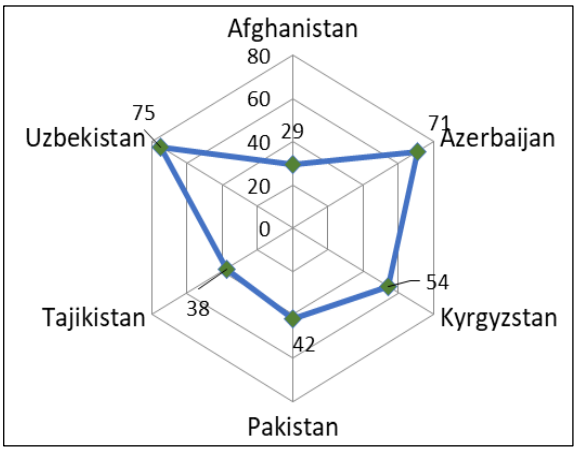
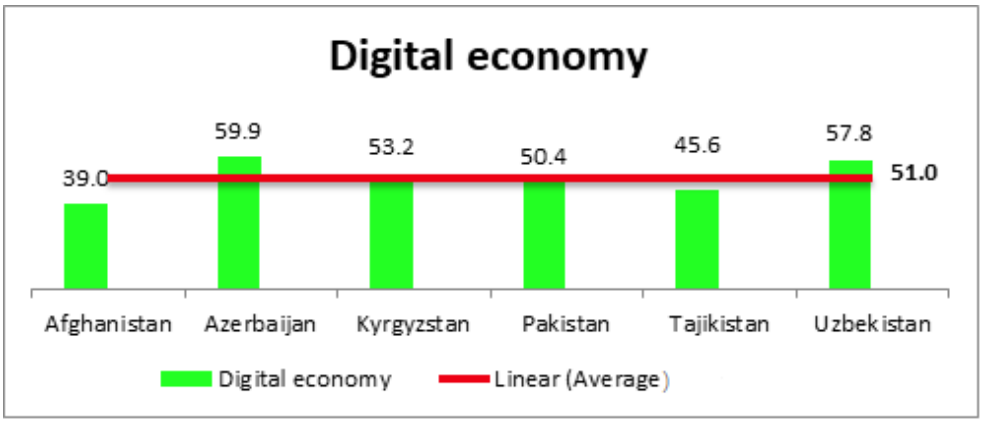


Figure 5: Average Indicator on Digital Economy



3. **E-Commerce**
    - Absence of e-commerce platforms that meet international standards and carry out cross border trade (only for local transactions)
    - None of the selected countries can register directly on international marketplaces to sell cross border. Although since May, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan have gained an opportunity to sell on Amazon; however, the real registration has not yet happened owing to restrictions on the use (introduction of) international payment systems—such as PayPal—in the specified countries)
    - Lack of institutional mechanisms for regulating e-commerce such as single regulating body
    - Imperfect and insecure systems of online payments and lack of systems for delivery of goods and services in combination with a low level of consumer confidence
    - Slow or poor adaptation of mobile or online payment
    - Poor after sales service (for online sales), no clear recourse in the event of a negative e-commerce experience
    - Cases of counterfeit product sales. Inauthentic websites.
    - Poor marketing to attract the target audience
    - Lack of confidence in buying online, cyber security concerns
    - Lack of e-skills and trust in government structures
    - Consumer protection issues: difficulties with product returns, poor quality goods, delivery of the wrong goods
    - In two out of six countries, the 'green transport corridor' has not been introduced (this hinders the increase in cross border trade)
    - Absence of a legal framework for cross border electronic data exchange between customs in some countries hinders the increase in cross border trade
    - Absence of e-signature use for cross border transaction in selected countries (only Azerbaijan has a pilot project on using e-signature for cross border transactions with Belarus)
4. **Internet Access**
    - Lack of e-skills for using the internet
    - No access to digital infrastructure owing to poor connectivity or instability of electricity supply
    - High internet costs
    - Problems with internet accessibility, especially in remote areas

3.2 Secondary Analysis of Digital Divide

3.2.1 Background and Motivation

The existing literature highlights that the measurement of the digital divide can be subdivided into three stages: the first constitutes the physical admittance and incentive; the second covers the literateness as well as usage and skills of the digital world; and finally, the third combines the upshot of the first two stages with the impact of making use of digital technology (see van Dijk, 2018; Razzaq et al. 2021). Conventionally, the digital infrastructure gap is mainly considered a potential indicator of the digital divide; nevertheless, other socioeconomic factors are equally essential to estimate factual reasons for digital backwardness. Understanding the digital divide as the lack of access to digital opportunities to live the life one values (following Amartya Sen's (2001) capabilities approach), even basic forms of digitalization—such as access and connectivity—provide major opportunities for socioeconomic development. Thus, the digital divide is highly contingent on other non-infrastructure factors such as governance structure,

business regulations, cost of living, digital awareness, and security. Therefore, it is crucial to integrate all possible dimensions in one cumulative index to draw an inclusive picture of the digital divide.

3.2.2 Dimensions of the Digital Divide

Table 16 describes the key dimensions and indicators used to estimate the cumulative digital divide index (CDDI). The definitions and empirical rationality are also added in Table 16 for brevity. The data for these dimensions are collected from various sources, including but not limited to World Governance Indicators (WGI), Penn-World Tables, World Development Indicators (WDI), ITU World Telecommunication, Ministry of Finance and Commerce, China, and Telecom ministries in chosen CAREC countries.

3.2.3 Methodology for Composite Digital Divide Index

Multidimensional digital divide measures are usually used in the existing literature by considering several indicators and using different weighting schemes and finally leading to a ranking of all the countries under consideration. Policy think tanks and academicians commonly use these composite indices to measure the level of digital development. A comparison is usually made across different regions and countries based on the obtained ranking of the digital divide.

3.2.3.1 Construction of Composite Digital Divide Index

This study uses a principal component analysis (PCA) approach to construct a cumulative digital divide index for six CAREC economies (Azerbaijan, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, and Uzbekistan). These economies are selected based on the data availability of relevant indicators. Note that the principal components (PC) approach reduces a large number of variables of interest (Table 16) into more meaningful (fewer) components or constructs, known as PCs, and picks only the first PC that explains the maximum proportion of variation in data relative to other components that usually cater for a relatively smaller proportion compared to the first PC. This first PC is generally used as an index after being scaled by taking a deviation from the minimum value of this first PC and dividing this difference with the range (maximum minus the minimum value) of this selected PC to get the index in the range of 0 to 1 (see Razzaq et al. 2021a; An et al. 2021 for details). A general discussion commonly found in literature is the choice of weights to be used while creating an index. For this, generally, two routes are adopted. In the first route, the built-in weighting scheme adopted by the principal component approach is used, where weights are automatically assigned to each subdimension by the built-in mechanism by PCA. In the second route, the CDDI is constructed by allocating appropriate weights to each subindex, following the guidelines provided in the existing literature. The construction of composite index using an automated PCA weighting scheme is primarily followed by extant literature—for example, Razzaq et al. (2021b), Agarwal and Panda (2018), Bagchi (2005), Doong and Ho (2012), Park et al. (2015), Rath (2016), Serrano-Cinca (2018), and Wang (2021). This study follows the same approach where weights are chosen by the PCA in a panel setting, and a composite digital divide index (CDDI) is constructed using the seven subdimensions. The performance of each selected CAREC country in terms of the digital divide is analyzed by its digital divide ranking.

CDDI is calculated based on seven key dimensions measuring different aspects of the digital divide: cost and affordability, access and infrastructure, quality of internet, regulations, digital security, ICT output, and digital FDI. In the first step, seven subindices (one for each dimension) are constructed through PCA, and then in the second step, a CDDI is constructed via PCA for the subindices obtained in the first step. The constructed subindices and CDDI are normalized to take a value from 0 to 1. '0' implies the least digital development (higher digital divide), while '1' indicates a higher digital development (lower digital gap).

Table 16: List of Dimensions of the Digital Divide Index

Dimension	Abbreviations	Explanation	Indicators	Empirical rationality
Cost and affordability	COST&AFFORD	This covers cost and affordability of internet devices. The variables such as per capita GNI are measured considering the purchasing power parity.	Fixed broadband basket as a percentage of GNI per capita. Mobile cellular basket as a percentage of GNI per capita. Mobile broadband basket as a percentage of GNI per capita.	EIU (2019), United Nations (2018), Baller et al. (2016), Zhang (2013), Huyer et al. (2005).
Access and infrastructure	ACC&INFR	This covers the two main aspects of digital divides: digital access and infrastructure.	Fixed broadband subscriptions. Fixed telephone subscriptions. Mobile subscriptions. Households with a computer at home (percent). Households with internet access at home (percent). Individuals owning a mobile phone (percent). Individuals using the internet, total (percent). Population covered by at least a 3G/4G mobile network (percent).	Baliamoune-Lutz (2003), Varallyai et al. (2015).
Internet quality	QUALITY	Quality of internet includes internet speed using different devices.	International bandwidth per internet user (kbit/s). Monthly fixed broadband internet traffic per fixed broadband subscription (MB). Monthly mobile broadband internet traffic per mobile broadband subscription (MB).	Varallyai et al. (2015).
Digital security	DIGSEC	Level of digital security and implementation and efficacy of regulations.	E-commerce safety. Trust in government websites and apps. Trust in information from social media. Trust in non-government websites and apps. Trust in online privacy.	Huyer et al. (2005), United Nations (2018).

Dimension	Abbreviations	Explanation	Indicators	Empirical rationality
Regulations	REGULATIONS	It covers the social, political, environmental, and economic conditions in a country.	Institutional quality index. Ease of doing business index.	Robinson et al. (2018), Helsper (2017).
ICT output	ICTOUTPUT	It indicates the trade associated with ICT and high-tech goods.	High tech exports as a percentage of manufacturing exports.	(ITU, 2017)
Digital foreign direct investment	DFDI	Foreign direct investment from China in ICT sector.	FDI from China* in the ICT sector of CAREC economies.	(ITU, 2017)

Note: Chinese FDI in ICT sector is considered owing to the unavailability of global FDI flow data into CAREC economies. Also, China is investing a substantial amount of FDI in CAREC economies and publishes its ICT induced FDI statistics yearly. Therefore, it can capture major FDI projects in CAREC countries. Overall, it is a data limitation.

3.2.3.2 Principal Component Analysis Results

The PCA approach is used to construct different subindices and CDDI using the indicators provided in Table 16. The sample spans over five years (2016 to 2020). The choice of sample period is based upon the availability of data on relevant indicators. The idea was to consider maximum indicators and sample CAREC economies in the empirical analysis. After careful observation, we retained eight CAREC economies (Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, and Uzbekistan) in the sample, and the digital divide index is constructed for these selected CAREC countries.

Starting with the first subindex, 'cost and affordability (cost and affordability),' three indicators (first row of Table 16) are used: a) fixed broadband basket as a percentage of GNI per capita, b) mobile cellular basket as a percentage of GNI per capita, and c) mobile broadband basket as a percentage of GNI per capita. The principal component is applied to these three indicators to retain the first principal component explaining the maximum proportion of variation in data. The detailed results of PCA are provided in Table 1A in Appendix A.

Similarly, to construct the second subindex, 'access and infrastructure (access and infrastructure),' eight indicators are used (second row of Table 16): a) fixed broadband subscriptions; b) fixed telephone subscriptions; c) mobile subscriptions; d) households with a computer at home (percent); e) households with internet access at home (percent); f) individuals owning a mobile phone (percent); g) individuals

using the internet, total (percent); and h) population covered by at least a 3G/4G mobile network (percent). Again, the first principal component is retained explaining maximum proportion of variation. The detailed results to construct this second subindex are provided in Table 2A in Appendix A. Repeating the same process for other indicators, the subindicators for the other five dimensions—quality, regulations, digital security, ICT output, and digital FDI—are obtained via PCA. The detailed results are provided in Tables 3A and 4A in Appendix A. After obtaining all seven subindices, we applied PCA once again on these subindices and constructed a CDDI by picking the first principal component explaining maximum variation in these seven subindices. The compact results for all seven subindices and the CDDI obtained via PCA are provided in Table 19 (with detailed results in Table 5A in Appendix A). We labeled these as the PCA indices without normalization.

Finally, the original indices (non-normalized ones) and the normalized ones are categorized into the best and the worst performing ones using the color scheme in Table 17. This is done by highlighting the cells with a green color for the best performing indices while the worst performing indices are highlighted with a red color.

Table 17: Assessment Criterion for Indicators PCA

The Worst Performing Indicator	The Best Performing Indicator

Later, the same indices are normalized to take values between 0 and 1. This is done by subtracting the minimum value of the index from each value of the same index and dividing the resultant difference with the range (maximum value minus minimum value) of the index. Two different versions of CDDI are constructed: one having values between 0 and 1, labeled as CDDI (0–1); and the second having values ranging from 0 to 100, labeled as CDDI (0–100). The normalized subindices and two versions of the composite digital divide index are presented in Table 19.

Table 18: Results of PCA Indices without Normalization

Country	Year	Cost and affordability	Access and infrastructure	Internet quality	Regulations	Digital security	ICT output	Digital FDI	CDDI (PCA)
Azerbaijan	2016	0.71	1.07	-0.68	-0.46	0.28	0.07	0.00	0.23
	2017	0.64	1.08	-0.51	-0.53	0.52	0.08	0.00	0.31
	2018	0.59	1.12	-0.51	-0.43	0.66	0.11	0.00	0.36
	2019	0.62	1.14	-0.45	-0.32	0.9	0.14	0.00	0.50
	2020	0.64	1.17	-0.39	-0.22	0.95	0.17	0.00	0.58
Georgia	2016	0.29	0.77	0.97	1.81	0.8	0.09	0.07	0.95
	2017	0.27	0.78	1.16	1.83	0.86	0.08	0.07	1.01
	2018	0.63	0.86	1.47	1.86	0.90	0.08	0.08	1.28
	2019	0.65	0.95	1.55	1.88	0.85	0.06	0.09	1.32
	2020	0.7	1.04	1.64	1.91	0.85	0.04	0.09	1.4
Kaz	2016	1.00	1.12	-0.05	0.25	0.00	0.89	0.72	1.02

Country	Year	Cost and affordability	Access and infrastructure	Internet quality	Regulations	Digital security	ICT output	Digital FDI	CDDI (PCA)
	2017	0.81	1.16	0.36	0.36	0.26	0.67	1.00	1.17
	2018	0.95	1.20	0.64	0.42	0.80	0.65	0.97	1.45
	2019	1.00	1.31	0.86	0.49	0.90	0.82	0.96	1.65
	2020	1.02	1.42	1.09	0.56	1.00	1.00	0.95	1.87
Kyrgyzstan	2016	-1.54	-0.82	-0.36	0.00	0.17	0.55	0.16	-0.99
	2017	-1.71	-0.57	-0.16	0.07	0.15	0.48	0.17	-0.91
	2018	-0.99	-0.35	0.29	0.05	0.13	0.21	0.18	-0.55
	2019	-0.77	-0.25	0.71	0.03	0.26	0.18	0.20	-0.30
	2020	-0.78	-0.15	1.13	0.00	0.44	0.14	0.23	-0.11
Mongolia	2016	0.61	-0.82	-1.07	0.75	0.00	0.45	0.61	-0.21
	2017	0.53	-0.76	-0.93	0.98	0.10	0.08	0.73	-0.20
	2018	0.6	-0.20	-0.84	0.95	0.40	0.13	0.44	0.09
	2019	0.61	0.05	-0.65	0.93	0.26	0.52	0.45	0.32
	2020	0.66	0.29	-0.45	0.90	0.14	0.91	0.46	0.59
Pakistan	2016	-0.35	-1.47	-0.63	-1.07	0.26	0.04	0.63	-1.08
	2017	-0.56	-1.66	-0.65	-1.03	0.38	0.05	0.76	-1.15
	2018	-0.68	-1.56	0.03	-0.9	0.33	0.05	0.56	-1.03
	2019	-0.13	-1.43	0.43	-0.77	0.44	0.05	0.63	-0.60
	2020	-0.33	-1.3	0.84	-0.64	0.64	0.06	0.71	-0.41
Tajikistan	2016	-1.49	-1.17	-0.57	-1.1	0.23	0.06	0.15	-1.51
	2017	-1.52	-1.13	-0.44	-1.27	0.18	0.03	0.21	-1.50
	2018	-0.61	-1.09	-0.07	-1.14	0.14	0.00	0.26	-1.05
	2019	-0.55	-1.06	0.28	-1.01	0.09	0.01	0.26	-0.90
	2020	-1.70	-1.02	0.63	-0.88	0.03	0.01	0.26	-1.22
Uzbekistan	2016	-0.88	-0.49	-1.18	-1.06	0.09	0.06	0.14	-1.21
	2017	-0.34	-0.08	-1.11	-1.09	0.16	0.03	0.12	-0.82
	2018	0.56	0.08	-0.97	-0.89	0.66	0.00	0.49	-0.16
	2019	0.47	0.28	-0.79	-0.70	0.68	0.01	0.43	-0.03
	2020	0.37	0.49	-0.61	-0.5	0.73	0.01	0.37	-0.17

Table 19: Results of PCA Indices Normalized (0–1 and 0–100)

Country	Year	Cost and affordability	Access and infrastructure	Internet quality	Regulations	Digital security	ICT output	Digital FDI	CDDI (0–1)	CDDI (0–100)
Azerbaijan	2016	0.89	0.89	-0.68	0.25	0.28	0.07	0.00	0.51	51.42
	2017	0.86	0.89	0.24	0.23	0.52	0.08	0.00	0.54	53.6
	2018	0.84	0.9	0.24	0.26	0.66	0.11	0.00	0.55	55.28
	2019	0.85	0.91	0.26	0.3	0.90	0.14	0.00	0.59	59.35
	2020	0.86	0.92	0.28	0.33	0.95	0.17	0.00	0.62	61.61
Georgia	2016	0.73	0.79	0.76	0.97	0.8	0.09	0.07	0.73	72.7
	2017	0.72	0.79	0.83	0.98	0.86	0.08	0.07	0.74	74.46
	2018	0.86	0.82	0.94	0.98	0.90	0.08	0.08	0.82	82.5
	2019	0.86	0.85	0.97	0.99	0.85	0.06	0.09	0.84	83.73
	2020	0.88	0.88	1.00	1.00	0.85	0.04	0.09	0.86	85.98
Kazakhstan	2016	0.99	0.9	0.4	0.48	0.00	0.89	0.72	0.75	74.78
	2017	0.92	0.92	0.55	0.51	0.26	0.67	1.00	0.79	79.25
	2018	0.97	0.93	0.64	0.53	0.8	0.65	0.97	0.87	87.41
	2019	0.99	0.96	0.72	0.55	0.9	0.82	0.96	0.93	93.48
	2020	1.00	1.00	0.81	0.57	1.00	1.00	0.95	1.00	100
Kyrgyzstan	2016	0.06	0.27	0.29	0.40	0.17	0.55	0.16	0.15	15.22
	2017	0.00	0.36	0.36	0.42	0.15	0.48	0.17	0.18	17.66
	2018	0.26	0.43	0.52	0.41	0.13	0.21	0.18	0.28	28.3
	2019	0.34	0.46	0.67	0.41	0.26	0.18	0.2	0.36	35.8
	2020	0.34	0.49	0.82	0.40	0.44	0.14	0.23	0.41	41.28
Mongolia	2016	0.85	0.27	0.04	0.64	0.00	0.45	0.61	0.38	38.48
	2017	0.82	0.29	0.09	0.71	0.1	0.08	0.73	0.39	38.62
	2018	0.85	0.48	0.12	0.70	0.4	0.13	0.44	0.47	47.31
	2019	0.85	0.56	0.19	0.69	0.26	0.52	0.45	0.54	54.16
	2020	0.87	0.64	0.26	0.68	0.14	0.91	0.46	0.62	61.89
Pakistan	2016	0.5	0.06	0.19	0.06	0.26	0.04	0.63	0.13	12.5
	2017	0.42	0	0.19	0.08	0.38	0.05	0.76	0.11	10.53
	2018	0.38	0.03	0.43	0.12	0.33	0.05	0.56	0.14	14.2
	2019	0.58	0.08	0.57	0.16	0.44	0.05	0.63	0.27	26.97
	2020	0.51	0.12	0.72	0.20	0.64	0.06	0.71	0.33	32.56
Tajikistan	2016	0.08	0.16	0.21	0.05	0.23	0.06	0.15	0.00	0.00
	2017	0.07	0.17	0.26	0.00	0.18	0.03	0.21	0.00	0.05

Country	Year	Cost and affordability	Access and infrastructure	Internet quality	Regulations	Digital security	ICT output	Digital FDI	CDDI (0–1)	CDDI (0–100)
	2018	0.40	0.18	0.39	0.04	0.14	0.00	0.26	0.13	13.44
	2019	0.42	0.20	0.52	0.08	0.09	0.01	0.26	0.18	17.82
	2020	0.00	0.21	0.64	0.12	0.03	0.01	0.26	0.08	8.42
Uzbekistan	2016	0.30	0.38	0.00	0.07	0.09	0.06	0.14	0.09	8.76
	2017	0.50	0.52	0.03	0.06	0.16	0.03	0.12	0.20	20.19
	2018	0.83	0.56	0.07	0.12	0.66	0.00	0.49	0.40	39.94
	2019	0.80	0.63	0.14	0.18	0.68	0.01	0.43	0.44	43.77
	2020	0.76	0.70	0.2	0.24	0.73	0.01	0.37	0.40	39.62

To check the robustness of the constructed index, we adopted a simple general rule of constructing an index, where several composite digital divide indices (CDDIs) are constructed (cindex_1), the composite index is constructed using the first two subindices only—that is, using only 'cost and affordability' and 'access and infrastructure'. The second one adds the third subindex (quality) to the first two and constructs a CDDI for the three subindices (cindex_2). Later, a CDDI is constructed by considering the fourth subindex (regulations) to the first three subindices, and this is labeled cindex_3. Then digital security is added as the fifth subindex to get a CDDI of five subindices (cindex_4). Next, cindex_5 is constructed by considering ICT output as the sixth subindex in addition to the first five, and finally, a CDDI is constructed by introducing the seventh subindex (digital FDI) in addition to the first six. This index is labeled cindex_6 (CDDI), which integrates all subindices into one cumulative index. The correlation matrix of this final CDDI with all subindices is reported in Table 20, showing a strong positive correlation with all subindices, confirming the reliability of CDDI estimations.

Table 20: Correlation Matrix of Subindices with Composite Index (CDDI)

Indicators	Cost and affordability	Access and infrastructure	Internet quality	regulations	Digital security	ICT output	Digital FDI	CDDI (0–1)
Cost and affordability	1		-0.68					
Access and infrastructure	0.74	1.00						
Internet quality	0.19	0.29	1.00					
Regulations	0.51	0.53	0.54	1.00				
Digital security	0.57	0.55	0.54	0.78	1.00			
ICT output	0.34	0.39	0.12	0.32	0.37	1.00		
Digital FDI	0.29	-0.10	0.02	-0.01	0.20	0.54	1.00	
CDDI	0.80	0.81	0.50	0.82	0.86	0.56	0.7	1.00

The summary of step wise results of the PCA approach considering different combinations of subindices is provided in Table 21. The overall range of CDDI remained consistent in CAREC economies after adding different dimensions. Tables 2A and 2B in Appendix 2 provide detailed results of step wise index construction for interested readers.

Table 21: Summary of PCA for Different Combinations of Subindices (Simple to General)

Subindex No.	Subindices	Highest eigen value	KMO	Mean	SD	Min	Max
1	Cost and affordability, and access and infrastructure	1.739	0.500	0.000	0.860	-1.400	1.215
2	Cost and affordability, access and infrastructure, and quality	1.831	0.474	0.000	0.875	-1.349	1.311
3	Cost and affordability, access and infrastructure, quality, and regulations	2.394	0.589	0.000	0.904	-1.462	1.524
4	Cost and affordability, access and infrastructure, quality, regulations, and digital security	2.906	0.651	0.000	0.924	-1.399	1.638
5	Cost and affordability, access and infrastructure, quality, regulations, digital security, and ICT output	3.057	0.663	0.000	0.930	-1.418	1.631
6	Cost and affordability, access and infrastructure, quality, regulations, digital security, ICT output, and digital FDI	3.080	0.386	0.000	0.959	-1.507	1.873

Note: Total number of observations in each case is 40.

3.2.4 Summary of PCA Indices

Tables 22 and 23 display countrywise summary statistics of subindices and CDDI for both normalized and non-normalized indices, respectively. The overall results show significant heterogeneity across different dimensions and countries. Notably, the best performing indicators are highlighted with green cell color while the worst performing indicators are highlighted with red cell color as before following the color coding scheme.

Table 22: Summary Statistics of Indices (Normalized Data)

Country	Indices	Mean	SD	Median	IQR	Min	Max
Azerbaijan	Cost and affordability	0.859	0.016	0.858	0.007	0.840	0.885
	Access and infrastructure	0.902	0.013	0.903	0.019	0.887	0.919
	Internet quality	0.236	0.039	0.236	0.022	0.175	0.279
	Digital security	0.276	0.039	0.265	0.043	0.231	0.331
	Regulations	0.663	0.278	0.660	0.381	0.279	0.951
	ICT output	0.112	0.041	0.109	0.058	0.067	0.168
	Digital FDI	0.001	0.002	0.000	0.003	0.000	0.003
	CDDI	0.562	0.043	0.550	0.050	0.510	0.620
Georgia	Cost and affordability	0.811	0.077	0.856	0.133	0.724	0.882
	Access and infrastructure	0.826	0.038	0.820	0.056	0.790	0.879
	Internet quality	0.900	0.101	0.939	0.139	0.761	1.000
	Digital security	0.984	0.012	0.983	0.017	0.970	1.000
	Regulations	0.850	0.038	0.845	0.011	0.797	0.905
	ICT output	0.069	0.021	0.078	0.022	0.037	0.089
	Digital FDI	0.082	0.009	0.084	0.014	0.072	0.092
	CDDI	0.798	0.059	0.820	0.100	0.730	0.860
Kazakhstan	Cost and affordability	0.975	0.032	0.990	0.022	0.920	1.000
	Access and infrastructure	0.942	0.039	0.928	0.049	0.904	1.000
	Internet quality	0.624	0.158	0.644	0.179	0.400	0.805
	Digital security	0.530	0.038	0.532	0.043	0.478	0.575
	Regulations	0.592	0.437	0.803	0.637	0.000	1.000
	ICT output	0.805	0.150	0.823	0.222	0.646	1.000
	Digital FDI	0.919	0.114	0.959	0.023	0.718	1.000
	CDDI	0.868	0.102	0.870	0.140	0.750	1.000
Kyrgyzstan	Cost and affordability	0.202	0.161	0.262	0.277	0.000	0.345
	Access and infrastructure	0.401	0.087	0.425	0.103	0.274	0.492
	Internet quality	0.533	0.218	0.522	0.309	0.290	0.820
	Digital security	0.408	0.009	0.407	0.013	0.398	0.421
	Regulations	0.230	0.128	0.166	0.103	0.133	0.443
	ICT output	0.312	0.188	0.213	0.305	0.141	0.547
	Digital FDI	0.189	0.025	0.184	0.033	0.163	0.225
	CDDI	0.276	0.112	0.280	0.180	0.150	0.410
Mongolia	Cost and affordability	0.847	0.017	0.849	0.004	0.820	0.868
	Access and infrastructure	0.447	0.160	0.476	0.262	0.273	0.636
	Internet quality	0.138	0.086	0.119	0.101	0.038	0.258
	Digital security	0.683	0.028	0.691	0.015	0.636	0.707
	Regulations	0.180	0.155	0.143	0.156	0.000	0.403
	ICT output	0.418	0.336	0.450	0.392	0.084	0.911
	Digital FDI	0.540	0.126	0.462	0.158	0.445	0.730
	CDDI	0.480	0.102	0.470	0.150	0.380	0.620
Pakistan	Cost and affordability	0.476	0.078	0.498	0.084	0.379	0.578

Country	Indices	Mean	SD	Median	IQR	Min	Max
	Access and infrastructure	0.058	0.044	0.063	0.042	0.000	0.118
	Internet quality	0.419	0.232	0.428	0.378	0.189	0.715
	Digital security	0.122	0.056	0.116	0.080	0.063	0.197
	Regulations	0.408	0.145	0.380	0.106	0.256	0.638
	ICT output	0.049	0.005	0.048	0.004	0.042	0.055
	Digital FDI	0.657	0.076	0.634	0.078	0.561	0.756
	CDDI	0.196	0.098	0.140	0.140	0.110	0.330
Tajikistan	Cost and affordability	0.197	0.200	0.082	0.332	0.004	0.423
	Access and infrastructure	0.185	0.021	0.185	0.026	0.159	0.211
	Internet quality	0.406	0.178	0.395	0.257	0.214	0.642
	Digital security	0.060	0.046	0.053	0.041	0.000	0.123
	Regulations	0.135	0.079	0.145	0.092	0.027	0.230
	ICT output	0.024	0.026	0.015	0.025	0.000	0.064
	Digital FDI	0.228	0.045	0.257	0.044	0.154	0.257
	CDDI	0.078	0.079	0.080	0.130	0.000	0.180
Uzbekistan	Cost and affordability	0.638	0.229	0.759	0.299	0.302	0.831
	Access and infrastructure	0.558	0.120	0.565	0.115	0.381	0.698
	Internet quality	0.088	0.082	0.074	0.112	0.000	0.201
	Digital security	0.132	0.079	0.118	0.115	0.056	0.242
	Regulations	0.464	0.310	0.660	0.515	0.090	0.729
	ICT output	0.024	0.026	0.015	0.025	0.000	0.064
	Digital FDI	0.310	0.168	0.370	0.290	0.124	0.488
	CDDI	0.306	0.153	0.400	0.200	0.090	0.440
Total	Cost and affordability	0.626	0.310	0.779	0.468	0.000	1.000
	Access and infrastructure	0.540	0.321	0.536	0.641	0.000	1.000
	Internet quality	0.418	0.290	0.326	0.467	0.000	1.000
	Digital security	0.399	0.306	0.365	0.485	0.000	1.000
	Regulations	0.440	0.319	0.355	0.605	0.000	1.000
	ICT output	0.227	0.293	0.081	0.287	0.000	1.000
	Digital FDI	0.366	0.308	0.257	0.512	0.000	1.000
	CDDI	0.446	0.283	0.405	0.495	0.000	1.000

Table 23: Summary Statistics of Indices (without Normalization)

Country	Indices	Mean	SD	Median	IQR	Min	Max
Azerbaijan	Cost and affordability	0.638	0.045	0.636	0.018	0.587	0.711
	Access and infrastructure	1.116	0.041	1.118	0.059	1.069	1.167
	Internet quality	-0.511	0.109	-0.514	0.061	-0.683	-0.392
	Digital security	-0.392	0.124	-0.428	0.137	-0.534	-0.217
	Regulations	0.663	0.278	0.660	0.381	0.279	0.951
	ICT output	0.112	0.041	0.109	0.058	0.067	0.168
	Digital FDI	0.001	0.002	0.000	0.003	0.000	0.003
	CDDI	0.395	0.141	0.362	0.194	0.231	0.576
Georgia	Cost and affordability	0.508	0.211	0.632	0.363	0.269	0.701
	Access and infrastructure	0.882	0.117	0.863	0.174	0.772	1.044
	Internet quality	1.357	0.283	1.466	0.389	0.966	1.638
	Digital security	1.858	0.039	1.856	0.052	1.812	1.908
	Regulations	0.850	0.038	0.845	0.011	0.797	0.905
	ICT output	0.069	0.021	0.078	0.022	0.037	0.089
	Digital FDI	0.082	0.009	0.084	0.014	0.072	0.092
	CDDI	1.193	0.200	1.282	0.313	0.951	1.399
Kazakhstan	Cost and affordability	0.956	0.089	0.999	0.058	0.806	1.025
	Access and infrastructure	1.241	0.121	1.197	0.150	1.122	1.418
	Internet quality	0.580	0.445	0.637	0.504	-0.051	1.090
	Digital security	0.415	0.119	0.423	0.135	0.249	0.557
	Regulations	0.592	0.437	0.803	0.637	0.000	1.000
	ICT output	0.805	0.150	0.823	0.222	0.646	1.000
	Digital FDI	0.919	0.114	0.959	0.023	0.718	1.000
	CDDI	1.433	0.347	1.448	0.481	1.021	1.873
Kyrgyzstan	Cost and affordability	-1.159	0.439	-0.994	0.758	-1.711	-0.768
	Access and infrastructure	-0.427	0.268	-0.353	0.317	-0.818	-0.147
	Internet quality	0.323	0.614	0.291	0.869	-0.362	1.132
	Digital security	0.028	0.030	0.026	0.043	-0.005	0.068
	Regulations	0.230	0.128	0.166	0.103	0.133	0.443
	ICT output	0.312	0.188	0.213	0.305	0.141	0.547
	Digital FDI	0.189	0.025	0.184	0.033	0.163	0.225
	CDDI	-0.572	0.380	-0.550	0.613	-0.992	-0.112
Mongolia	Cost and affordability	0.605	0.048	0.613	0.011	0.531	0.664
	Access and infrastructure	-0.287	0.492	-0.197	0.806	-0.824	0.295
	Internet quality	-0.787	0.244	-0.841	0.285	-1.070	-0.450
	Digital security	0.903	0.089	0.928	0.049	0.751	0.977
	Regulations	0.180	0.155	0.143	0.156	0.000	0.403
	ICT output	0.418	0.336	0.450	0.392	0.084	0.911
	Digital FDI	0.540	0.126	0.462	0.158	0.445	0.730
	CDDI	0.119	0.342	0.092	0.525	-0.206	0.585
Pak	Cost and affordability	-0.409	0.213	-0.349	0.230	-0.676	-0.131

Country	Indices	Mean	SD	Median	IQR	Min	Max
	Access and infrastructure	-1.487	0.137	-1.470	0.131	-1.664	-1.302
	Internet quality	0.003	0.653	0.026	1.064	-0.646	0.836
	Digital security	-0.882	0.177	-0.899	0.255	-1.070	-0.644
	Regulations	0.408	0.145	0.380	0.106	0.256	0.638
	ICT output	0.049	0.005	0.048	0.004	0.042	0.055
	Digital FDI	0.657	0.076	0.634	0.078	0.561	0.756
	CDDI	-0.853	0.331	-1.027	0.489	-1.151	-0.406
Tajikistan	Cost and affordability	-1.173	0.548	-1.487	0.910	-1.701	-0.553
	Access and infrastructure	-1.095	0.063	-1.095	0.079	-1.174	-1.015
	Internet quality	-0.034	0.499	-0.066	0.723	-0.574	0.629
	Digital security	-1.079	0.146	-1.101	0.130	-1.269	-0.879
	Regulations	0.135	0.079	0.145	0.092	0.027	0.230
	ICT output	0.024	0.026	0.015	0.025	0.000	0.064
	Digital FDI	0.228	0.045	0.257	0.044	0.154	0.257
	CDDI	-1.238	0.269	-1.222	0.452	-1.507	-0.904
Uzbekistan	Cost and affordability	0.035	0.625	0.366	0.815	-0.884	0.561
	Access and infrastructure	0.056	0.371	0.076	0.357	-0.489	0.487
	Internet quality	-0.930	0.232	-0.968	0.316	-1.177	-0.610
	Digital security	-0.849	0.250	-0.895	0.364	-1.091	-0.501
	Regulations	0.464	0.310	0.660	0.515	0.090	0.729
	ICT output	0.024	0.026	0.015	0.025	0.000	0.064
	Digital FDI	0.310	0.168	0.370	0.290	0.124	0.488
	CDDI	-0.477	0.515	-0.167	0.668	-1.211	-0.027
Total	Cost and affordability	0.000	0.849	0.420	1.279	-1.711	1.025
	Access and infrastructure	0.000	0.990	-0.013	1.976	-1.664	1.418
	Internet quality	0.000	0.816	-0.260	1.314	-1.177	1.638
	Digital security	0.000	0.973	-0.111	1.541	-1.269	1.908
	Regulations	0.440	0.319	0.355	0.605	0.000	1.000
	ICT output	0.227	0.293	0.081	0.287	0.000	1.000
	Digital FDI	0.366	0.308	0.257	0.512	0.000	1.000
	CDDI	0.000	0.959	-0.134	1.675	-1.507	1.873

3.2.5 Explanation of PCA Indices

Based on the above summary statistics, Table 24 ranks each indicator in sample countries; higher rank implies lower digital gap, while lower rank higher digital gap. Starting from top performing (lower digital gap/divide) countries, Kazakhstan secured first rank in overall sample economies with a cumulative average score of 0.868 (86.8 percent) against the average score of CAREC economies (0.445). The score of subindices exhibits that cost and affordability, access and infrastructure, digital FDI, and ICT output are top performing indicators with an average score of 0.975, 0.942, 0.919, 0.805, respectively. Internet quality (0.624), regulations (0.592), and digital security (0.530) possess lower scores, which implies a relatively higher digital gap. Manifestly, out of eight subindicators, Kazakhstan secured its distinction in the top six indicators. Table 20 visualizes the same, where the strong green color across different dimensions confirms a relatively higher digital penetration (lower digital divide).

The second-best performing country in the CAREC region is Georgia by secured second rank with a cumulative average score of 0.798 (79.8 percent). The results exhibit that digital security, internet quality, regulations, access and infrastructure, and cost and affordability are high performing indicators with an average score of 0.984, 0.900, 0.850, 0.826, 0.811, respectively. ICT output (0.069) and digital FDI (0.082) show the lowest scores, implying a relatively higher digital gap. Tables 18 and 20 draw the same, where a strong red or light green color implies the potential digital space to be filled by effective measures in the respective indicator. The CDDI ranges from 0.730 to 0.850, confirming a relatively lower digital divide when compared with the maximum value of 1.

Azerbaijan secured third rank in overall sample countries with a cumulative average score of 0.562 (56.2 percent). The score of subindices exhibits that cost and affordability, and access and infrastructure are top performing indicators reflecting a relatively lower digital divide. In contrast, digital FDI, ICT output, internet quality, and regulations are the worst performing indicators, suggesting a higher relative backwardness. In the last four years, CDDI has progressively improved and ranges between 0.510 to 0.620. Similarly, other subindices also improved; however, digital security has displayed the highest improvement in the last few years.

Although Mongolia is the fourth best performing country in the CAREC region with a cumulative score of 0.480 (48 percent), it still shows a significant digital gap in internet quality (0.138), digital security (0.180), ICT output (0.418), and digital FDI (0.540). Tables 18 and 20 display that most of the indicators are either light green or medium red, implying a significant potential for digital development in those indicators. Notably, CDDI has significantly improved from 0.380 to 0.620 in the last few years; that said, there is still room for improvement in the digital space. However, the average score of Mongolia is higher than the CAREC average score (0.445).
Uzbekistan ranks fifth in terms of digital development with an average CDDI score of 0.306 (30.6 percent). Out of seven subindices, four indices are much lower (red), confirming higher levels of digital divide such as ICT output (0.024), internet quality (0.088), regulations (0.132), and digital FDI (0.310). Cost and affordability (0.638), and access and infrastructure (0.558) also show lower scores, followed by digital security (0.464). Notably, the CDDI score has improved from 0.090 to 0.440 in the last five years; however, it is still lagging behind the average CDDI score (0.445) of the CAREC countries.

Kyrgyzstan secured sixth rank in its CDDI score—0.276 (27.6 percent). A relatively lower score demonstrates a substantial digital gap as compared to the earlier countries, which display on average a 50 percent level of digital development. Kyrgyzstan's score is almost half of the CAREC average score (0.445). In Tables 18 and 20 most of the indicators are highlighted in red, indicating that the highest gap

exists in digital FDI (0.189), digital security (0.230), and ICT output (0.312). Similarly, internet quality (0.533), regulations (0.408), and access and infrastructure (0.401) also show a significant digital gap as their values are also far behind the optimal values of the best performing country in the sample. The CDDI ranges from 0.150 to 0.410, the significant push required in all dimensions to develop an inclusive digital framework.

Pakistan is the second least performing country in the CAREC region with a cumulative score of 0.196 (19.6 percent), significantly lower than the CAREC average (0.445) and other member countries. Among all indicators, access and infrastructure (0.058) and regulations (0.122) exhibit the lowest scores, followed by cost and affordability (0.476), internet quality (0.419), and digital security (0.408). The range of CDDI is 0.110 to 0.330, implying a substantial digital gap in major dimensions. Notably, all indicators are lower than the CAREC average given in Table 22. These results imply the need for a government intervention to improve regulations, access and infrastructure, and ICT output.

Tajikistan is the least performing country in terms of digital development in the CAREC region. The average CDDI score is just 0.078 (7.8 percent) against the average score of CAREC economies (0.445). Almost every subindicator is highlighted with red color (lowest values and higher gap), implying that Tajikistan lags behind its partnering countries. It shows the lowest scores in cost and affordability, access and infrastructure, digital security, digital FDI, ICT output, and regulations.

Table 24: Country Ranking in Different Subindices and Composite Index

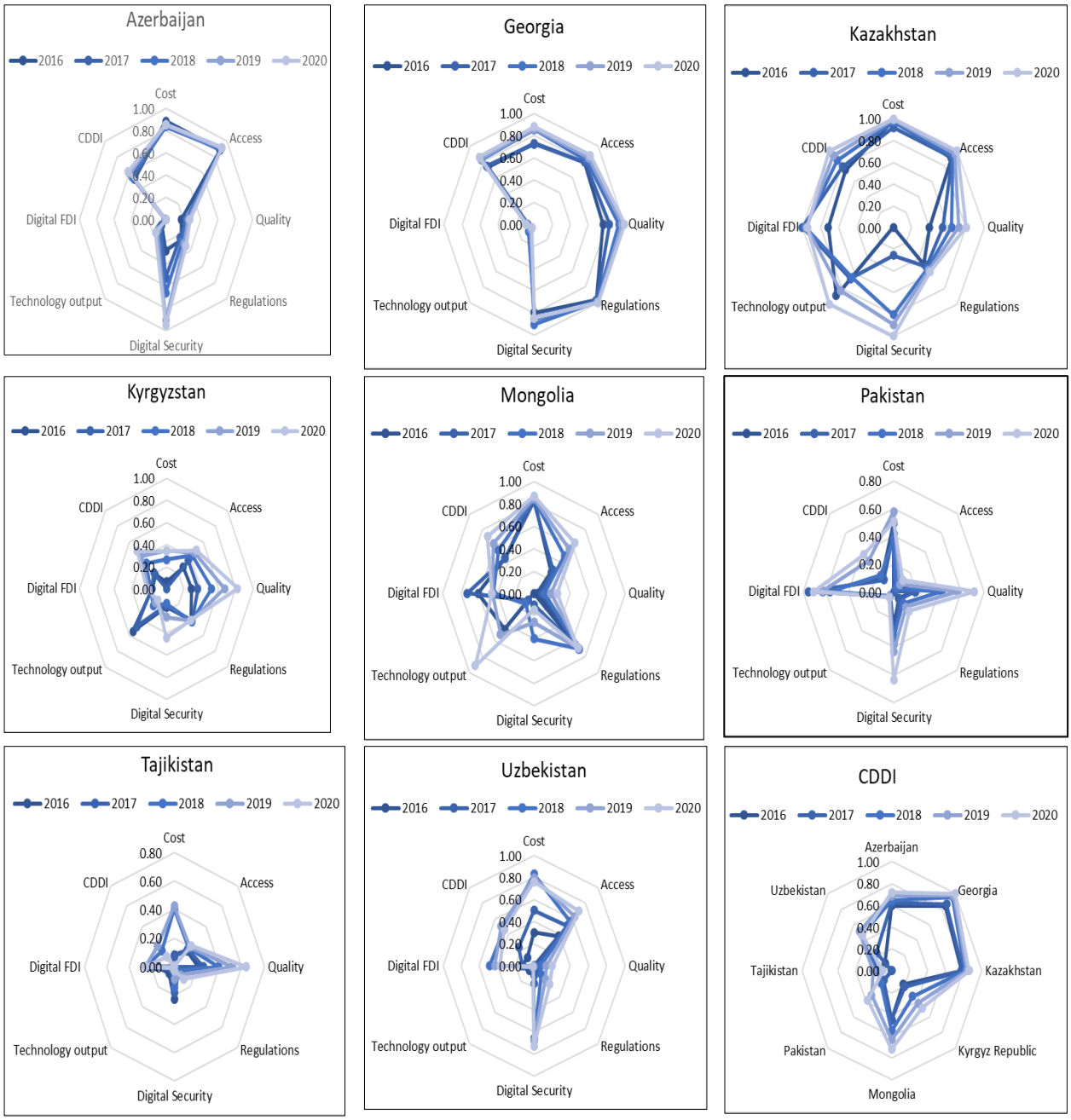
Indicators	Azerbaijan	Georgia	Kazakhstan	Kyrgyzstan	Mongolia	Pakistan	Tajikistan	Uzbekistan
Cost and affordability	5	7	8	2	6	3	1	4
Access and infrastructure	7	6	8	3	4	1	2	5
Internet quality	3	8	6	7	2	5	4	1
Regulations	4	8	6	5	7	2	1	3
Digital security	7	6	8	3	2	4	1	5
ICT output	6	3	8	5	7	4	2	1
Digital FDI	1	2	8	3	6	7	4	5
Cumulative DDI	6	7	8	3	5	2	1	4

Note: Highest rank/green highlighted cells show lower digital divide while lowest rank/red highlighted cells indicate higher digital divide

3.2.6 Graphical Analysis of Subindices and Composite Index

The countrywise radar charts of all subindices and the CDDI are provided in Figure 6. All subindices, including cost, access, quality, regulations, digital security, technology output, digital FDI, and the composite digital divide index are visualized over different time periods (from 2016 until 2020) to get an idea of how the indices evolve across different CAREC economies in the given time. The whole idea of radar charts is to plot all subindices across different axes with a common central point, all plotted in a 2D plane. An advantage of a radar chart is that one can compare all subindices across different countries and across different periods. The following visuals display that there is no absolute divide in any country. For example, Azerbaijan shows a lower digital divide in cost, access, and digital security, and a higher divide in quality, regulations, digital FDI, and technology output. In contrast, Pakistan shows a higher divide in digital access and digital cost. And Mongolia is less divided in terms of regulations; however, it is lagging behind in terms of digital security, access, and quality. On the other hand, Kyrgyzstan and Tajikistan are digitally divided in almost each digital development dimension. Kazakhstan and Georgia have a relatively lower digital divide. The former is lagging behind in its regulations score while the latter is lagging behind in digital FDI and technological output.

Figure 6: Countrywise Radar Charts of Subindices and PCA Composite Index



Note: Cost implies 'cost and affordability' and access implies 'access and infrastructure'

3.2.7 Identified Gaps in CAREC Economies

The results indicate significant heterogeneity in the digital divide across various dimensions in the CAREC countries. Therefore, the prevailing gaps are specific to each country, enabling the creation of an inclusive digital framework for each country.

Tajikistan, Pakistan, Kyrgyzstan

- Higher cost of internet limits a large segment of society to remain digitally disconnected. Affordability is one of the main factors that reduces internet penetration. It has the lowest score in 'cost of internet' compared to other CAREC countries.
- Weak access and infrastructure is the most vulnerable segment of the digital divide, which requires a substantial amount of fixed asset investment from domestic and foreign sources.
- Weak institutional quality and business regulations failed to create a conducive environment for individuals and businesses to adopt and disseminate digital technologies on a national scale.
- Digital security is another area that is lagging behind—particularly in Tajikistan—which caused e-commerce failure, bad reputation, consumer mistrust, reputational damages, cyber-attacks, financial burglaries, and so on.
- No export diversification and almost zero ICT related output, which indicates a lack of basic education, industrial structure, and absorption capacity to adopt, imitate, and produce digital technologies.

Uzbekistan, Mongolia, Azerbaijan

- Lower internet quality leads to poor service deliveries in e-commerce, inefficient logistics, and disruption in daily business operations. Failure to integrate effectively with virtual education, learning, and reverse technology spillovers.
- Digital security is another gray area in Mongolia, while Azerbaijan and Uzbekistan possess a moderate level of digital security.
- Weak institutional framework of these countries is one of the key socioeconomic challenges, which create bottlenecks for business operations, encourage rent seeking behavior and corruption, and discourage innovation and adoption of digital technologies.
- Uzbekistan and Mongolia were lagging behind in access and infrastructure, failed to embrace reasonable digital FDI inflows, and consequently have higher ICT infrastructure gaps.
- ICT related industrial output can transform the industry from primary exports (natural resources) to technology exports. Many CAREC economies are rich in natural resources and less diversified in exports, translating into lower demand for ICT skills and the job market.

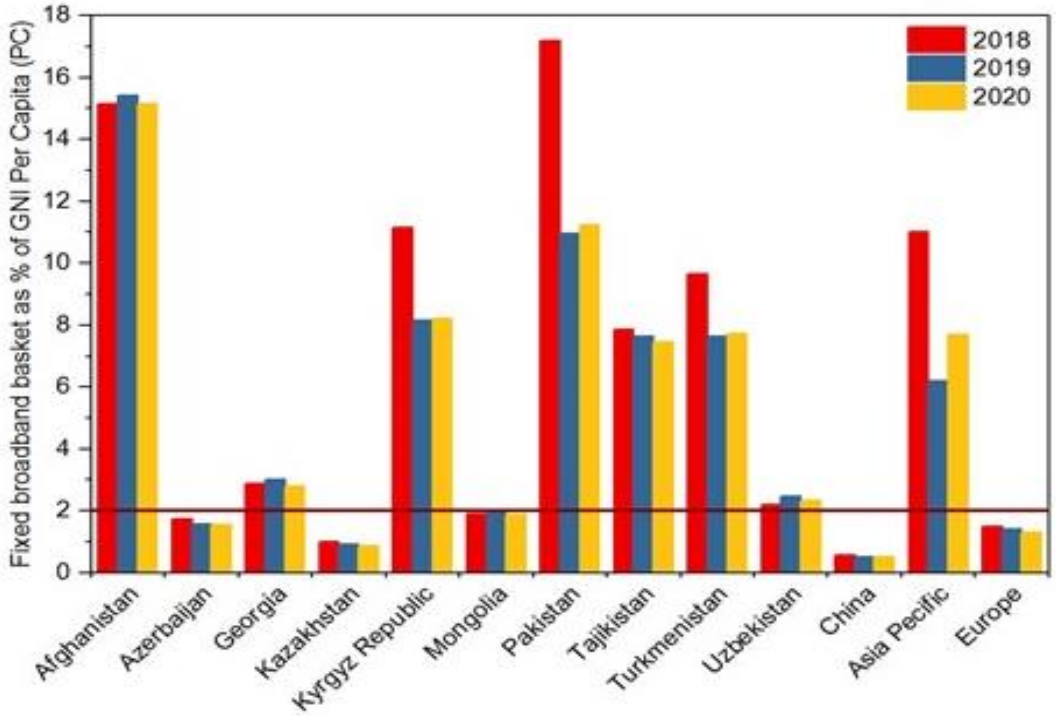
Kazakhstan and Georgia

- Although these countries are the best performing countries in the CAREC region and report a lower digital divide than their counterparts, compared with other emerging countries such as China or the EU, there is significant potential for digital improvement in digital access, infrastructure, quality, and security. Also, Kazakhstan is lagging behind in its institutional quality score, while Georgia is the only exception and the best performing country in institutional governance in the CAREC region. However, it has the lowest score in technology related output. Thus, the best performing countries in the CAREC region are also lagging behind in specific dimensions compared to other developed regions.

3.2.8 Comparison of Key Digital Divide Indicators

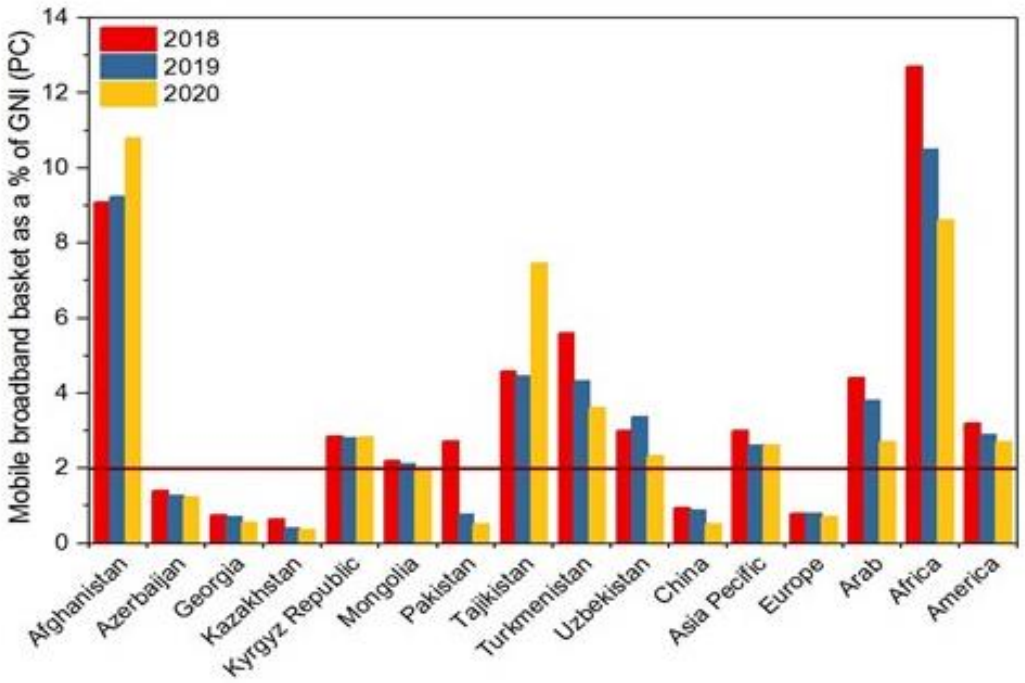
Against this backdrop, it is imperative to compare key digital divide indicators with other leading regions or countries like the EU and China. Thus, we have visualized key raw indicators to compare with other regions. Figures 7 and 8 draw the cost of the internet in terms of broadband and mobile baskets in the last three years. The UN Broadband Commission set the broadband and mobile cost targets at no more than 2 percent of the average monthly income in any country by 2026. But increasing income inequality and poverty in the CAREC region have reiterated the importance of internet costs. Figures 7 and 8 set a 2 percent threshold on income and disclose that China and Europe (average) are falling within the threshold limit in both baskets, while most of the CAREC economies and Asia pacific (average) are also falling above the maximum threshold.

Figure 7: Fixed Broadband Basket as a Percentage of GNI Per Capita



Source: Author's drawing using ITU (2020) data

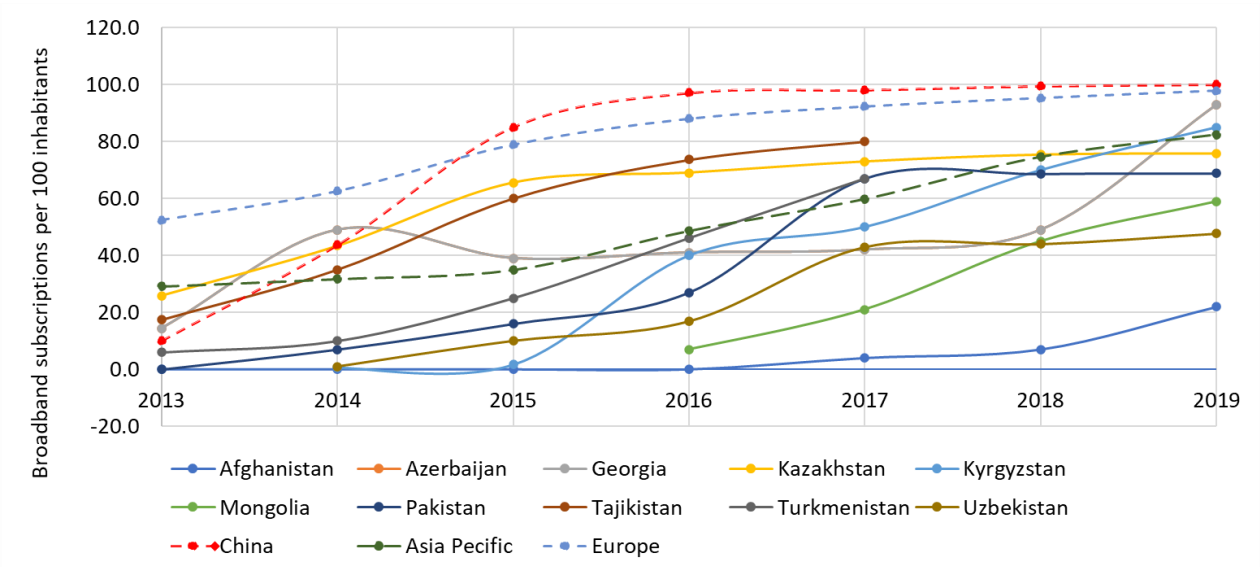
Figure 8: Mobile Broadband Basket as a Percentage of GNI Per Capita



Source: Author's drawing using ITU (2020) data

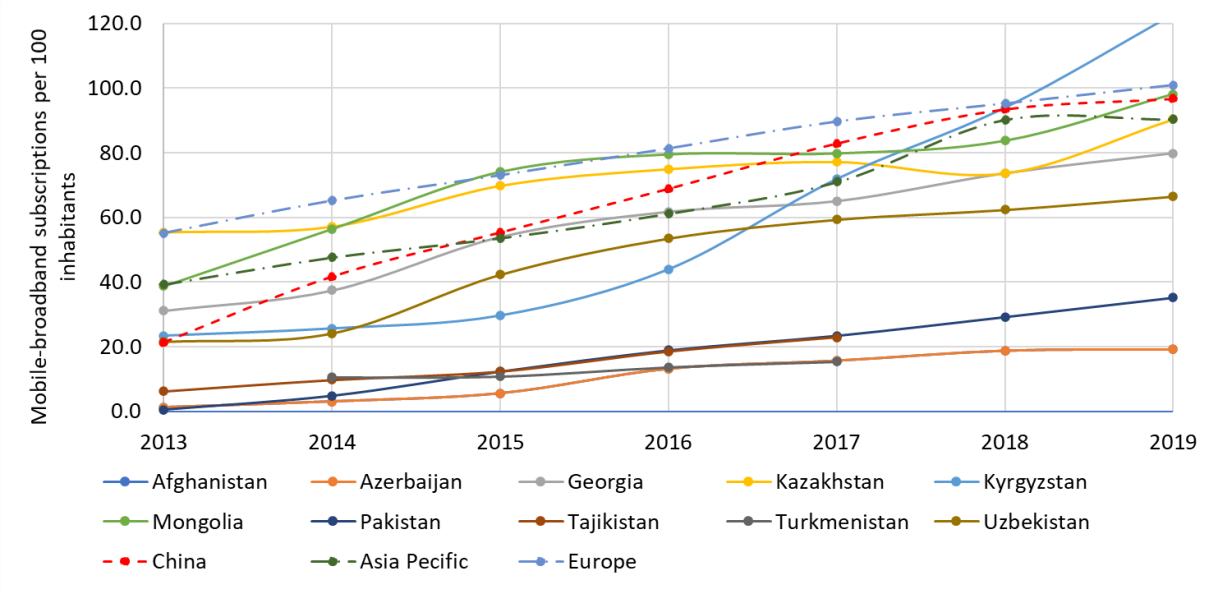
Although Kazakhstan and Georgia secured the highest ranking in access and infrastructure, they are still lagging behind compared with China and the EU. Figures 9 and 10 display broadband subscriptions and mobile subscriptions, indicating that Europe (blue dotted line) and China (red dotted line) are far above the CAREC countries. Notably, the best performing countries in the CAREC region are also far from the emerging and developed regions, as can be observed between the curve's gap. However, all CAREC economies are showing upward trends in digital access, and the gap is squeezing over time.

Figure 9: Broadband Subscriptions per 100 Inhabitants



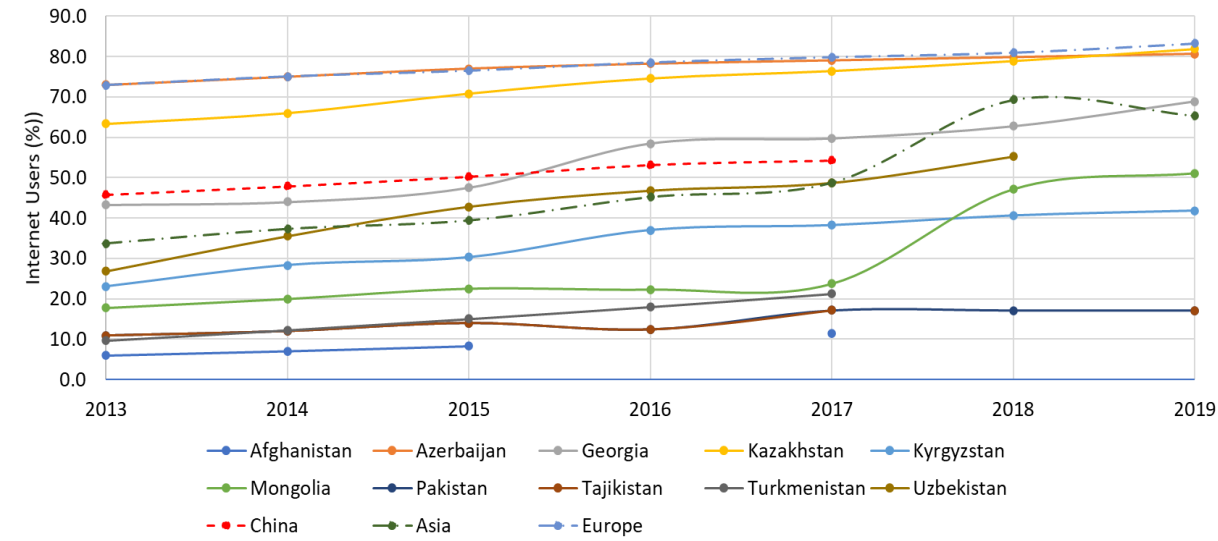
Source: Author's drawing using ITU (2020) data

Figure 10: Active Mobile Subscriptions per 100 Inhabitants



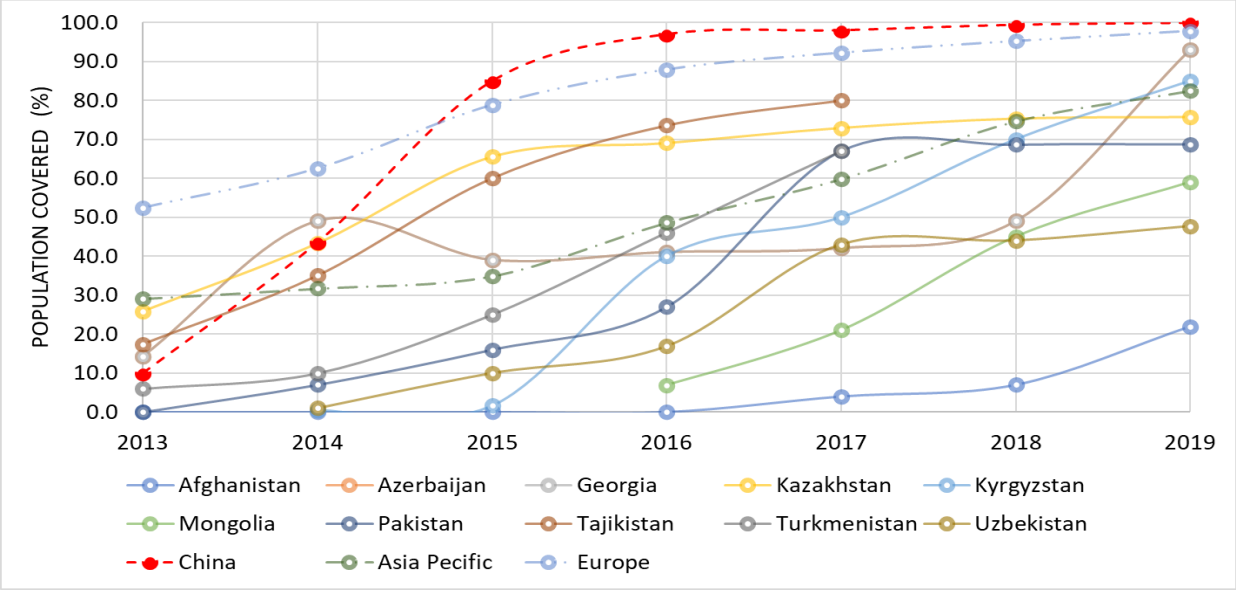
Source: Author's drawing using ITU (2020) data

Figure 11: Individuals Using the Internet, Total (Percent)



Source: Author's drawing using ITU (2020) data

Figure 12: Population Covered by at least a 4G Mobile Network



Source: Author's drawing using ITU (2020) data

Figure 11 shows that the percentage of internet users in Kazakhstan and Azerbaijan is compatible with the EU, while other countries lagged behind. Most of the CAREC economies are falling lower than the curve of Asia Pacific, implying a relatively lower percentage of internet users within and across the regions. For digital infrastructure, Figure 12 shows that China and EU are leading in terms of digital infrastructure (4G network), and CAREC economies are progressing in the last few years and squeezing the gap with developed regions. Recently, only Georgia achieved almost 100% coverage of 4G network, followed by Kyrgyzstan and Kazakhstan.

4. Conclusion and Policy Recommendations

4.1 Conclusion

In today's virtual world, access to digital technologies is equally important for all. Despite its significant importance, 50 percent of the world's population is still unconnected. This gap needs to be addressed between and within countries to ensure equitable gains from digitalization. In 2015, the United Nations designated 'access to the internet and information and communication technologies' as a dedicated target of SDG 9c. To realize these goals, the first step is to estimate and highlight digitally divided areas and then recommend possible solutions. Against this backdrop, this study intends to estimate the digital divide between CAREC economies using recent indicators collected from primary and secondary sources. First, this study developed a detailed questionnaire collected from Afghanistan, Azerbaijan, Kyrgyzstan, Pakistan, Tajikistan, and Uzbekistan and obtained valuable information from ministries and institutions about digital infrastructure and digital payments, e-commerce, internet access, and digital economy. The data of all indicators are scaled between 0 to 100 (0 specify higher digital divide, while 100 specify lowest digital divide).

The overall findings expose the highest digital gaps in e-payments and e-commerce across all sample countries. In contrast, digital access and infrastructure show a moderate gap; however, significant heterogeneity exists at country level outcomes. The average score report that Azerbaijan (59.9) and Uzbekistan (57.8) are relatively less digitally divided economies compared to Kyrgyzstan (53.2), Pakistan

(50.4), Tajikistan (45.6), and Afghanistan (39.0). However, there is substantial heterogeneity across subindicators.

Notably, these rankings are subject to the dimensions and indicators to be chosen for measuring the digital divide. A few countries are performing in one dimension and lagging in another, which prompts us to discuss each dimension of the digital divide. For example, Afghanistan is lagging across all indicators, and the highest digital divide is observed in internet access (29.2), e-commerce (31.3), and digital payments (45.8). These indicator scores are far lower than the CAREC average in respective dimensions. Similarly, Tajikistan is the second most digitally divided country in the CAREC region, and the highest digital gap exists in e-commerce (34.4), internet access (37.5), digital payment (50), and digital infrastructure (60.7). The third most digitally divided country is Kyrgyzstan, which shows the highest gap in e-commerce (37.5) and digital payments (50). However, Kyrgyzstan secured a reasonable score in digital infrastructure (71.4) and internet access (54.2). Pakistan is the fourth digitally divided country in our sample and reports a significant digital gap in e-commerce (34.4), digital payments (54.2), and internet access (41.7). Similar insights are observed in Uzbekistan except for internet access (75.0), which produces a relatively higher score. Finally, Azerbaijan is the best performing country in selected CAREC economies and secured the highest score in digital infrastructure (75.0), followed by internet access (70.8). Nonetheless, the digital gap in e-commerce (43.8) and digital payments (50) is still higher.

Although the above results provide valuable insights (subjective and objective) about the key indicators of the digital economy, several non-infrastructure indicators affect digital penetration across countries. Manifestly, digital divide is a multidimensional phenomenon, which requires an inclusive assessment based on several socioeconomic and regulatory factors. Apart from that, there is a need to access yearly trends in multiple domains to compare the convergence of economies towards digital development. Therefore, this study constructed a composite digital divide index (CDDI) that offers an inclusive picture of the digital divide in the CAREC region. We apply PCA on secondary data of eight CAREC economies: Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, and Uzbekistan, while Afghanistan, Turkmenistan, and China are dropped owing to lack of data. CDDI integrates all possible dimensions subject to data availability, including cost and affordability, access and infrastructure, internet quality, digital security, regulations, digital FDI, and ICT output. The PCA index (CDDI) results are normalized between 0 to 1 (higher to lower digital divide), which shows that Kazakhstan and Georgia are the least digitally divided countries in the CAREC region with a cumulative average score of 0.868 and 0.798, respectively. In contrast, Azerbaijan and Mongolia are moderately divided in the digital spectrum, with an average score of 0.562 and 0.480, respectively. Moreover, Uzbekistan (0.306), Kyrgyzstan (0.276), Pakistan (0.196), and Tajikistan (0.078) are the least performing countries in terms of cumulative digital development in the CAREC region. Notably, the results of subindicators show different ranks compared to overall CDDI.

In Kazakhstan, cost and affordability, access and infrastructure, digital FDI, ICT output are top performing indicators with an average score of 0.975, 0.942, 0.919, 0.805, respectively. Internet quality (0.624), digital security (0.592), and regulations (0.530) possess a lower score, which implies a relatively higher digital gap in these domains. Similarly, in Georgia, regulations, internet quality, digital security, access and infrastructure, cost and affordability are high performing indicators with an average score of 0.984, 0.900, 0.850, 0.826, 0.811, respectively. ICT output (0.069), digital FDI (0.082) show the lowest score, implying a relatively higher digital gap. As the third best performing country in CDDI, Azerbaijan shows that cost and affordability (0.859) and access and infrastructure (0.902) are top performing indicators, reflecting a relatively lower digital divide. In contrast, ICT output (0.112), quality of internet services (0.236), and

regulations (0.663) are the worst performing indicators, suggesting a relatively higher digital gap in these domains.

Mongolia shows a significant digital gap in internet quality (0.138), digital security (0.180), ICT output (0.418), and digital FDI (0.540). However, the average CDDI score has significantly improved from 0.380 to 0.620 from 2016 to 2020. In Uzbekistan, ICT output (0.024), internet quality (0.088), regulations (0.132), and digital FDI (0.310) show the highest backwardness, while cost and affordability (0.638), and access and infrastructure (0.558) report a moderate gap followed by digital security (0.464). Notably, the CDDI score has improved from 0.090 to 0.440 in the last five years; however, it is still lagging behind the average CDDI score (0.4455) of CAREC countries. The average CDDI score of Kyrgyzstan (0.276) is almost half of the average CDDI score (0.4455) of the CAREC region. Almost every indicator exhibits a lower score, such as internet quality (0.533), regulations (0.408), and access and infrastructure (0.401), digital FDI (0.189), digital security (0.230), ICT output (0.312). Despite that, CDDI has shown an upward trend in the last five years, and its score increased from 0.150 to 0.410. As the second least performing country in the CAREC region, Pakistan's average CDDI score is 0.196, significantly lower than the CAREC average (0.445). Most of the subindicators have shown lower scores, such as access and infrastructure (0.058) and regulations (0.122), cost and affordability (0.476), internet quality (0.419), and digital security (0.408). Tajikistan is the least performing country in CDDI score (0.078) against the average score of CAREC economies (0.445). The score of all Tajikistan's subindicators is lower than the CAREC average. For example, cost and affordability, access and infrastructure, digital security, digital FDI, ICT output, and regulations have shown index scores 0.197, 0.185, 0.060, 0.228, 0,024, 0.135, respectively. These scores imply that Tajikistan falls behind in almost every indicator. For interregional comparison, we have compared key indicators of CAREC counties with Asia Pacific, Europe, and China and found that almost all CAREC economies have a significant digital gap. Even the best performing CAREC countries, Kazakhstan and Georgia, have a substantial digital divide compared with Europe and China.

Although the output from both methods (questionnaire and PCA index) is partially varied owing to the diverse nature of indicators and integration of yearly trends. However, both procedures produce unlike features of the same phenomena, which indicates that the digital divide not only persists in digital infrastructure and access, but also in socioeconomic factors such as internet cost and quality, overall business and political regulations, and digital security.

4.2 Policy Implications

Based on the estimated digital divide across various dimensions, the following are some brief policy recommendations.

1. Digital Infrastructure
    a. Digital infrastructure is a basic foundation of the digital divide on which subsequent gaps formed. Thus, expansion of internet (4G) coverage across the whole territory and test the launch of 5G networks. For this, public–private partnership is an optimal solution to fund and manage infrastructure expansion projects. Afghanistan, Turkmenistan, Mongolia, Uzbekistan, and Pakistan are falling behind their peer countries in 4G network coverage. Although the gap is squeezing; however, it needs substantial investment to speed up the process.
    b. Government needs to allocate dedicated funds or subsidize ICT industries to develop business-oriented infrastructure for e-commerce development—transmission lines, network stations, and compatibility with the existing digital network (all countries).
    c. Establish backbone networks, internet exchange points, data centers, and the cloud (all countries).
    d. Replace conventional cable-based transmissions with fiber optic to increase internet (upload/download) speed (Mbps) (Afghanistan, Pakistan, Tajikistan).
    e. Encourage multinational firms to invest in the (digital FDI) ICT sector by offering lucrative tax rebates and swift approvals for new ventures from respective ministries through one window operations (all countries).
2. Digital Payments
    a. Ensure the wide range of major payment methods used worldwide to sell and pay for goods on the major marketplaces (all countries).
    b. Strengthen the legal framework for cashless payments, implement programs and marketing campaigns to increase the volume of cashless payments (all countries).
    c. Increase the use of digital technologies in social spheres (all countries).
    d. Introduce the drive of virtual economy across the whole supply chain (manufacturing, wholesaling, retailing), where each transaction pair will be connected through a digital framework.
    e. Government may follow the famous quote 'charity begins with home' to expand digital penetration by restricting all public offices to make virtual payments, documents submissions, clearance of contracts, salaries disbursements, financial appraisals, claims, and so on.
3. E-Commerce
    a. Develop a dedicated e-commerce framework (development strategy, programs) aligned with SDG 9c (all countries).
    b. Support funding for startups and small businesses especially engaged in e-trade activities (all countries).
    c. Developing a digital e-commerce platform meeting the international standards for cross border trade (all countries).
    d. Work on strengthening consumer protection issues (all countries):
        - Return of goods purchased online
        - Introduce e-court system in charge of e-trade disputes
    e. Further development of e-commerce infrastructure:
        - Implementation of the pilot project EU4Digital Virtual warehouse in CAREC economies to develop cross border trade between CAREC and European countries.

- Make appropriate measures in legislation to ensure the use of international payment methods and cards (all countries).

f. Introduce cross border electronic data exchange between customs agencies (Kyrgyzstan, Tajikistan, Uzbekistan)
g. Introduce 'green transport corridor' system/approach (Afghanistan, Uzbekistan).
h. Ensure the use of digital services, especially e-signature for cross border transactions (all countries except for Azerbaijan)

4. Internet Access
    a. Weak access and infrastructure are the most vulnerable segment of the digital divide, which requires a substantial amount of fixed asset investment from domestic and foreign sources. It also relies upon consumer buying capacity, basic education, and skills to learn, adapt, and utilize IOTs. Afghanistan, Pakistan, Tajikistan, Kyrgyzstan, Uzbekistan, and Mongolia have a higher divide in internet access and infrastructure, which entails effective government intervention to tackle.
    b. Increase the access to computers at household level. For this, financial institutions may offer consumer loans and provide computers, laptops, smartphones, printers in easy instalments. Besides laptops and computers, ICT equipment can be zero taxed to decrease retail prices or promote local assembling.
    c. Introduced lucrative household internet packages. Particularly in those areas, where exiting digital infrastructure is underutilized as a major cost of internet service providers has pertained to fixed capital investment.
    d. Conduct wide awareness raising campaigns to:
        - Educate people (consumers and businesses) on the use of the internet, online services, payment procedures, making online transactions, and enabling trust in virtual trading.
        - Increase the level of public confidence in digital transactions
    e. Review and reduce internet tariffs to increase internet usage and the number of active internet users.
5. Internet Cost and Affordability
    a. Regularization of internet cost (less than 2 percent threshold of gross national income) as per target of UN Broadband Commission. Notably, the cost of the internet is too high in Afghanistan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. In the CAREC regions, only China, Georgia, and Azerbaijan are exceptional countries where internet costs are within the accepted threshold.
    b. Sales tax waiver for consumers on recharge of mobile and broadband internet packages can help to reduce internet cost.
    c. A national blanket policy for affordable internet is required to achieve low-cost internet targets.
6. Digital Security
    a. Cyber security regulations need to be implemented and updated regularly on legal grounds. Most of the CAREC economies secured the lowest score in digital security. In particular, Afghanistan, Kyrgyzstan, Mongolia, Tajikistan, and Turkmenistan are the most vulnerable countries in e-commerce safety, trust in government websites and apps, trust in information from social media, trust in non-government websites and apps, and trust in online privacy. Therefore, an inclusive digital security policy is recommended that adheres to all these concerns.
    b. On technical grounds, increase the number of secured internet servers.
    c. At an organizational level, implementation of the company's cyber security framework.
    d. Establish a dedicated hierarchy of cyber security under IT ministry for evaluations.

e. Increase cyber security awareness to control scams, hacking, and digital frauds.
f. Public–private partnership is dominant in designing and implementing national cyber security frameworks and their implementations.

7. Regulations and governance
    a. The CAREC region is more susceptible to overall regulations and governance. Except for Georgia, none of the countries secured a positive score in the institutional regulation index (-2.5 + 2.5 worse to best). Afghanistan, Turkmenistan, Tajikistan, Pakistan, Uzbekistan, and Kyrgyzstan have lower institutional quality and business regulations, thus failing to create a conducive environment for individuals and businesses to adopt and disseminate digital technologies.
    b. Encourage conducive environment for individuals and businesses through:
        i. Efficient legal system and property rights protection.
        ii. Consistent policies and inclusive digital regulations for the continuation of long term digital development.
        iii. Legal provision for continuation and implementation of digital development projects.
        iv. A certain percentage of the annual public budget may allocate to digital infrastructure and access across underdeveloped (rural) and digital backward areas and industries.
8. Regional Integration
    a. Regional integration is one of the main factors that help countries overcome divisions that impede the flow of people, technology, ideas, goods, and services. Disintegration leads to a higher digital divide, particularly in developing economies. Thus, sequester measures are required to integrate CAREC economies with other technology leading countries. For this, the harmonization of regulatory policies is a steppingstone to promote and establish an inclusive connectivity network for virtual and physical technology transfer.
    b. Regional integration helps to increase export diversification through technology spillovers from source to host countries. Most CAREC economies are less diversified, embodied with lower technological levels, operating at lower end economic models with a heavy reliance on natural resources, and are exports of primary products. Therefore, regional integration in trade, investment, connectivity, institutional, and social aspects help to remove these bottlenecks, leading to higher technology spillovers from technology leaders and therefore lower digital backwardness.

4.3 Limitations and Future Directions

This study attempts to estimate possible dimensions of the digital divide in selected countries; however, there are a few limitations that can be considered for future projects/studies:

1. The study was conducted within a limited time and owing to higher stringency measures and limited data availability, only selected CAREC economies were evaluated. Future projects may expand to all CAREC economies, and a comparative analysis would be performed with digitally advanced countries.
2. Although the questionnaire included over 80 questions in multiple domains, only 37 of them were collected for digital gap assessment. Future studies may consider those remaining uncollected indicators or introduce new indicators (replacing some indicators) to fully reflect the digital gap situation in the CAREC region.
3. The digital divide is a multidimensional phenomenon and includes various dimensions and socioeconomic indicators that are not evaluated in this study, such as poverty, income inequality, gender inequality, household income, human capital development, budgetary allocations in ICT sector, R&D allocations, global FDI in ICT industry, education, and skills level of inhabitants, and taxation policies of the ICT sector. Therefore, future projects may expand the cumulative digital divide index considering new dimensions of digital divide.
4. This study estimated the digital divide using national level aggregate indicators and did not incorporate the digital gap within a country considering income inequality, gender inequality, and rural–urban inequality. Future projects may study subnational or regional digital differences within a country based on suggested indicators.
5. It would be advisable to provide an instrument (program) implementing the proposed method (for questionnaire data processing and cumulative digital divide index) so that this would not be a single-use study but could be used when new data is acquired (for example, next year), and so that the list of subindicators could be altered and new indicators could be taken into account if necessary. Moreover, the proposed digital divide index can be estimated yearly to evaluate the increase or decrease in digital development.

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Appendices

Appendix 1: Results of Principal Component Analysis for all indices and subindices

Table A1: PCA for Dimension 1

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.94053	1.17804	0.6468	0.6468
Comp2	0.762494	0.465519	0.2542	0.9010
Comp3	0.296974		0.0990	1.0000
Number of obs			40	
Number of comp.			3	
Trace			3	
Rho			1.0000	

Principal components (eigenvectors)					
Variable	Comp1	Comp2	Comp3	Unexplained	
a1	0.5624	-0.6273	0.5387	0	
a2	0.6532	-0.0625	-0.7546	0	
a3	0.5070	0.7763	0.3746	0	

Factor analysis/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.37294	1.28109	1.1320	1.1320
Factor2	0.09185	0.34383	0.0757	1.2078
Factor3	-0.25198		-0.2078	1.0000
Number of obs			40	
Retained factors			1	
Number of params			3	
LR test: independent vs. saturated	chi2(3)	1.0000	Prob>chi2	0.0000

Factor loadings and unique variances		
Variable	Factor1	Uniqueness
a1	0.6511	0.5761
a2	0.8144	0.3367
a3	0.5345	0.7143

Kaiser-Meyer-Olkin measure of sampling adequacy	
Variable	Kmo
a1	0.5436
a2	0.5245
a3	0.5656
Overall	0.5394

Scoring coefficients	
Variable	Factor1
a1	0.5436
a2	0.55876
a3	0.18011

Variable	Obs	Mean	Std. Dev.	Min	Max
f1	40	3.73e-10	.8488845	-1.024533	1.711165

Correlation matrix of indicators

	cost	a1	a2	a3
Cost	1.0000			
a1	0.7670	1.0000		
a2	0.9594	0.6220	1.0000	
a3	0.6297	0.2420	0.5217	1.0000

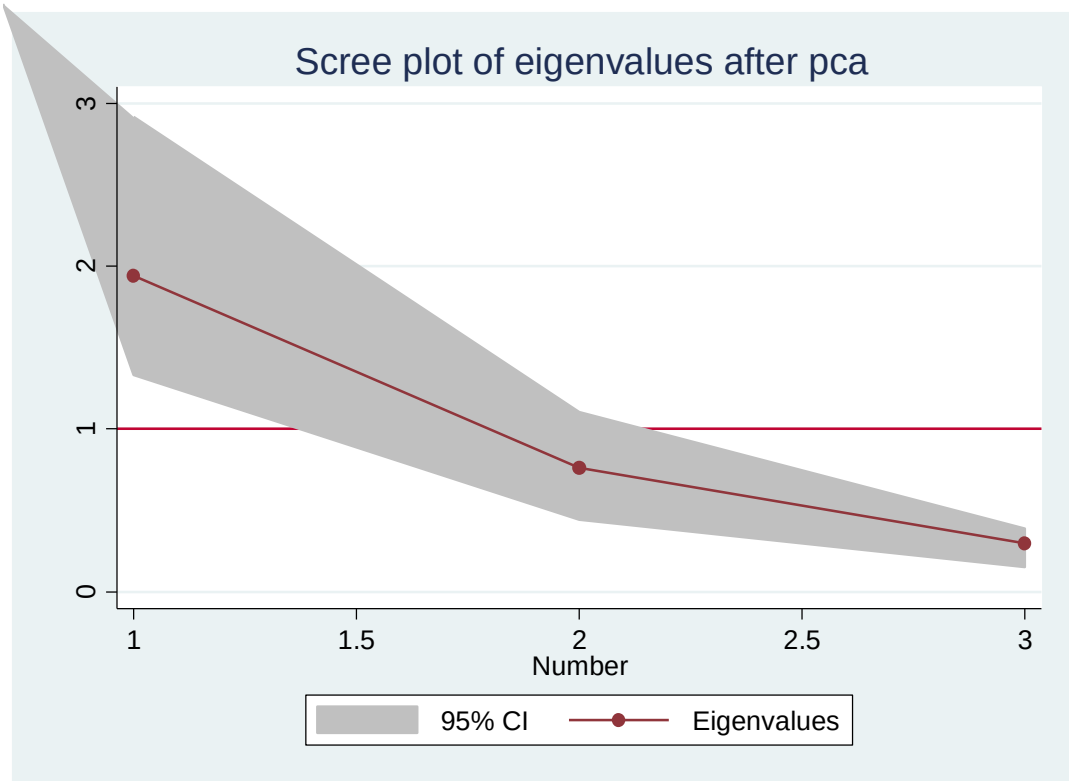

Figure A1: Screen Plot PCA

Table A2: PCA for Dimension 2

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.24819	4.10744	0.6560	0.6560
Comp2	1.14076	.276992	0.1426	0.7986
Comp3	.863765	.497709	0.1080	0.9066
Comp4	.366057	.154553	0.0458	0.9523
Comp5	.211504	.120765	0.0264	0.9788
Comp6	.0907393	.0431761	0.0113	0.9901
Comp7	.0475633	.0161441	0.0059	0.9961
Comp8	.0314191	.	0.0039	1.0000
Number of obs	40			
Number of comp.	3			
Trace	3			
Rho	1.0000			

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Unexplained
a4	0.3988	0.0752	-0.0858	-0.1765	0.7718	-0.3572	-0.2690	-0.0340	0
a5	0.4121	-0.0724	-0.0305	-0.1500	-0.4634	-0.6911	0.3034	-0.1307	0
a6	0.3124	-0.0729	-0.5635	0.7513	0.0110	0.0857	0.0559	-0.0677	0
a7	0.4219	-0.0475	0.0570	-0.0572	-0.3746	0.1363	-0.6797	0.4386	0
a8	0.3792	-0.3638	0.2566	-0.0309	0.1998	0.2729	0.5476	0.4928	0
a9	0.4145	-0.1717	0.0938	-0.2335	-0.0632	0.4745	-0.0320	-0.7108	0
a10	0.1975	0.7395	-0.3749	-0.3251	-0.0712	0.2599	0.2627	0.1619	0
a11	0.2024	0.5223	0.6751	0.4663	0.0112	-0.0419	0.0257	-0.1024	0

Factor analysis/correlation

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.10000	4.21806	0.8142	0.8142
Factor2	0.88195	0.50105	0.1408	0.9550
Factor3	0.38089	0.29740	0.0608	1.0158
Factor4	0.08349	0.06671	0.0133	1.0291
Factor5	0.01678	0.03815	0.0027	1.0318
Factor6	-0.02138	0.04873	-0.0034	1.0284
Factor7	-0.07011	0.03769	-0.0112	1.0172
Factor8	-0.10779	.	-0.0172	1.0000
LR test: independent vs. saturated: chi2(28)	171.87	Prob>chi2	0.0000	
Number of obs	21			
Retained factors	1			
Number of params	8			

Factor loadings and unique variances

Variable	Factor1	Uniqueness
a4	0.8961	0.1969
a5	0.9378	0.1206
a6	0.6641	0.5590

a7	0.9696	0.0599
a8	0.8733	0.2373
a9	0.9554	0.0872
a10	0.4318	0.8136
a11	0.4177	0.8255

Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	kmo
a4	0.8572
a5	0.9184
a6	0.8591
a7	0.8391
a8	0.7265
a9	0.8227
a10	0.4491
a11	0.6007
Overall	0.7934

Scoring coefficients

Variable	Factor1
a4	0.15556
a5	0.10369
a6	0.01232
a7	0.39437
a8	0.20824
a9	0.13447
a10	0.11832
a11	-0.01457

Variable	Obs	Mean	Std. Dev.	Min	Max
f1	21	-1.42e-09	.991226	-1.773212	1.035002

Correlation matrix of indicators

	access	a4	a5	a6	a7	a8	a9	a10	a11
Access	1.0000								
a4	0.9041	1.0000							
a5	0.9461	0.8113	1.0000						
a6	0.6700	0.6392	0.6498	1.0000					
a7	0.9782	0.8211	0.9345	0.6495	1.0000				
a8	0.8810	0.7617	0.8143	0.5215	0.8492	1.0000			
a9	0.9639	0.8364	0.8999	0.5889	0.9386	0.9168	1.0000		
a10	0.4356	0.5021	0.3876	0.3576	0.3882	0.0195	0.2903	1.0000	
a11	0.4214	0.3913	0.3535	0.0880	0.4396	0.3289	0.3531	0.3750	1.0000

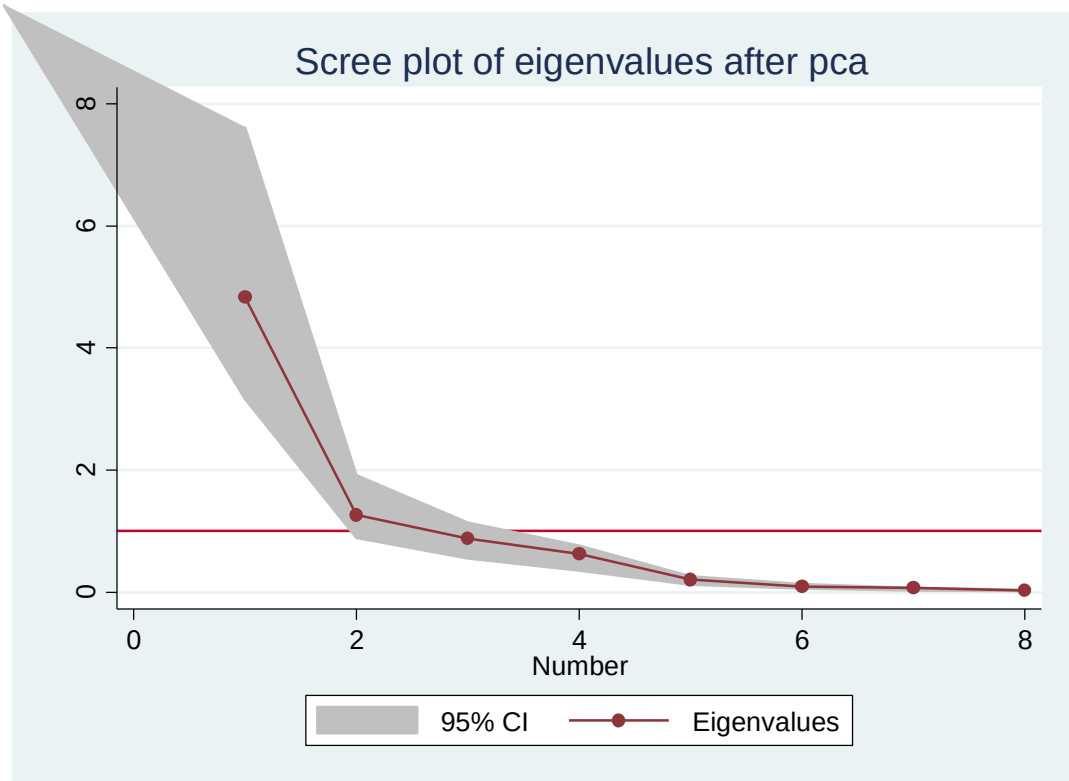

Figure A2: Screen Plot PCA

Table A3: PCA for Dimension 3

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.9978	1.0924	0.6659	0.6659
Comp2	0.905401	0.808598	0.3018	0.9677
Comp3	0 0968028		0.0323	1.0000
Number of obs	17			
Number of comp.	3			
Trace	3			
Rho	1.0000			

Variable	Comp1	Comp2	Comp3	Unexplained
a12	0.6709	-0.2422	0.7008	0
a13	0.6795	-0.1776	-0.7119	0
a14	0.2969	0.9538	0.0454	0

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.9978	1.0924	0.6659	0.6659
Comp2	0.905401	0.808598	0.3018	0.9677
Comp3	0.0968028		0.0323	1.0000
Number of obs	17			
Number of comp.	3			
Trace	3			
Rho	1.0000			
LR test: independent vs. saturated: chi2(3)	1.0000		Prob>chi2	0.0000

Factor loadings and unique variances		
Variable	Factor1	Uniqueness
a12	0.9219	0.1501
a13	0.9312	0.1329
a14	0.2379	0.9434

Kaiser-Meyer-Olkin measure of sampling adequacy	
Variable	kmo
a12	0.5114
a13	0.5108
a14	0.7348
Overall	0.5195

Scoring coefficients	
Variable	Factor1
a12	0.44385
a13	0.52535
a14	0.02330

Variable	Obs	Mean	Std. Dev.	Min	Max
f1	17	0	.9507524	-.9614098	1.979968

Correlation matrix of indicators				
	quality	a12	a13	a14

quality	1.0000			
a12	0.9696	1.0000		
a13	0.9794	0.9014	1.0000	
a14	0.2503	0.1918	0.2465	1.0000

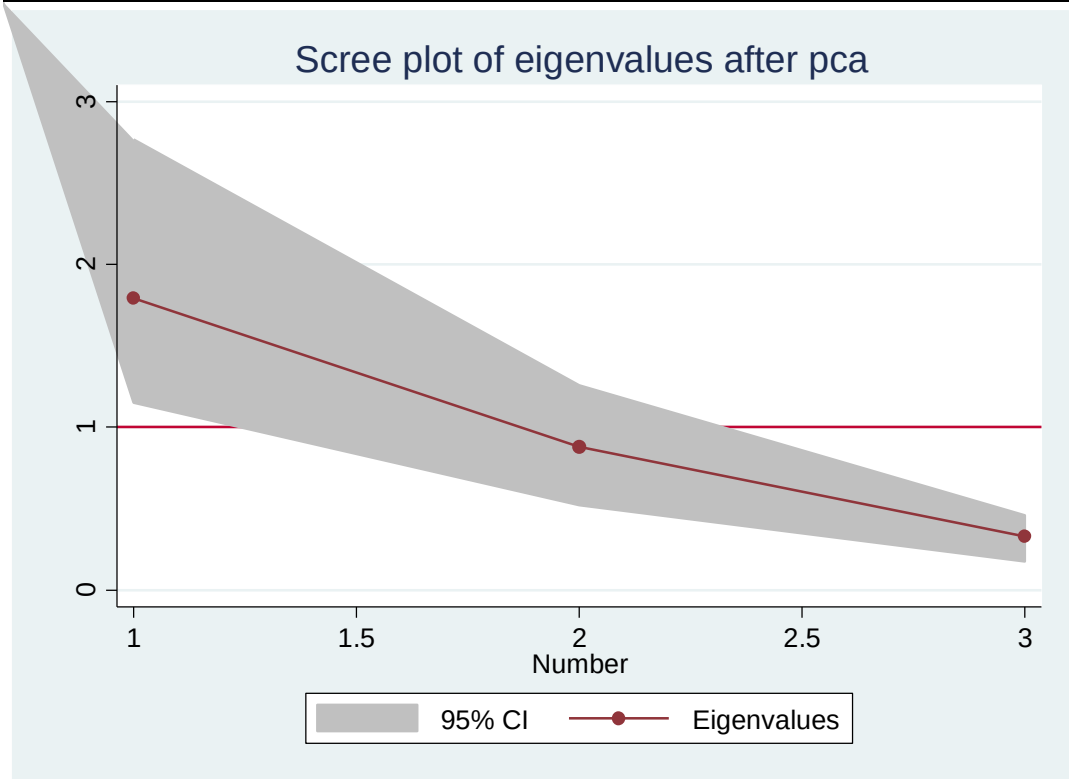

Figure A3: Screen Plot PCA

Table A4: PCA for Dimension 5

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.94483	1.88966	0.9724	0.9724
Comp2	.0551724	.	0.0276	1.0000
Number of obs	21			
Number of comp	2			
Trace	2			

Principal components (eigenvectors)			
Variable	Comp1	Comp2	Unexplained
a16	0.7071	0.7071	0
a17	0.7071	-0.7071	0

factor analysis/correlation				
Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.83753	1.88966	1.0292	1.0292
Factor2	-0.05213	.	-0.0292	1.0000
Number of obs	21			
Number of comp	1			
Trace	1			
LR test: independent vs. saturated: chi2(1)	43.53	Prob>chi2	0.0000	

Factor loadings and unique variances		
Variable	Factor1	Uniqueness
a16	0.9585	0.0812
a17	0.9585	0.0812

Kaiser-Meyer-Olkin measure of sampling adequacy	
Variable	Kmo
a16	0.5000
a17	0.5000
Overall	0.5000

Scoring coefficients					
Variable			Factor1		
a16			0.49286		
a17			0.49286		
variable	obs	mean	Std.dev	min	max
F1	21	4.08e-09	.9720224	-1.279499	1.714227

Correlation matrix of indicators			
	enviro~t	a16	a17
environment	1.0000		
a16	0.9861	1.0000	
a17	0.9861	0.9448	1.0000

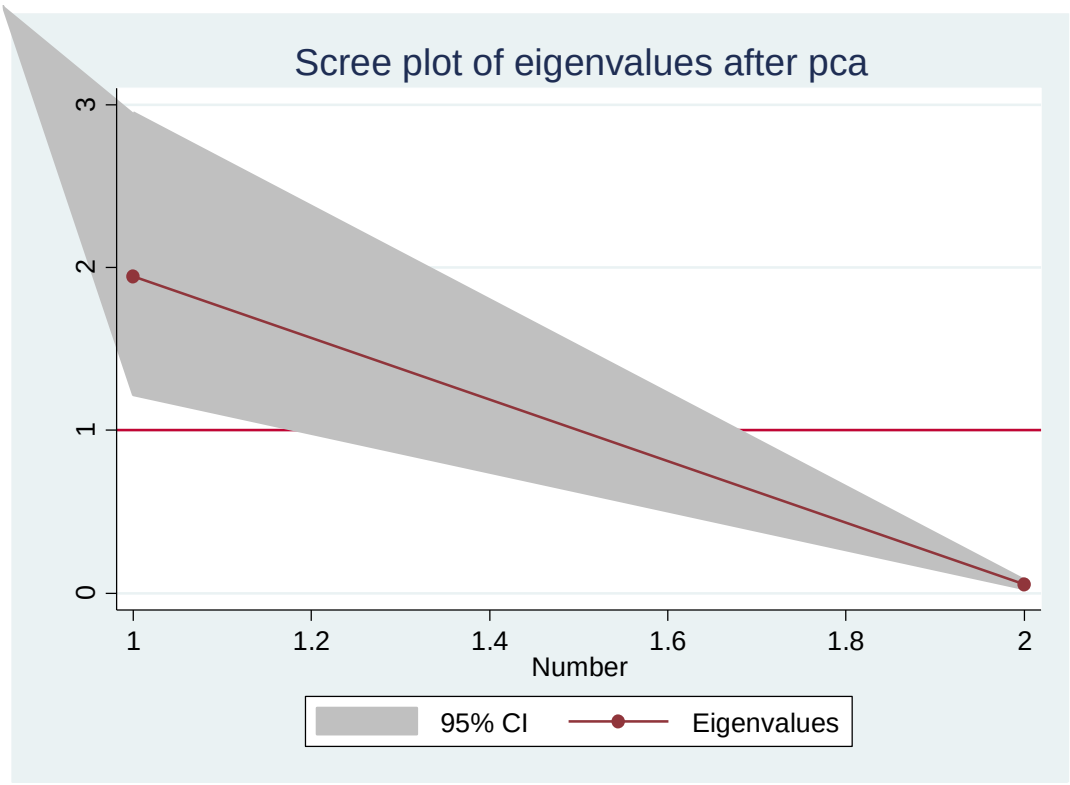

Figure A4: Screen Plot PCA

Table A5: PCA for Composite Digital Divide Index

Principal components/correlation				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.39973	1.50385	0.4857	0.4857
Comp2	1.89588	.646083	0.2708	0.7565
Comp3	1.24979	.901237	0.1785	0.9351
Comp4	.348557	.271854	0.0498	0.9849
Comp5	.0767025	.0495134	0.0110	0.9958
Comp6	.0271891	.025038	0.0039	0.9997
Comp7	.00215103	.	0.0003	1.0000
Number of obs	11			
Number of comp	7			
Trace	7			
Rho	1.000			

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Unexplained
Cost	-0.3938	-0.3463	0.3907	0.3509	0.0164	0.6574	0.1299	0
Access	0.4321	0.1859	-0.4605	0.1806	0.4743	0.4607	0.3111	0
Quality	0.4394	-0.2037	0.2198	0.7593	0.0206	-0.3604	-0.1017	0
environment	0.4830	-0.2238	0.2301	-0.2770	-0.4852	0.0785	0.5877	0
digitalsec~y	0.4282	-0.2715	0.3655	-0.4075	0.3646	0.2068	-0.5172	0
ictexports	0.2078	0.6466	0.1590	0.1493	-0.4735	0.3733	-0.3572	0
digitalfdi	-0.0726	0.5120	0.6125	-0.0520	0.4264	-0.1934	0.3681	0

Factor analysis/correlation

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	3.36976	1.49383	0.4949	0.4949
Factor2	1.87593	0.64750	0.2755	0.7703
Factor3	1.22843	0.93838	0.1804	0.9507
Factor4	0.29005	0.22567	0.0426	0.9933
Factor5	0.06438	0.06796	0.0095	1.0028
Factor6	-0.00359	0.01185	-0.0005	1.0023
Factor7	-0.01543	.	-0.0023	1.0000
Number of obs	11			

Retained factors	03			
No of params	18			
LR test: independent vs. saturated: chi2(1)	88.38	Prob>chi2	0.0000	

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
Cost	-0.7211	-0.4646	0.4293	0.0799
Access	0.7960	0.2511	-0.5155	0.0376
quality	0.7918	-0.2663	0.2299	0.2492
environment	0.8932	-0.3082	0.2630	0.0381
digitalsec~y	0.7916	-0.3728	0.4158	0.0614
ictexports	0.3833	0.8893	0.1667	0.0344
digitalfdi	-0.1336	0.7080	0.6750	0.0252

Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	kmo
cost	0.3988
access	0.2848
quality	0.3691
environment	0.3207
digitalsec~y	0.2921
ictexports	0.2296
digitalfdi	0.1308
Overall	0.2873

Scoring coefficients

Variable	Factor1	Factor2	Factor3
Cost	0.18400	-0.26192	0.35742
Access	0.78898	0.06998	-0.35294
Quality	-0.05792	-0.09295	0.12885
Environment	1.06024	-0.30068	0.34194
digitalsec~y	-0.34304	-0.09419	0.24446
Ictexports	-0.20449	0.55004	0.05648
Digitalfdi	0.35577	0.29534	0.61898

Variable	Obs	Mean	Std. Dev.	Min	Max
f1	11	5.93e-09	.9994811	-1.683748	1.2551

Correlation matrix of indicators

	compos~x	cost	access	quality	enviro~t	digita~y	ictexp~s	digita~i
CDDI	1.0000							
Cost	-0.7215	1.0000						
Access	0.7964	-0.8944	1.0000					
quality	0.7923	-0.2608	0.4912	1.0000				
environment	0.8936	-0.4202	0.4646	0.7962	1.0000			
digitalsec~y	0.7920	-0.2624	0.3129	0.7358	0.9491	1.0000		

ictexports	0.3835	-0.6008	0.4382	0.1396	0.1161	0.0103	1.0000	
digitalfdi	-0.1337	0.0509	-0.2687	-0.1492	-0.1711	-0.0717	0.6776	1.0000

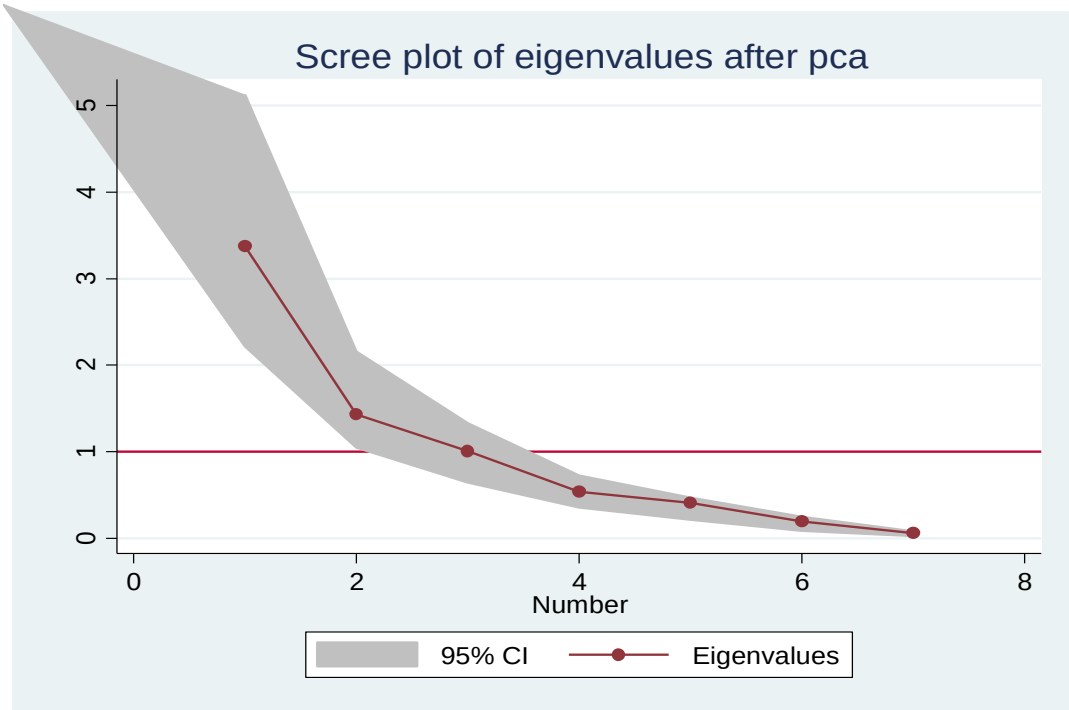

Figure A5: Screen Plot PCA

Appendix 2: Simple to General Case: PCA Results for Different Combinations

Table 2A: Summary Tables obtained from PCA for different combinations—simple to general

Cost & Affordability and Access & Infrastructure			
Country	Mean	Min	Max
Azerbaijan	0.867	0.835	0.894
Georgia	0.684	0.499	0.865
Kazakhstan	1.094	0.982	1.215
Kyrgyzstan	-0.828	-1.225	-0.494
Mongolia	0.198	-0.070	0.506
Pakistan	-0.910	-1.095	-0.727
Tajikistan	-1.150	-1.400	-0.792
Uzbekistan	0.045	-0.712	0.429
Total	0.000	-1.400	1.215
Cost & Affordability, Access & Infrastructure and Quality			
Country	Mean	Min	Max
Azerbaijan	0.856	0.828	0.894
Georgia	0.805	0.617	1.002
Kazakhstan	1.143	1.024	1.311
Kyrgyzstan	-0.731	-1.174	-0.352
Mongolia	0.063	-0.252	0.436
Pakistan	-0.985	-1.201	-0.780
Tajikistan	-1.128	-1.349	-0.799
Uzbekistan	-0.023	-0.755	0.387
Total	0.000	-1.349	1.311
Cost & Affordability, Access & Infrastructure, Quality and Regulations			
Country	Mean	Min	Max
Azerbaijan	0.443	0.387	0.537
Georgia	1.322	1.111	1.524
Kazakhstan	1.049	0.856	1.279
Kyrgyzstan	-0.535	-0.965	-0.146
Mongolia	0.255	-0.037	0.553
Pakistan	-0.957	-1.246	-0.625

Tajikistan	-1.185	-1.462	-0.848
Uzbekistan	-0.390	-1.053	0.057
Total	0.000	-1.462	1.524
Cost & Affordability, Access & Infrastructure, Quality, Regulations and Digital Security			
Country	Mean	Min	Max
Azerbaijan	0.490	0.222	0.742
Georgia	1.438	1.182	1.638
Kazakhstan	1.048	0.480	1.531
Kyrgyzstan	-0.561	-1.040	-0.011
Mongolia	-0.025	-0.395	0.237
Pakistan	-0.770	-1.095	-0.274
Tajikistan	-1.148	-1.399	-0.839
Uzbekistan	-0.471	-1.183	0.055
Total	0.000	-1.399	1.638

Cost & Affordability, Access & Infrastructure, Quality, Regulations, Digital Security and ICT Output			
Country	Mean	Min	Max
Azerbaijan	0.480	0.238	0.718
Georgia	1.364	1.125	1.554
Kazakhstan	1.152	0.659	1.631
Kyrgyzstan	-0.530	-0.950	-0.046
Mongolia	0.032	-0.327	0.399
Pakistan	-0.841	-1.153	-0.377
Tajikistan	-1.177	-1.418	-0.882
Uzbekistan	-0.479	-1.164	0.009
Total	0.000	-1.418	1.631

Cost & Affordability, Access & Infrastructure, Quality, Regulations, Digital Security, ICT Output and Digital FDI			
Country	Mean	Min	Max
Azerbaijan	0.395	0.231	0.576
Georgia	1.193	0.951	1.399
Kazakhstan	1.433	1.021	1.873
Kyrgyzstan	-0.572	-0.992	-0.112
Mongolia	0.119	-0.206	0.585
Pakistan	-0.853	-1.151	-0.406

Tajikistan	-1.238	-1.507	-0.904
Uzbekistan	-0.477	-1.211	-0.027
Total	0.000	-1.507	1.873

Table 2B: Correlation Matrix for Different Combinations—Simple to General

Cost & Affordability and Access & Infrastructure			
	cindex_1	**Cost & Affordability**	**Access & Infrastructure**
cindex_1	1.000		
Cost & Affordability	0.933	1.000	
Access & Infrastructure	0.933	0.739	1.000

Cost & Affordability, Access & Infrastructure and Quality				
	cindex_2	**Cost & Affordability**	**Access & Infrastructure**	**Quality**
cindex_2	1.000			
Cost & Affordability	0.898	1.000		
Access & Infrastructure	0.957	0.739	1.000	
Quality	0.290	0.092	0.296	1.000

Cost & Affordability, Access & Infrastructure, Quality and Regulations					
	cindex_3	**Cost & Affordability**	**Access & Infrastructure**	**Quality**	**Regulations**
cindex_3	1.000				
Cost & Affordability	0.837	1.000			
Access & Infrastructure	0.888	0.739	1.000		
Quality	0.492	0.092	0.296	1.000	
Regulations	0.808	0.510	0.531	0.538	1.000

Cost & Affordability, Access & Infrastructure, Quality, Regulations and Digital Security						
	cindex_4	**Cost & Affordability**	**Access & Infrastructure**	**Quality**	**Regulations**	**Digital Security**
cindex_4	1.000					
Cost & Affordability	0.799	1.000				
Access & Infrastructure	0.864	0.739	1.000			
Quality	0.583	0.092	0.296	1.000		

Regulations	0.768	0.510	0.531	0.538	1.000	
Digital Security	0.763	0.492	0.563	0.520	0.421	1.000

Cost & Affordability, Access & Infrastructure, Quality, Regulations, Digital Security and ICT Output

	cindex_5	**Cost & Affordability**	**Access & Infrastructure**	**Quality**	**Regulations**	**Digital Security**	**ICT Output**
cindex_5	1.000						
Cost & Affordability	0.808	1.000					
Access & Infrastructure	0.881	0.739	1.000				
Quality	0.561	0.092	0.296	1.000			
Regulations	0.770	0.510	0.531	0.538	1.000		
Digital Security	0.732	0.492	0.563	0.520	0.421	1.000	
ICT Output	0.403	0.339	0.393	0.119	0.320	0.035	1.000

Cost & Affordability, Access & Infrastructure, Quality, Regulations, Digital Security, ICT Output and Digital FDI

	cindex_6	**Cost & Affordability**	**Access & Infrastructure**	**Quality**	**Regulations**	**Digital Security**	**ICT Output**	**Digital FDI**
cindex_6	1.000							
Cost & Affordability	0.835	1.000						
Access & Infrastructure	0.881	0.739	1.000					
Quality	0.526	0.092	0.296	1.000				
Regulations	0.745	0.510	0.531	0.538	1.000			
Digital Security	0.668	0.492	0.563	0.520	0.421	1.000		
ICT Output	0.501	0.339	0.393	0.119	0.320	0.035	1.000	
Digital FDI	0.196	0.291	-0.096	0.022	-0.015	-0.042	0.542	1.000

Appendix 3: E-commerce virtual warehouse: implementation in the selected CAREC countries

Introduction

The EU, currently the second biggest cross border buyer of goods, has established its own e-commerce rules, processes, knowhow, and ways of engaging stakeholders. Naturally, the member states expect these rules to be considered and followed by all their trading partners, including non-EU businesses. Otherwise, different rules create various obstacles and barriers that complicate e-commerce transactions. There is a need to harmonize the digital environments between the Eastern partner countries and the EU to avoid such complications. Thus, the EU4Digital Facility focused on:

1. Facilitating harmonization of cross border e-commerce laws, standards, and ecosystem among the Eastern partner countries (Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova, and Ukraine) and the EU;
2. Piloting technical solutions to support cross border e-commerce.

Regarding harmonization of cross border e-commerce laws, standards and ecosystem, the EU4Digital Facility has published recommendations to:

- eliminate the barriers for cross border e-commerce;
- boost cross border e-commerce volume;
- increase awareness and prepare the countries for the EU 2021 e-commerce changes.

Regarding piloting technical solutions to support cross border e-commerce, the EU4Digital Facility has launched the pilot, establishing national virtual warehouses in the pilot countries, including Azerbaijan, to support retailers, marketplaces, delivery operators, and customs to place the products for sale abroad and facilitate cross border delivery.

1. About the piloted e-commerce virtual warehouse

How and why the pilot solution was developed: the cross border challenges in e-commerce prompted EU4Digital to look for a possible solution that would strengthen the e-commerce ecosystem and increase e-commerce volumes. After analyzing e-commerce legal, standards, and ecosystem areas, one of the developed recommendations was selected to become the pilot solution to address the challenges.
What is the pilot? virtual e-commerce warehouse is developed and piloted to facilitate the automated exchange of e-commerce data. The piloted solution supports retailers, marketplaces, delivery operators, and customs to place goods for sale abroad and facilitate cross border delivery.

The national virtual warehouse enables sellers to place goods abroad and exchange data electronically about sold goods with logistics and transport providers so that they can complete the physical delivery of purchased products to buyers. A virtual warehouse was configured and tested for the pilot to connect with Azerpost to support the physical delivery of purchased products. Azerpost has been selected as a delivery operator because it uses a unified postal system provided by the Universal Postal Union for data exchange.

During the e-commerce pilot activities in the scope of the EU4Digital Facility, the virtual warehouse technical solution was deployed and configured in three Eastern Partnership countries, including Azerbaijan. Pilot participants had an opportunity to observe how the virtual warehouse works in practice

by exchanging real time e-commerce electronic data with a marketplace and the national postal operators. Data exchange was tested between pilot countries, including Azerbaijan, where the eBay marketplace was selected for the pilot.
In addition to the pilot between the Eastern Partnership countries and Germany, the EU4Digital also launched a pilot between Azerbaijan and Georgia. The aim was to explore the potential benefits of the virtual e-commerce warehouse between the Eastern partner countries.

What are the benefits of the pilot? The developed and tested solution aims to support e-commerce actors as follows:

- For retailers: cost and time efficiency. The retailers manage the inventory in real time on a single virtual warehouse, which is integrated with marketplaces allowing to place products for sales from one place on different marketplaces simultaneously.
- Marketplaces: growth possibilities. By allowing new businesses to list goods on the interfaces, the virtual warehouse allows marketplaces to grow a portfolio of products.
- Postal operators: timely delivery and quality. Once the sale happens, marketplaces notify the virtual warehouse through the application programming interface (API) so that the national post can initiate cross border transportation procedures immediately. All data required for postal operations is collected in the virtual warehouse before sales and shared with the postal operators as soon as sales happen.

An additional—and very important—goal of the pilot activity was to prepare e-commerce actors in the Eastern partner countries for the 2021 e-commerce VAT package introduced in the EU:

- Mandatory electronic customs declaration;
- Available reduced customs data set to all parcel operators from July 2021;
- Harmonized ID linking all assigned IDs on a parcel to items stored inside.

At the pilot conclusion phase, the developed and tested application and relevant configurations were handed over to Azerbaijan to customize further and use them.
The continuation of the pilot outcomes is expected to result in more efficient data exchange and commercial goods delivery between Azerbaijan, the EU, and beyond and reduce business transaction costs and improve efficiency and business relations.

2. How the pilot was launched in Azerbaijan

During the pilot, sellers from the Eastern partner countries accomplished the following:

1. **Product placing in the virtual warehouse**. Sellers use the newly established national virtual warehouse to add products for online sale in Germany. Sellers create a centralized product listing to describe products both to list on the marketplace and customs purposes.
2. **Product listing on the German marketplace.** Next, the harmonized product listing on the virtual warehouse is sent to German eBay to place products for sale on the marketplace.
3. **Product purchase.** Once a purchase happens on eBay, the piloted virtual warehouse automatically generates mandatory and necessary data for customs, import duties, transport security, and product safety documentation in real time.
4. **Exchange of product data and final delivery**. Generated data is shared by the piloted solution with the logistics and transport provider so that they can complete the physical delivery of

purchased products to buyers. This way, sellers enter product data only once in the virtual warehouse, and the virtual warehouse shares this data to complete the transaction.

During the pilot launch, Azerbaijani seller 'ISAR' LLC sold a handmade wooden desk organizer, which was delivered in five working days to the buyer in Germany. Throughout the entire delivery period, the buyer in Germany could track the purchased item online.

Both the intra-EaP as well as the EaP-EU pilots have now been concluded successfully. They have proven that automated e-commerce data exchange via virtual warehouse is technically feasible and highly desirable for both public and private entities across the Eastern partnership region.

As this project was successfully tested in two CAREC countries—Azerbaijan and Georgia—it is possible to propose its implementation in other countries of the region to increase e-commerce between the CAREC and EU countries.

Appendix 4: Questionnaire (Shorter Version)

Questionnaire on Digital Divide Gap (For CI)

CAREC Institute Research on Digital CAREC: Analysis of the Regional Digital Gap (Phase 1)

Country (please provide name of survey country): _____

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
1. Digital Infrastructure				
		1.1 Digital Public Services		
1.	Are there any specific national strategies for digital infrastructure development?	Yes (please provide details): No (please explain why not):		
2.	Is there any national legal framework to support digital infrastructure development?	Yes (please provide details): No (please explain why not):		
3.	Country coverage with 4G networks.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c)60% and above		
4.	E-government users (individuals sending filled forms to public authorities, over the internet, last 12 months, percentage of internet users).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
5.	Are there any e-health methods available in your country? List down all.	a) _____ b) _____ c) _____		
6.	Please describe what are the existing micro small and medium enterprise (MSMEs) innovation and digitalization hubs (techno parks, SEZs), their activities.	a) _____ b) _____ c) _____ d) _____ _____		
		1.2. Integration of Digital Technology		
7.	Percentage of enterprises sending and/or receiving e-invoices.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: c) Up to 10% d) More than 10% but less than 60% e) 60% and above		
8.	Please identify the main players in your country's digitalization drive (telecom companies, government agencies, etc.) and their development strategies and plans.	a) _____ b) _____ c) _____		
		1.3 Access to Digital Financial Services		
9.	Name few fintech industries providing services (such as, to improve credit scoring, anti money laundering/combating the financing of terrorism (AML/CFT), fraud detection)	a) _____ b) _____ c) _____ d) _____ _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
10.	How much funding is available for startups or early stage small businesses?	a) No funding (specify reasons: a. _____ b. _____ b) Funding is available (please specify amount in US dollars) _____		
11.	What is the status of micro financing or lease for individuals? Choose one option	a) Yes available (please specify the duration in years)_____ b) Not available (please specify any hurdles) a. _____ b. _____ _____		
2. Digital payments				
1.	Any programs for increasing the volume of cashless payments in your country	a) _____ b) _____ c) _____		
2.	Which of the payment methods are the accepted ways to sell and pay for goods on the major marketplaces in your country? Please list all.	a) _____ b) _____ c) _____		
3.	Amount of DFDI (in million USD) in the last five years in digital infrastructure (including digital payments).	_____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
4.	Are there any digital financial services that provide privilege or subsidies in developing digital payments?	Yes (please provide details): No (please explain why not):		
5.	List recent major projects introduced or underway in the mentioned sector (by government and private sector).	a) _____ b) _____ c) _____ d) _____		
6.	Are there any specific programs or policies aimed at digital economy/digital payment development? Add details of all.	a) _____ b) _____ c) _____ d) _____		
3. E-commerce				
1.	Percentage of enterprises receiving orders for products via websites or apps, by type of web platform (own website or intermediary platforms)	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
2.	Can SMEs as companies directly register on global marketplaces (such as Amazon, Alibaba, eBay, WISH etc., available in your country) to sell cross border?	a) Yes available (please provide name of all those that are available. b) Not available (please provide reasons of unavailability) a. _____ b. _____ c. _____		
3.	List the key marketplaces in your country and indicate if they allow to buy and sell cross border.	a) _____ b) _____ c) _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		d) _____		
4.	Origin of sellers (national, EU, China, rest of world) of goods, services or content bought or ordered for private use over the internet.	a) National b) China c) United States d) United Kingdom e) Others (please specify)		
5.	Are there any single window platforms (supporting online sales) available in your country?	If yes, please specify_____		
6.	Is there any association or similar organization in your country that supports the activities in e-commerce	If yes, please specify the activity of the organization___		
7.	Availability of 'green transport corridor' approach in any part of the transport sector. Pick one option and explain.	a) Yes available _____ b) Not available (please provide some reasons of non-availability)_____		
8.	Legal framework for cross border electronic data exchange between customs	a) Yes available _____ b) Not available (please provide some reasons of non-availability)_____		
9.	What are the most common delivery methods of cross border parcels in your country?	a) DHL b) DPD c) UPS d) FedEx e) Others (please specify)		
10.	What is the share (in percentage) of major marketplaces using any international parcel	a) DHL (in percentage) b) DPD (in percentage) c) UPS (in percentage) d) FedEx (in percentage)		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
	delivery services such as DHL, DPD, UPS and FedEx in your country?	e) Others (please specify) (in percentage)_____		
11.	Please describe what are the common delivery locations for parcel delivery in your country. You may add several options.	a) _____ b) _____ c) _____ d) _____ e) _____		
12.	How delivery to remote areas happens in your country. Specify sources.	a) _____ b) _____ c) _____ d) _____ e) _____		
13.	How the process for buyers to return purchased goods online is processed in your country?	_____ _____		
14.	Please describe the following areas and involved stakeholders (domestic and global): a) Number of days to decide whether to keep purchased goods and when does this period start. b) Reasons and other information provided to seller. c) Key stakeholders that manage the process of backwards delivery back to seller (such as, delivery operators, specialized software).	a) one week b) two weeks c) one month d) others (please specify)_____ _____ _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
	d) Most common locations for customers to drop purchased goods to be delivered back to seller. a) home, b) office, c) nearest outlet/sale center, d) others (please specify) e) Control of the preservation of the original product.	_____ _____ a) home b) office c) nearest outlet/sale center d) other (please specify)_____		
15.	Amount of DFDI (in USD) in the last five years in the area of (development of) e-commerce.	_____		
16.	List recent major projects introduced or underway in e-commerce sector.	a) _____ b) _____ c) _____		
4. Internet Access				
1.	Amount of DFDI (in USD) in the last five years in the area of internet access.	_____		
2.	List recent major projects introduced or underway in the mentioned sector	a) _____ b) _____ c) _____ d) _____		
		4.1 Use of Internet		
3.	Percentage of individuals using the internet for internet banking.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		b) More than 10% but less than 60% c) 60% and above		
4.	Percentage of individuals using online learning resources (online courses, material other than a complete online course, educational websites/portals).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
5.	Percentage of individuals purchasing e-books.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		

Appendix 5: Questionnaire (Full Version)

Questionnaire on Digital Divide Gap (Full Version)

CAREC Institute Research on Digital CAREC: Analysis of the Regional Digital Gap (Phase 1)

Country (please provide name of survey country): _____

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
1. Digital Infrastructure				
		1.2 Digital Public Services		
1.	Are there any specific national strategies for digital infrastructure development?	Yes (please provide details): No (please explain why not:		
2.	Is there any national legal framework to support digital infrastructure development?	Yes (please provide details): No (please explain why not:		
3.	Percentage of citizens using online public services (obtaining information from websites, submitting forms online).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
4.	Country coverage with 4G networks.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		60% and above		
5.	E-government users (individuals sending filled forms to public authorities, over the internet, last 12 months, percentage of internet users).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
6.	E-prescription (GPs using electronic networks to transfer prescriptions to pharmacists, percentage of General Practitioners).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
7.	Are there any e-health methods available in your country? List down all.	a) _____ b) _____ c) _____		
8.	Please describe what are the existing micro small and medium enterprise (MSMEs) innovation and digitalization hubs (techno parks, SEZs), their activities.	a) _____ b) _____ c) _____ d) _____ _____		
1.2. Integration of Digital Technology				
9.	Percentage of enterprises whose internal business processes are automatically linked (for example, using enterprise resource planning (ERP) software).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options:		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
10.	Percentage of enterprises using RFID technologies, by purpose (person or product identification).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
11.	Percentage of enterprises using 3D printing in various stages of the production process (design, manufacturing).	Provide percentage here (____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
12.	Percentage of enterprises using industrial or professional personal robots in various stages of the production process (assembly, warehouse, delivery, assistance).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
13.	Percentage of enterprises analyzing big data, by type of source.	Source a (percentage):_____(___)		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		Source b (percentage):_____(___) Source c (percentage):_____(___) Source d (percentage):_____(___)		
14.	Big data analytics by internal/external provider	By internal provider, percent: By external provider, percent:		
15.	Percentage of enterprises sending and/or receiving e-invoices.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
16.	Percentage of enterprises using social media, by purpose.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
17.	Please describe what digitalization programs have been implemented or under implementation in your country, their targets and outputs.	a) _____ b) _____ c) _____		
18.	Please identify the main players in your country's digitalization drive (telecom companies,	d) _____ e) _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
	government agencies, etc.) and their development strategies and plans.	f) _____		
1.3 Access to Digital Financial Services				
19.	What digital financial products are offered by traditional financial service providers (banks, credit unions, micro financial institutions) that are accessible to a broad range of consumers?	a) Online/mobile banking b) Payment cards c) Digital credit d) Short and long term loans Others (please specify all)		
20.	Name few fintech industries providing services (such as, to improve credit scoring, anti money laundering/combating the financing of terrorism (AML/CFT), fraud detection and so on)	a) _____ b) _____ c) _____ d) _____ _____		
21.	How much funding is available for startups or early stage small businesses?	a) No funding (specify reasons: a. _____ b. _____ b) Funding is available (please specify amount in US dollars)		
22.	What is the status of micro financing or lease for individuals? Choose one option	a) Yes available (please specify the duration in years)_____ b) Not available (please specify any hurdles) a. _____ b. _____		
2. Digital payments				
1.	Volume of cashless payments, percent			
2.	Volume of purchased goods paid cashless.	_____		

1	2	3	4	5
#	Indicator/Questions	Choose appropriate option(s) and add explanation wherever asked for it	Source of data (name the publication and URL)	Comments (can also be described separately in additional Annex)
3.	Any programs for increasing the volume of cashless payments in your country	a) _____ b) _____ c) _____		
4.	Number of online purchases and amount spent on buying or ordering goods, services, or content over the Internet.	Number (please specify)_____ Amount (in USD) _____		
5.	What problems are encountered when buying or ordering goods, services, or content over the internet. Provide a list.	a) _____ b) _____ c) _____		
6.	Which of the payment methods are the accepted ways to sell and pay for goods on the major marketplaces in your country? List down all.	a) _____ d) _____ e) _____		
7.	Amount of FDI (in million USD) in the last five years in digital infrastructure (including digital payments).	_____		
8.	Are there fiscal incentives in place to accelerate digital infrastructure investment and development via online (e.g., accelerated depreciation for connectivity infrastructure investments, tax credits for research and development, or loans or subsidies for connectivity infrastructure)?	Yes (please provide details): No (please explain why not:		
9.	Are there digital banking services that help to process financial transactions (financial operations, receiving bank certificates)?	Yes (please provide details): No (please explain why not:		
10.	Are there any digital financial services that provide privilege or subsidies in developing digital payments?	Yes (please provide details): No (please explain why not:		
11.	List recent major projects introduced or under way in the mentioned sector (by government and private sector).	a) _____ b) _____ c) _____ d) _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
12.	Are there any specific programs or policies aimed at digital economy/digital payment development? Add details of all.	a) _____ b) _____ c) _____ d) _____		
3. E-commerce				
		3.1 E-commerce ecosystem		
1.	Percentage of enterprises having a website with e-commerce functions	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
2.	Percentage of enterprises receiving orders for products via websites or apps, by type of web platform (own website or intermediary platforms)	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
3.	Are global marketplaces, such as Amazon, Alibaba, eBay, WISH, available in your country? Name all those available.	a) Yes available (please provide name of all those that are available. b) Not available (please provide reasons for unavailability a. _____ b. _____ c. _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
4.	Can SMEs as companies directly register on such marketplaces to sell cross border?	a) Yes available (please provide name of all those that are available. b) Not available (please provide reasons for unavailability a. _____ b. _____ c. _____		
5.	Can customers in your country purchase goods from platforms such as Amazon, Alibaba, eBay, WISH?	a) Yes available (please provide name of all those that are available. b) Not available (please provide reasons for unavailability a. _____ b. _____ c. _____		
6.	List the key marketplaces in your country and indicate if they allow to buy and sell cross border.	a) _____ b) _____ c) _____ d) _____		
7.	List obstacles to selling and buying products online, in general and cross border.	a) _____ b) _____ c) _____ d) _____		
8.	Percentage of individuals purchasing goods, services, or content over the internet.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		b) More than 10% but less than 60% c) 60% and above		
9.	Types of goods, service, or content most generally bought or ordered for private use over the internet in the last 12 months.	a) Clothes b) Electronic devices c) Household appliances d) Books e) Others (please specify)		
10.	Origin of sellers (national, EU, China, rest of world) of goods, services or content bought or ordered for private use over the internet.	a) National b) China c) United States d) United Kingdom e) Others (please specify)		
11.	Reasons for not buying or ordering any goods or services over the internet.	a) Security issues (fear of loss of money) b) Lack of confidence of buying online c) Return issues in case of incorrect/unwanted item(s) d) Other (please specify)		
12.	Are there any single window platforms (supporting online sales) available in your country?	If yes, please specify_____		
13.	Availability of 'green transport corridor' approach in any part of the transport sector. Pick one option and explain.	a) Yes available _____ b) Not available (please provide some reasons of non-availability)_____		
14.	Legal framework for cross border electronic data exchange between customs	a) Yes available _____		

1	2	3	4	5
#	Indicator/Questions	Choose appropriate option(s) and add explanation wherever asked for it	Source of data (name the publication and URL)	Comments (can also be described separately in additional Annex)
		b) Not available (please provide some reasons of non-availability)_____		
15.	Is pre-arrival declaration procedure available in your country in electronic format? (As an example, you could indicate rail and road transport procedures while crossing border, indicate time spend at the border, what documents can/can't be provided electronically). Pick one option and explain.	a) Yes available _____ b) Not available (please provide some reasons of non-availability)_____		
16.	What are the standards, based on which e-invoice is used in transport sector? List down at least three.	a) _____ b) _____ c) _____		
17.	What are the most common delivery methods of cross border parcels in your country?	a) DHL b) DPD c) UPS d) FedEx e) Others (please specify)		
18.	What share (percentage) of major marketplaces using any of international parcel delivery services such as DHL, DPD, UPS and FedEx, operate in your country?	a) DHL (in percentage) b) DPD (in percentage) c) UPS (in percentage) d) FedEx (in percentage) e) Others (please specify) (in percentage)_____		
19.	Please describe the common delivery locations for parcel delivery in your country. You may add several options.	a) _____ b) _____ c) _____ d) _____ e) _____		
20.	How delivery to remote areas happens in your country. Specify sources.	a) _____ b) _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		c) _____ d) _____ e) _____		
21.	How the process for buyers to return goods purchased online is processed in your country?	_____ _____ _____		
22.	Please describe the following areas and involved stakeholders (domestic and global): a) Number of days to decide whether to keep purchased goods and when does this period start. b) Reasons and other information provided to seller. c) Key stakeholders that manage the process of backwards delivery back to seller (for example, delivery operators, specialised software). d) Most common locations for customers to drop purchased goods to be delivered back to seller: a) home, b) office, c) nearest outlet/sale center, d) others (please specify) e) Control of the preservation of the original product.	a) One week b) Two weeks c) One month d) Others (please specify)_____ _____ _____ _____ _____ _____ _____ a) home b) office c) nearest outlet/sale center		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		d) other (please specify)_____ _____ _____ _____		
23.	Amount of FDI (in USD) in the last five years in (for the development of) e-commerce sector.	_____		
24.	List recent major projects introduced or under way in e-commerce sector.	a) _____ b) _____ c) _____		
		3.2 Trust, Security and Privacy		
25.	Experience of security related incidents through using the internet.	a) Theft of bank credentials/social network accounts b) Using fraudulent or third party unauthorized source c) Any other (please specify)_____		
26.	Security concerns limiting individuals from doing certain activities via the internet for private purposes.	a) Computer virus resulting in loss of information or time b) abuse of personal information c) 'spam'—unsolicited emails sent to address of user d) low speed of internet connection e) other problems (please specify)		
27.	Types of activity carried out to manage access to personal data and implement security measures	a) _____ b) _____ c) _____		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
	(that is, use of anti-tracking software by individuals).	d) _____		
28.	Concerns/knowledge of individuals about cookies and personalized advertising.	a) Excellent b) Very good c) Good d) Average e) Below average f) No knowledge		
29.	Percentage of enterprises having an up-to-date ICT security policy.	a) Up to 10% b) More than 10% but less than 60% c) 60% and above Note: It's better to not make categories and later we can make categories as per our need.		
30.	Experience of security related incidents in enterprises (including report of security breaches) in years.	a) Less than 10 years b) 10 years or more		
31.	Do you use e-signature for cross border operations? If yes which countries?			
4. Internet Access				
1.	Percentage of households using a fixed broadband internet connection at home.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
2.	Percentage of enterprises using a fixed broadband internet connection, by speed.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
3.	Percentage of individuals using mobile devices to access the internet away from home or work.	Provide percentage here (_____) and in case exact information is Not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
4.	Reasons for not having access to the internet.	a) computer equipment is expensive b) lack of skills c) no need of it d) access charge is to high e) lack of technical facilities in the territory f) other reasons (specify please)		
5.	Percentage of households with internet access.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		b) More than 10% but less than 60% c) 60% and above		
6.	Percentage of schools with internet access.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
7.	Distribution of computer users by age groups (percent).	a) Less than 18 years b) More than 18 and up to 30 years c) More than 30 and up to 50 years d) Above 50 years		
8.	Percentage of computerization of households and enterprises.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
9.	Share of enterprises with internet access in total number of all enterprises, %	Provide percentage here (____) and in case exact information is not available, please choose one of the following options: a) Up to 10%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		b) More than 10% but less than 60% c) 60% and above		
10.	Amount of FDI (in USD) in the last five years in the area of internet access.	_____		
11.	List recent major projects introduced or under way in the mentioned sector	a) _____ b) _____ c) _____ d) _____		
4.2 Use of Internet				
12.	Percentage of individuals using the internet on purpose	Provide percentage: a) for sending/receiving emails: ____percent b) for telephoning (via webcam), video calls over the internet: ____percent c) for participating in social networks: ____percent d) for listening to music (e.g., web radio, music streaming): ____percent e) for watching internet streamed TV (live or catch-up) from TV broadcasters: ____percent f) for playing or downloading games: ____percent g) reading/downloading online newspapers/news magazines: ____percent		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		h) for looking for information about goods or services: ____percent i) for uploading self-created content (text, photos, music, videos, software etc.) to any website to be shared: ____percent		
13.	Percentage of individuals using the internet for watching video on demand from commercial services.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
14.	Percentage of individuals purchasing e-books.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% d) More than 10% but less than 60% e) 60% and above		
15.	Percentage of individuals using the internet for looking for information about goods or services.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10%		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		b) More than 10% but less than 60% c) 60% and above		
16.	Percentage of individuals using online learning resources (online courses, material other than a complete online course, educational websites/portals).	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
17.	Percentage of individuals using the internet for internet banking.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
18.	Percentage of individuals using the internet for selling goods or services.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
19.	Percentage of individuals using peer-to-peer web services to sell/rent/exchange goods or services, both as a supplier or as a consumer	Provide percentage here (_____) and in case exact information is		

1	2	3	4	5
#	**Indicator/Questions**	**Choose appropriate option(s) and add explanation wherever asked for it**	**Source of data (name the publication and URL)**	**Comments (can also be described separately in additional Annex)**
		not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
20.	Percentage of individuals looking for a job or sending a job application.	Provide percentage here (_____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		
21.	Percentage of individuals using storage space on the internet (cloud computing services).	Provide percentage here (____) and in case exact information is not available, please choose one of the following options: a) Up to 10% b) More than 10% but less than 60% c) 60% and above		

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