THE DIGITALIZATION AND THE ECONOMIC GROWTH: A COMPARATIVE ANALYSIS OF DEVELOPING ECONOMIES IN THE ASIA PACIFIC

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CERTIFICATE

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I Hamza Shakeel hereby state that my M.Phil. Thesis titled Digitalization and economic growth: An analysis of developing economies in Asia-Pacific is my own work and has not been submitted previously by me for taking any degree from Pakistan Institute of Development Economics or anywhere else in the country/world.

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Dedication

I enjoy immense pleasure in dedicating my dissertation work to my lovely parents and my family. My father who has remained my staunch supporter throughout this arduous process of setting down my thesis, and whose inspiration, tenacity & devotion has always compelled me to complete my thesis work with my generous attentiveness & without any disquietude. My mother who has always been extremely enthusiastic, attentive, and strict not only in completing my research work but also throughout my all-academic career. Otherwise, without her unwavering stance and the endeavors she put into my academics, I might not be at this stage today in my life. I am immensely grateful to them for this all.

My lovely elder sister, whose support and love was always indisputable & exceptional to me. My humorous younger brother Falak Sher whose unrivaled respect towards me throughout my life is unmatchable. Who whenever comes in front of my eye gives me heartily peace & makes me delightful. Mr. Faizan who has been supportive, friendly & caring to me. Whose ecstatic & humorous conversations relatively made me distressed whenever I was stressed throughout this robust process.

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ABSTRACT

In this era of industrial revolution 4.0, where digitalization is transforming the world economy rapidly & productively, incentivizing and contributing toward economies. Whether a developed or developing economy, it has now been indispensable for almost all economies' futuristic survival. It made us keen to determine the contribution of digitalization in developing economies in the Asia Pacific. Those economies have not been researched extensively in this field. Therefore, this study analyzes the role of digitalization in driving economic growth concerning 17 developing economies in the Asia Pacific region spanning six years from 2014 through 2019. This study employs the Partial Least Square Structural Equation Modelling (PLS-SEM) approach for evaluating the path model or relationship among exogenous and endogenous latent constructs. The empirical findings of the research purport that connectivity, human capital, ICT regulation, and spectrum have positively & significantly influenced economic growth, whereas affordability and network coverage have a negative & significant influence on economic growth. Following that, this study supported paths or relationships between affordability and GDP, connectivity and GDP, human capital and GDP, ICT regulation and GDP, and spectrum and GDP, rejecting the path between network coverage and GDP. The relevant Government authorities or regulators can use the recommendations proposed by this study for further crucial developments for stimulating digitalization. Such as enhancing broadband affordability, expanding internet connectivity, ameliorating ICT regulations, and making spectrum management effective and thereby benefiting the economy.

Keywords: ICTs, Digital technologies, Digitalization, Broadband, Economic growth, Developing economies, Asia Pacific, PLS-SEM.

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LIST OF ABBREVIATION

No	Abbreviation	Definitions
1	AI	Artificial Intelligence
2	APAC	Asia-Pacific
3	ASEAN	Association of Southeast Asian nations
4	AFFORD	Affordability
5	ARDL	Autoregressive Distributive Lag model
6	AVE	Average Variance Extracted
7	BGD	Bangladesh
8	BH	Bhutan
9	CHN	China
10	CNT	Connectivity
11	CLF	Converged Licensing Framework
12	CR	Construct reliability
13	COVID-19	Corona Virus Disease 2019
14	DTs	Digital Technologies
15	DX	Digital Transformation
16	3D	3-Dimmensional
17	DESI	Digital Economic & Society Index
18	E-Government	Electronic Government
19	E-commerce	Electronic Commerce
20	EI	Education Index
21	FJ	Fiji
22	GDP	Gross Domestic Product

23	GNI	Gross National Income
24	GSMA	Global System for Mobile Communications
25	GPT	General Purpose Technologies
26	GST	General sales tax
27	GB	Gigabyte
28	G4	4th Generation Regulator
29	GII	Global Innovation Index
30	GMM	General Method of Moments
31	GLS	General Least Square
32	HDI	Human Development Index
33	HCI	Human Capital Index
34	HTMT	Heterotrait Monotrait metric
35	IND	India
36	IDN	Indonesia
37	IR	Iran
38	ITU	International Telecommunication Union
39	ICTs	Information Communication Technologies
40	IT	Information Technology
41	IPB	ITU Prices Basket
42	KHM	Cambodia
43	LA	Lao P.D.R
44	LKA	Srilanka
45	MCI	Mobile Connectivity Index
46	MB	Megabyte
47	MHz	Million Hertz
48	MW link	Microwave link

49	MYS	Malaysia
50	MNG	Mongolia
51	MV	Maldives
52	NPL	Nepal
53	NRI	Networked Readiness Index
54	NC	Network coverage
55	OECD	Organization for Economic Cooperation and Development
56	OLS	Ordinary Least Square
57	PAK	Pakistan
58	PHL	Philippines
59	PTA	Pakistan Telecommunication Authority
60	PLS	Partial Least Square
61	PLS-SEM	Partial Least Square Structural Equation Modelling
62	PCA	Principal Component Analysis
63	PCA	Partial Component Analysis
64	QoS	Quality of Service
65	QoE	Quality of Experience
66	RoW	Right of Way
67	R&D	Research & Development
68	Reg	Regulation
69	SAARC	South Asian Authority for Regional Cooperation
70	SEM	Structural Equation Modelling
71	SMS	Short Message Service
72	SSA	Sub-Saharan African
73	SP	Spectrum

74	SO	Smartphone ownership
75	THA	Thailand
76	TCMO	Total Cost of Mobile Ownership
77	TFP	Total factor productivity
78	UN	United Nation
79	UNSD	United Nation Statistics Division
80	UNCTAD	United Nation conference on Trade and Development
81	USF	Universal Service Fund
82	USD	United State Dollar
83	VNM	Vietnam
84	VA	Vanuatu
85	VAT	Value Addition Tax
86	VIF	Variance Inflation Factor
87	WB	World Bank
88	WDI	World Development Indicators

CHAPTER 1

INTRODUCTION

1.1 Introduction

1.1.1 Digitalization & Digital technologies

The industrial revolution 4.0 and emerging digital technologies & innovation have been revolutionizing our society & economy promptly, enabling us to meet the challenges of our economic & societal progress. Moreover, these emerging Digital Technologies (DTs) has unfolded the foundation of the digital economy and its generativity in the form of revamped production & consumption pattern. Digitalization can be a vital genesis for GDP growth, competitiveness, innovation, sustainability, labor & total factor productivity in today's information age, as contended by (Bukht & Heeks, 2017).

The digital economy is instituted through construction of five requisite foundational pillars: Digital infrastructure, Digital financial services, Digital platform[1], Digital skills & Digital entrepreneurship. Digital infrastructure & digital connectivity are core confabulations of this study as they are fundamental aspects of the digital economy. Digital transformation fundamentally takes into consideration some queries. Such as initially, to what extent digital infrastructure & connectivity endorse participants in the digital ecosystem in any economy. Secondly, how efficiently and effectively people afford, utilize and achieve from these digital technologies [2]& platforms and eventually contribute productively to the economy by utilizing them.

[1] The digital platform is a platform-based business model. That provides multiple participants & users to interact online to maximize revenue through enhanced collaboration.

[2] Digital technologies can utilize a large amount of data so that users can perform tasks online like smartphones, IPads, and laptops. Moreover, these technologies make it possible for participants in the digital ecosystem.

Almost all nations throughout the past leaned heavily on city infrastructures such as roads for transit, buildings, and bridges for public convenience. That led to ameliorating the living standards of the citizens, wealth generation, and stimulating economic growth & productivity. Notwithstanding in the 21st century, the industrial revolution 4.0 is reshaping the global economy and economic growth by utilizing digital technologies, digital platforms, software, and applications to replace the conventional approach of manipulating physical assets (Union, 2019).

The study was undertaken in an era of the Covid-19 pandemic. Hence, it makes a pertinent theme to accentuate the role of digitalization in dealing with the repercussion of Covid-19. We have seen that the prominence of using digital technologies has become considerable in the period of Covid-19. Many businesses and economies are striving for growth and stability in their business and economic activities coupled with the lockdowns and criteria for social distancing.

Digital technologies have played a crucial role in mitigating the effect of economic losses caused by the Covid-19 and pandemic-triggered lockdowns. Economies with a higher level of digital inclusivity tend to tackle the challenges & losses caused by the pandemic hence effective digital infrastructure possesses the capability to minimize the economic deterioration triggered by the pandemic. Moreover, the role of government policies in the time of pandemic has surely been valuable. Such as in many economies, Governments respecting national emergency plans allowed the telecom operators to utilize the additional spectrum to meet the rising demand for the internet as internet traffic increased during the pandemic. But for the future, economies must have to prepare in terms of digital connectivity for emergencies and such possible pandemics (Union, 2021c).

1.2 Background of the study

General appellations used for delineating the digital economy are the network economy, web economy, knowledge economy, or information-based economy. According to the Digital Economy report 2019[3], the estimated size of the digital economy ranges from 4.5 to 15.1 percent of the overall GDP of the global economy. If we explore the two terms Digitalization and Digitization, both have close association with each other are used in several pieces of literature. (Brennen & Kreiss, 2016) have conceptualized these two terms; Digitalization refers to using Digital Technologies to achieve economic, organizational, and societal goals. On the other hand, Digitization refers to converting hard form data into digital data. This study will focus on digitalization at an economic level as the world is moving toward digitalization. Particularly developing economies that are in their initial stages of digital transformation.

Digitalization in any economy institutes using digital technologies, digital platforms & digital services. Peculiarly, the digital economy fuels through the frontier digital technologies like 5G, the Internet of things[4], Cloud computing, Artificial Intelligence, Big data, Blockchain, Data Analytics, Automation & Robotics, 3D Printing, and systems that manipulate digital data & signals. Digital technologies are considered General-Purpose Technologies (GPTs). They influence almost all facets of life & become more improved as time passes. Furthermore, they foster innovations and technological advancements in an economy (Andreessen, 2011).

[3] https://unctad.org/system/files/official-document/der2019_overview_en.pdf.

[4] Internet of things is the network of electronic devices interconnected with each other through data such as Sensors, Wearable devices, Home-automation, Internet-enabled appliances, Health-monitoring devices, etc. IoT is becoming an essential part of our life as the world is becoming a "Connected world."

Furthermore, the ICT sector is characterized as the fundamental sector of the digital economy, as a model of the digital economy is based on digital goods & services and digital technologies (Bukht & Heeks, 2017). The scope of the digital economy varies with the inclusivity of digital technologies, as distinguished in Figure 1.1.

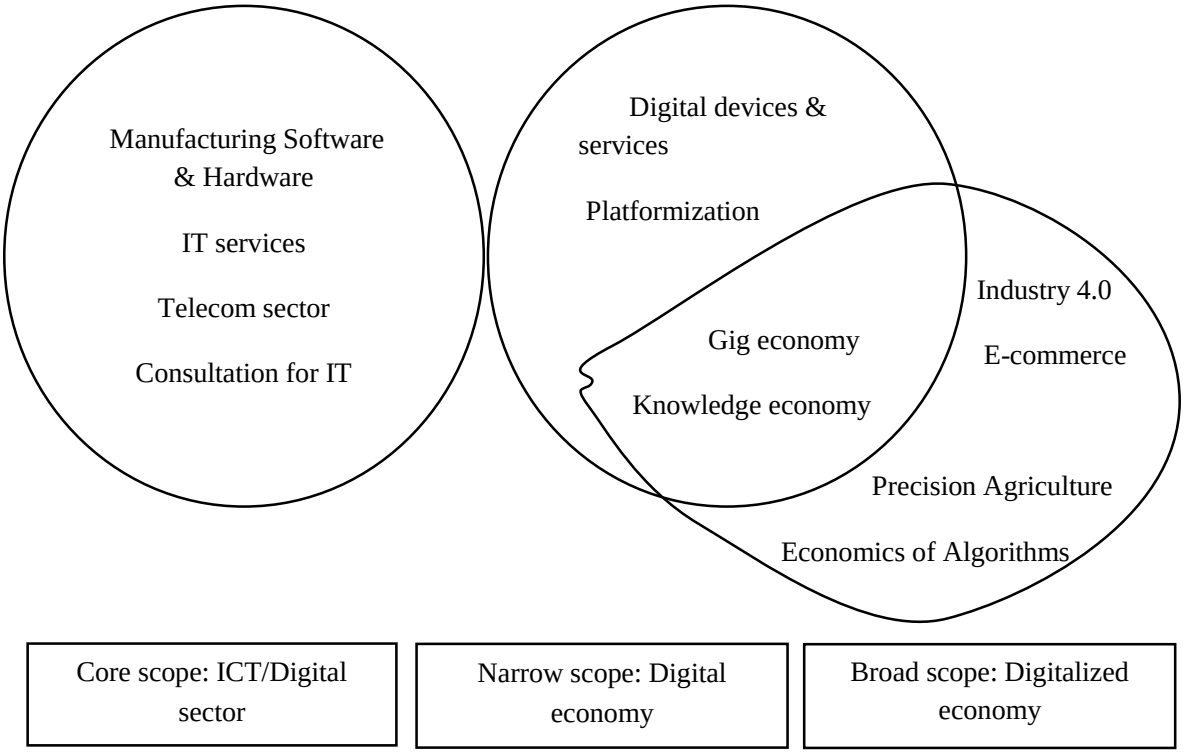


Figure 1.1, Dimensions of the Digital Economy; Source: (Bukht & Heeks, 2017)

Therefore, it seems paradoxical to identify the impact of digital technologies wholly on the GDP. Instead of holistically, the effect of digital technologies is generally measured through the level of ICT diffusion interchangeably with the other factors such as human capital & labor, especially in developing & less technologically advanced economies in present days. ICT diffusion has played a crucial role in the prospering of the economy (Hernandez et al., 2016). The study (Mesenbourg, 2001) argues that the digitalization of the economy means the inclusion of ICTs within an economy productively.

1.2.1 Digital trends & policies in the Asia-Pacific

Asia-pacific is a diversified region with an amalgam of developing, emergent & high-income economies. With a population of approximately 4.2 billion people, many of whom live below the poverty line and lots of diversification in this region in terms of geography, economics, income level & technological advancement, and rate of population, such as China, Pakistan, India, and Bangladesh. Asia-pacific belongs to economies that have embraced digitalization very rapidly as the digital economy is building up rapidly in developing economies such as China, India, Malaysia, and the Philippines are the epitomai of rapid digital transformation.

Several economies in the APAC region have been remodeling their economies into digital economies through diffusing digital technologies (DTs) and incurring innovative business models. Over the past few years, this region has made vital advancements in digital infrastructure like enhancing internet connectivity through mobile broadband & fixed broadband and widening the network coverage. According to the ITU estimation 2020, 94.2 percent of the population was covered by the 4G network coverage & more than 96.1 % was covered by the 3G network coverage in Asia-Pacific. Moreover, almost 70 percent of youth in Asia-Pacific were using the internet in 2019 (ITU, 2020).

In recent years, many economies in Asia-Pacific have increased their fixed broadband connectivity. Such as China dominates the fixed broadband market in developing economies, which possessed 31.34 percent of fixed broadband subscriptions per 100 individuals. Pakistan possesses the lowest market for fixed broadband connectivity, following Cambodia, Bhutan, Fiji & India. Pakistan just possesses 0.81 per 100 individuals, as distinguished in Figure 1.2. During the years 2015-2019, the percentage of fixed broadband connections has been declining in some

economies such as Pakistan, India, Cambodia, Bhutan, and Fiji. Most likely, people are switching to mobile broadband connections may be due to high prices for fixed broadband or due to the poor infrastructure for fixed or (wired) broadband (Union, 2021b).

In recent years, the Pakistan government has also introduced a Digital policy (2018) to create a digital ecosystem with infrastructure and institutional frameworks. Similarly, "Digital Pakistan policy survey 2021" is another initiative of Pakistan's Ministry of Information Technology and Telecommunication to speed-up Pakistan's digital transformation and improve the quality of life and economic well-being of residents by providing modern, affordable and reliable digital services.

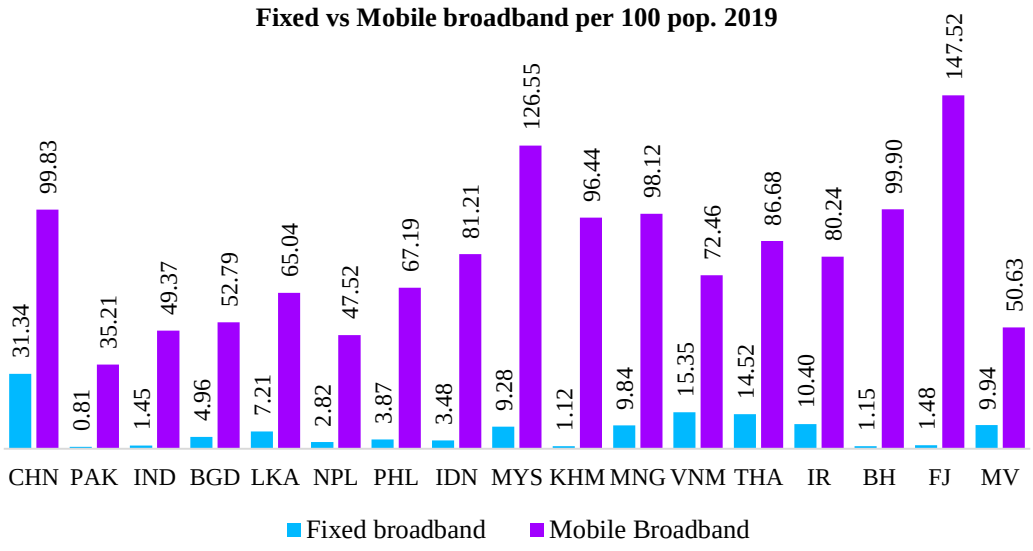


Figure 1.2: Fixed vs Mobile broadband, Source: ITU

The supply-side view of digitalization assumes that making investments in digital technologies provide laborers with digital good & services to be integrated into the labor force. That results in capital deepening and ultimately enhances labor productivity (Myovella et al., 2020). Another prerequisite for digitalization of the economy is the proliferation of digital infrastructure factors and thus eventually utilizing the best socio-economic benefits of the digital economy (Evangelista et al.,

2014). In developing economies, digitalization is likely to affect gradually because of the non-competitive market environment. Secondly, the Government is generally directed by the markets in the developing economies (Samimi et al., 2015).

Apart from digital infrastructure & connectivity, the institutional and regulatory reforms also contribute to developing the digital economy through making policy & structural changes in the digital sector and policing related to ICTs. The governmental institution, which is responsible for the digital policing regarding ICT sectors & telecom operators in any economy (Union, 2021b). The regulatory & institutional reforms in the ICT sectors improve the performances of the ICT sector hence, holistically influencing the economy.

Generally, in the APAC economies deploying the digital infrastructure is costly, complicated, and speculative. Increasing demand for the internet requires an expanding network deployment. It also creates complexities for the government and telecom operators in predicting the long-term plan for expanding the network coverage and making an investment because making rapid technological advancements require proper planning (Union, 2019).

In this condition, the government needs to reduce the unnecessary bureaucratic burden & delays. It should avoid creating resistance and improve procedures for getting the right of way[5] (RoW) for the telecom operators. A 50 percent decrease in the administrative & bureaucratic processes leads to the increasing networked investment which is good for consumers and ultimately for the economy (Union, 2021c).

[5] Right of way refers to permitting any person or authority to hand over the property of others for deploying the network infrastructure.

1.2.2 The Affordability of Mobile Technology & Services in APAC Economies

In some economies in the APAC region, digitalization is still in its phase of initiation; especially those economies that are still categorized as emerging & transitioned economies in terms of digitalization. Additionally, the issue of affordability has been problematic for the many APAC economies with low GNI & GDP per capita. Here in these economies, the mobile industry tends to promote the digital economy through providing mobile services particularly in the form of mobile broadband and hence; digitally enhancing digital connectivity & ecosystem, but some socio-economic issues both from the demand & supply side constrain operators in performing phenomenal (Union, 2019).

Unfortunately, many people in the APAC region living below the poverty line have to face affordability issues because of the low income. In the crisis of Covid-19 where many businesses, people, academic institutions have shifted to digital platforms for doing their prime & daily functioning. Simultaneously, many people are experiencing challenges & issues in terms of non-affordability of ICT services because; of the higher cost of the internet services such as mobile & fixed broadband services. The high prices of digital technologies & internet services create an issue of affordability for consumers in developing economies. Which consequently restricts their capability to fully utilize internet services (Bulturbayevich et al., 2020).

The median price of mobile broadband or mobile data in the Asia-Pacific region has remained largely unvaried since 2019. However, its price changed in 2020 from percent 1.9 in the year 2019 to percent 1.7 in the year 2020. In 2019, many consumers in the APAC region typically have to pay higher prices for utilizing the fixed (wired) broadband internet. That leads to low penetration of fixed broadband & digital information as well because fiber optic cables possess the capability of carrying an

enormous amount of digital data. Such as in Pakistan, Cambodia & Indonesia, the price of utilizing fixed broadband is substantially higher than other economies in the region that is certainly detrimental for consumers residing in these countries as distinguished in Figure 1.3.

In many developing economies in Asia-Pacific, data users have to pay more than 2% of their monthly income for at least (1.5 GBs) of data (Union, 2021). For instance, in economies like Bangladesh, Nepal, Mongolia, Fiji & Maldives here, for consuming (1.5 GBs) mobile data consumers have to pay more than 2 percent of their monthly income. It does not appear to be fulfilling the 2025 target of the UN Broadband Commission [6]by these economies, as distinguished in Figure 1.3.

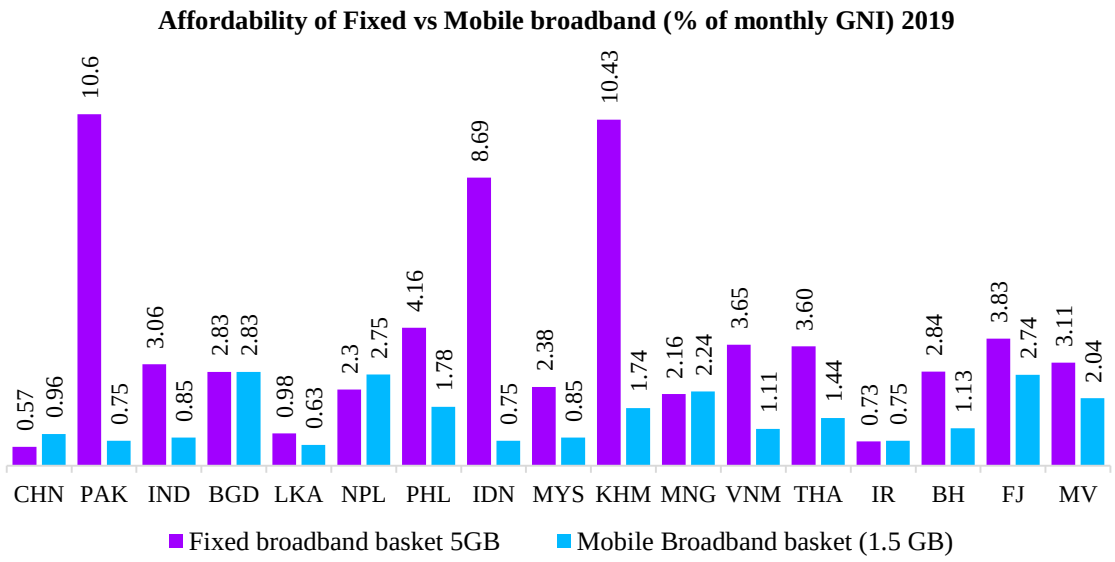


Figure 1.3: Affordability of Fixed vs Mobile broadband (percentage of monthly GNI) 2019, Source ITU Price basket.

[6]In developing economies, entry-level broadband data should cost below 2 percent of monthly (GNI) per capita by 2025.

Similarly, economies such as Pakistan, Nepal, Cambodia, Thailand, Mongolia & Fiji here just for consuming the low-basket mobile data (500 MBs+20 SMS+70 mints); consumers have to pay more than 2 percent of their monthly income. It again does not appear to be fulfilling the 2025 target of the UN Broadband commission by these economies as distinguished in Figure 1.4.

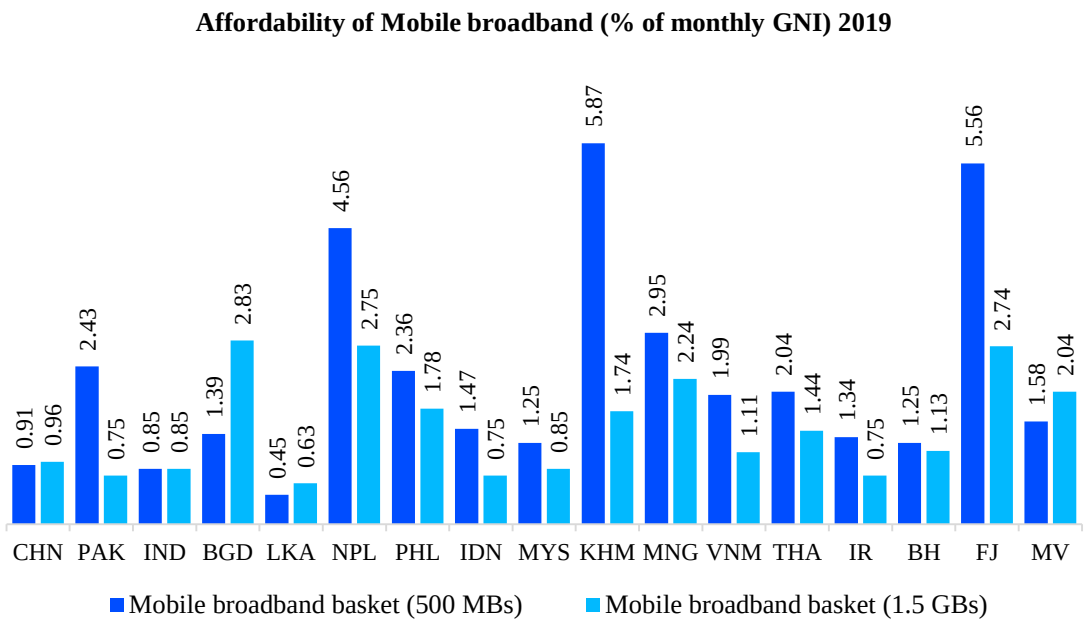


Figure 1.4: Affordability of Mobile broadband (percentage of monthly GNI) 2019, Source ITU Price basket.

The Covid-19 has revealed the societal inequality in terms of fixed broadband affordability. It is diverting the attention of policymakers to look upon setting the policy for fixed broadband adaptability. In some developing economies, the imprudent ICT rules & regulations can create hurdles in adopting fixed broadband in the form of affordability subject to the high cost of fixed broadband. If everyone can afford broadband regardless of their low income, it would undoubtedly incentivize the people with low income doing their daily & prime activities.

In Pakistan and some other economies in the APAC region, there are a few reasons for the low penetration rate of fixed broadband. These concerns incorporate paying a vast amount for gaining the right of way. Operators have to wait for a long period for gaining (RoW) or NOC for installing broadband cables under a particular piece of land. Mobile operators have to make numerous visits to the particular institution for gaining (RoW) or NOC. There is a slow expansion of underground fiberization, high taxes on the mobile sector & internet providers, and relying excessively on the MW links. These are a few issues that constrained the people in adopting the fixed broadband internet as opposed to mobile broadband (Union, 2021c).

Another issue is that many developing economies in the Asia-Pacific lack extensive fixed internet infrastructure, with only a few urbanized cities having access to fixed or (wired) broadband. Therefore, the majority of the unconnected people in urbanized and rural cities are more likely to get internet access through mobile broadband because that is the cheap way of being connected through the internet for people in these areas.

The supply-side perspective states that participants in the digital ecology such as the telecommunication sector, broadband internet providers, E-commerce platforms, and online consumers[7] are taxed[8] differently and sometimes severely due to the luxurious perception of these services & items. Consequently, it raises the issue of affordability and reduces the consumption of broadband by the consumer. Ultimately, it makes the consumers and online users unconnected in the digital ecosystem.

[7] Generally, taxes paid by the telecommunication consumers incorporate sale tax, acquisition & usage fee, and Sim-card ownership fee & handset prices.
[8] Taxes paid by the telecom operator incorporate corporation tax, property tax, profit tax, import duties, spectrum licensing fees, auction reserve fees, and sometimes luxury taxes.

Reducing broadband taxes increases broadband adaptability because of the elasticity of demand. The adaptability of broadband service increases the connectivity of fixed and mobile broadband. An increase in connectivity leads to an enhanced return on the network. It subsequently directs the internet providers to lower the broadband prices and make it affordable for the consumers. Ultimately, broadband effectively and indirectly contributes to economic growth and job creation (Union, 2021c).

An effective competition among telecom operators in a country forces the operators to initiate innovative initiatives that lead to making investments in modern ICTs technologies in the presence of competition. If any operator rolls out 4G in a market, it would not only force the operator to provide high-speed data but provide these services at reasonable pricing. Ultimately, it increases the affordability of the consumers for mobile broadband and enhances connectivity that benefits the economy. Therefore, reframing driven by the market demand needs to be prioritized by the Governments. Still, many APAC economies are reticent regarding doing it despite its thriving effects on the economy (Zehle, 2019).

Spectrum is a limited resource, how the Government & regulators manage it through legal rules & procedures. It poses a fundamental challenge for both of Government & regulators. Generally, managing the spectrum with limited resources is referred to as spectrum management. Increasing demand for digital connectivity and internet traffic tends to increase spectrum allocation.

Notwithstanding, the significance & generativity of digital technologies & services are accentuated above that, digital technologies like mobile devices connect people through digital connectivity so that they can utilize digital platforms and digital goods & services. Hence, it also leads to the concern that, how can someone get access to the digital connectivity and mobile internet due to non-accessibility, unaffordability

subject to poor coverage & higher cost of utilizing the mobile data especially; in low-income economies and far places? Where people own mobile devices & services as the rapid & cost-effective sources for internet accessibility through using mobile broadband and properly utilize these privileges of digital technologies & fully materialize the digital goods & services? Generally, this process is known as mobile leapfrogging.

1.3 Significance of the research

The significance of this research is that as we, all know in this 21st-century digital technology & services are vital tools for economic growth. Many economies across the globe have been advancing towards a digital economy to replace the conventional approach of enhancing economic growth & productivity. Indeed, it is a need of time for staying connected with the rest of the world for futuristic survival in terms of economic growth.

Especially developed economies that tend towards digital economies or digitalized economies compared to developing economies. They are doing it because of better ICT infrastructure; but economies like ours have to go through some important challenges to embrace the digital economy because of poor ICT infrastructure & Internet connectivity.

The Asia Pacific is a much-diversified region in terms of technological integration, population, and income level. Here people have to face many challenges in pursuing digital technologies & services. Therefore, this study would emphasize challenges faced by these developing economies in terms of digital infrastructure & connectivity in the APAC region.

1.4 Statement of the problem

Despite initiatives & steps being taken by the economies within the region. APAC region is still hesitating and lag behind other developed regions like Europe & Northern America in terms of digitalization. Likewise, some intra-region challenges are also being faced by developing economies in acquiring the tides of digitalization especially Pakistan, Bangladesh, Nepal, Cambodia, Maldives. It occurs due to the continual digital divide, poor digital infrastructure & issue of affordability, which need to be meliorated.

Secondly, several studies (Habibi & Zabardast, 2020; Myovella et al., 2020) have focused on the impact of digitalization on OECD economies, Middle East economies, and African economies, but there is a lack of study on how digitalization impacts the economic growth of the APAC developing economies are still unanswerable especially in developing economies of the Asia Pacific region.

Hence, there is a paucity of knowledge regarding the contribution of digitalization on economic growth in developing[9] & middle-income economies in the Asia-Pacific[10] region especially economies like Pakistan, India, Bangladesh, Nepal, Sri Lanka, Philippines, Cambodia, Vietnam. To fill these lacunae we evaluated that whether digitalization positively influences the economic growth of the developing economies within Asia-pacific.

[9] For checking the list of developing economies: https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2020_Annex.pdf.
[10] For checking the list of the middle-income countries:World-Bank-list-of-economies-2020_09.pdf

1.5 Research Questions:

To evaluate the aim of this study, we incorporated the research question that how does digitalization affect economic growth in developing economies in the Asia-pacific region. It then defines digitalization based on six constructs, as follows.

a. Affordability positively influences economic growth.
b. The connectivity positively influences economic growth.
c. Human capital positively influences economic growth.
d. The ICT regulation positively influences economic growth.
e. The network coverage positively influences economic growth.
f. The spectrum positively influences economic growth.

1.6 Objective of the research

This study incorporates the following objectives:

- How does digitalization affect economic growth in developing economies in the Asia-pacific region, based on the possible indicators of digitalization in the selected 17 countries[11]?

1.7 Plan of the study

Chapter 1 is purposed to introduce the concept & background of the study. In chapter 2, the existing literature is reviewed. The Data & methodology of the study is discussed in chapter 3. Chapter 4 apprises the results & findings of the study following it, chapter 5 is dedicated to the conclusion & recommendations of the study.

[11] China, India, Pakistan, Bangladesh, Sri Lanka, Nepal, Indonesia, Philippines, Malaysia, Cambodia, Mongolia, Vietnam, Thailand, Iran, Bhutan, Fiji, and the Maldives.

CHAPTER 2

Review of Literature

Digitalization has gained much attention in recent years and throughout these recent years; several researchers and policymakers have emphasized analyzing that how ICTs have influenced economic development and growth? Several studies (Habibi & Zabardast, 2020; Myovella et al., 2019; Niebel 2017; Yousefi, 2011) have analyzed the impact of ICTs on the individual, organizational, and national levels. Studies have demonstrated heterogeneous relationships based on the developed countries and developing countries, but typically studies have shown that ICTs have a positive impact on economic growth (Jorgenson & Vu, 2016).

2.1 Theoretical framework

The ICT & GDP growth is mainly theorized through two approaches of economic growth such as the endogenous growth theory and exogenous growth theory. In 2018, the US economist Paul Michael Romer was awarded a Nobel Prize for his contribution to developing an economic theory "the endogenous growth theory" in the 1980s. Romer argued that technological innovation should be integrated for the long-term prosperity of the country. Romer endogenized the technological change, which is previously exogenized by Robert Solow, an economist of the Massachusetts Institute of Technology, America. Although both economists emphasized the role of technological change in economic growth, Solow modeled it as an exogenous factor (Romer, 1990). The technological change relies on human capital and research & development R&D,[12] which increases the productivity level that in turn enhances economic growth. Hence, these two factors are contemplated endogenous factors.

[12] Research & Development refers to those activities that are undertaken to bring innovation into products & services and making innovative products & services (Liberto, 2020).

In literature, few studies are done on the topic related to the theme of this thesis. It is probably due to a lack of data on digitalization. However, few studies that addressed the issue are added. An interesting study of (Vu, 2011) proffers that the usage of ICTs gets improve as the effectiveness of human capital[13] also increases, moreover it ameliorates the accessibility to education and learning. An education substantiates as an accelerator for innovation in technological advancements, so therefore many countries in the world construct IT and research universities especially, in European countries that construct top innovation-driven universities to make progress in technological advancements (Habibi et al., 2020). In this crisis of Covid-19, where businesses are adopting the advanced technologies for operating business activities here at the same time many unskilled employees & laborers are losing their jobs; because their skills are mismatching with new emerging technologies. Hence, it is getting problematic for the adoption of tomorrow's technologies because in the end every existing technology is disrupted with upcoming & new technology[14] (Klaus Schwab, 2020).

Modern technologies require up-to-date skills & new IT qualifications to operate. In the digitalization era, advanced technologies will demand workforce, fresher & graduates to obtain compatible digital skills to survive in a future job market especially in technology companies & IT sector. Therefore, individuals with a higher level of updated skills & university degrees are more likely to survive in a future job market (Silva & Lima, 2015).

[13] Human capital tends to enhance the productivity of the labor force through acquiring skills, learning, and education. Human capital is considered one of the fundamental drivers for economic productivity and prosperity.

[14] As stated in "The Global Competitiveness report 2020" digital skills are lacking in today's labor market and must be upgraded to survive in the "Markets of Tomorrow."

Furthermore, in today's information age, the lives of the majority of people and their daily activities are interconnected with digital technologies & platforms and in the coming future, it will become more. In the coming future, increasing numbers of people will be relying on the advanced technologies of industry 4.0 such as Robotics, AI, machine learning, Internet of Things (IoT), data analytics & big data to do their prime activities. Undeniably, it would certainly require an emancipatory shift in a paradigm of human capital. An essential shift would be required both in terms of creating & developing new technologies as well as utilization of these technologies through the acquisition of new digital skills, competencies & capabilities for working in the future market (Grigorescu et al., 2021).

One more dimension of the endogenous theory based on Schumpeter's work purports that Research & Development (R&D) and technology tend to raise the level of production that consequently enhances the economic growth of the country. Moreover, this study incorporates that the most developed countries elevate the level of R&D expenditures that in turn increases the economic productivity (Dinopoulos & Sener, 2007).

The advancement and development in technology lead to enhancing economic growth by (a) providing the digital product & services such as applications for E-government, Automatic facial recognition systems at airports and other public institutions; that decrease the cost of using public services (b) by increasing the level of investment and adoption in different sectors across the country (Arendt, 2015). Therefore, this study incorporates the model of Endogenous growth theory. As the Endogenous growth approach relates a GDP with technological progress, labor & capital formation, hence digitalization is taken as a proxy for the technological progress in this study.

The endogenous growth model assumes that growth in the economy can ensue through advancing technology that is an endogenous factor. Effective policies of government regarding investment & incentivizing the market or particular industry such as in digital economy incentivizing IT sector, telecom industry, investing in digital platforms & E-commerce platform, as well as encouraging R&D can assist in advancing technology acceptance in the economy. The market share of the digital industry needs to be enhanced through making investments in various public & private sectors in the digital industry that ultimately leads to the establishment of a digital environment that is certainly conducive ambiance for digital transformation. Technology is regarded as non-rival input as firms of all sizes can make use of it at any pace of development. Low cost of inducing technology both at micro or macro assist in making advancements in new technology (Arendt, 2015). Such as digital platformization in public institutions & private firms at low subscription rates can help them, executing their task effectively & efficiently, and simultaneously integrated several other platforms & applications into a single digital platform can help them excessively by reducing the cost of operation, time consumption and additional burden on labor force (Bygstad & Hanseth, 2019).

2.2 The impact of Digital technologies in APAC economies

Digital technologies have a substantial contribution to the growth of the economy (Eberhard et al., 2015). This is how the usage of digital technologies affects economic growth: promoting the E-commerce and online payment method, bring flexibility in the operational activities of the banks, eventually meliorates the telecommunication resulting in improved economic productivity and growth (Bojnec & Fertő 2012). Following that, how researchers and policy-makers in developing economies in the APAC region can contemplate possible outcomes through reviewing existing literature.

In developing economies, digitalization ameliorates the economic development through the creation of employment, diminishing the cost of utilizing ICTs, ameliorating and making the resource allocation processes more efficient, increasing the investment levels, especially in the telecommunication sectors, providing businesses with the economies of scale (Myovella et al., 2020). It can further foster innovation, competitiveness, prevention from corruption, and enhance economic productivity.

Similarly, the study of (Majeed & Ayub, 2018) found that the developing and emerging economies are benefitting more from the ICTs as compared to the developed countries hence; demonstrating that the developing and emerging economies are accelerating their economic development through "leapfrogging." On the other hand, the study of (Niebel, 2018) has concluded there is no direct statistical evidence that the investments in ICT are impacting much on the emerging and developing economies as compared to the developed economies hence, does not validate the argument of leapfrogging.

As (Steinmueller, 2001) suggests that the developing countries can enhance the economic productivity through leapfrogging of digital technologies in case, making the investments in ICT does not provide enough benefits to the developing countries. (Steinmueller, 2001) proffers that there are some requisites for the leapfrogging of digital technologies that should be fulfilled prior: (a) there must exist the absorptive capabilities for effectively utilizing the ICTs. (b) Know how to make the best use of the digital technologies (c) there should be linkages among other digital technologies too.

2.2.1 The effect of ICT on the economic growth

Mobile technologies sustain a significant role in spanning the digital divide in the low-income and developing countries, where people typically prefer mobile technology especially smartphones for internet connectivity; the process of accessing the internet through using mobile devices is known as mobile leapfrogging. An analysis of GSMA (2020) observed that mobile technologies contributed above 1.6 trillion US dollars in terms of value addition to the Asia-Pacific economy through the generation of a GDP of 5.3 percent in a region.

The mobile industry supplied an amount of approximately 180 US dollars to the public sector through taxes (GSMA, 2020). The study of (Puspitasari & Ishii 2015) has found that the majority of people especially the educated & young individuals employ smartphones as compared to the handsets for the acquisition of information through using internet accessibility. The study of (Ghosh, 2016) found the significant impact of financial inclusivity through smartphone penetration in India. The mobile sector contributed 5.4 percent of the share in the economic growth of Pakistan in 2018 (James Robinson, 2020).

The study of (Ahmed & Ridzuan, 2012) incorporated ASEAN countries: China, Singapore, Japan, Indonesia, Korea, Thai land, Philippines & Malaysia and illustrated the impact of ICT on the growth of GDP. This study incorporates a panel data approach for making the statistical base and concluded that investment in ICT, capital, labor has long term and positive effect on economic growth in ASEAN countries, and hence, investing in ICT can provide favorable outcomes.

Moreover, the study conducted by (Rath & Hermawan, 2019) demonstrated the impact of ICTs technologies on economic growth, spanning thirty years period from 1980 through 2014. The study incorporated the ARDL technique, acronym for the

Autoregressive Distributed Lag Cointegration technique. The study further concluded that the ICT along with other factors such as human capital & Total Factor Productivity both positively influenced the economic growth of Indonesia in a short & long-term. Conclusively, the study recommended that the Government of Indonesia must need to ameliorate the ICT infrastructure through making investments so that the national economy of Indonesia and its consumers can be incentivized effectively in the future.

The study of (Sharma et al., 2020) analyzed the relationship between the ICT, energy consumption & economic growth of 10 emerging economies in Asia.[15] This study found that the penetration of mobile subscriptions influenced highly on the economic growth of Malaysia as the economic growth of Malaysia increases by 0.3128 units because of a 1-percent increase in mobile subscribers. Meanwhile, it has an insignificant & diminishing effect on the economic growth in Nepal by units 0.0281.

One more study (Chakpitak et al., 2018) evaluated the influence of digital technologies on the economy of Thailand as the country has been making social & economic reforms for enhancing digitalization to stimulate the digital economy. The stochastic frontier technique is employed by the study to purport findings. Therefore, the findings of the study suggested that digital technologies have a positive influence on the economy of Thailand hence recommended enhancing the capacity for integrating digital technologies as there is still a lot of space available for incorporating these technologies, and eventually Thailand's economy can be further stimulated.

The study of (Raeskyesa & Lukas, 2019) purported the impact of digitalization on the economic growth of 8 countries in the ASEAN region: Malaysia, Vietnam, Thailand, Indonesia, Myanmar, Philippines, Lao PDR, and Cambodia and found that

[15] Thailand, China, Malaysia, Indonesia, Philippines, India, Srilanka, Cambodia, Nepal & Bangladesh

the ICT, human capital, and physical capital has positively affected the GDP growth; among these indicators' human capital effects more. Hence, this study emphasizes investing in human capital for better utilization of ICTs.

Moreover, this study finds that Malaysia has progressed higher than the rest of the countries with 1.08809 % in 2014 in terms of human capital on the other hand; Myanmar has lowered in the human capital index by 0.4053138% in 1999. Additionally, the study reveals that a 1 percent increase in human capital will increase the economic growth by 0.91 percent and 1 percent increase in internet penetration will increase the growth by 0.038 percent.

(Tripathi & Inani, 2020) studies the effect of ICT on GDP for the period of 1990 to 2014 based on the panel analysis of SAARC countries. This study employs the pooled OLS estimation technique, along with fixed and random effects; by applying the Haussmann specification test. The study incorporates the mobile telephone subscriber and fixed telephone subscriber per 10 thousand individuals as proxies for ICT for only 4 countries from the SAARC group: Pakistan, Bangladesh, India, and Srilanka because of data limitations and; concluded that the ICT has highly contributed and impacted the economic growth in India as compared to the other countries. Additionally, this study reveals that the 1 percent increase in ICT adoption does increase the GDP by *ceteris paribus* 0.028 percentage at the minimum.

A new study by (Pradhan et al., 2021) explores the long & short-term impact of developing the infrastructure of ICT and the inclusion of digital finance such as digital platforms, digital financial services on GDP growth in India. This study incorporates twenty states of India from 1991 through 2018. This research relied on the Granger-causality approach and, suggested that developing the infrastructure of ICT & appropriate strategies for incurring ICTs, and the inclusion of digital financial services

has a significant impact on the sustainable growth of 20 states in India. The study further recommends that the inclusion of digital financial services trigger diminishing the gap between low & high-income people.

The study of (Ahmad et al., 2021) purported the impact of inclusivity of digital financial services on the economic growth of China's province for years of 2011 through 2018. The network coverage, level & usability of digitalization are incorporated as a proxy for digital financial services. Employing the fixed effect model, this study concludes that, the inclusion of digital financial services along with human capital has a significant impact on the economic growth of China's province. Furthermore, this study did recommend that Govt should work towards ameliorating human capital and upgrading the infrastructure for digital services.

The study of (Khan & Majeed, 2020) incorporates Pakistan, Bangladesh, Srilanka, Maldives, India, Bhutan, Afghanistan, and Nepal as cross-section countries and acknowledged that both ICT and E-government[16] positively impact the economic growth. The Principal Component Analysis (PCA) done for this study for the ICT index reveals that an increment of 1% in ICT does increase the economic growth by 0.24% and an increment of 1% in E-government does increase the economic growth by 3.33%. Moreover, the study further concluded that the countries in South Asia can take the better advantage of E-government facilities and ICT by normally ameliorate the infrastructure of ICT in their countries. This study incorporates Pakistan, Bangladesh, Srilanka, Maldives, India, Bhutan, Afghanistan, and Nepal as cross-section countries and analyzes the impact of ICT and E-government on these countries.

[16] United Nations defines E-Government as the sharing and exchanging of information & services to the public through using ICTs.

2.2.2 Broadband and the economic growth

Mobile broadband is the requisite enabler for digital connectivity and sustainable development of the economy especially in developing economies. Advanced broadband connectivity is becoming a driver of economic growth especially in developing g economies as more and more youth is connected through mobile devices using mobile internet services or mobile broadband. The study of (Katz & Callorda, 2018) has found that mobile broadband has a high impact on low-income economies as compared to middle- & high-income economies in Asia-Pacific. A 10 percent increase in the penetration of mobile broadband connection can lead to a 2 percent increase in economic growth in low-income economies and 1.8% in middle-income, countries while; no impact was observed on the high-income economies in the Asia-Pacific.

The study of (Zhang, 2021) explored the relationship between broadband and economic growth in China during the period of COVID-19 and found that the increasing penetration of broadband connections has positively & significantly impacted the economic growth during the first quarter in China. Furthermore, the study explored that broadband plays a crucial role in enhancing human capital & impacted better during a period of COVID-19 as compared to the other normal days. Moreover, the study of (Mason, 2015) analyzed the impact of mobile broadband & fixed broadband connections on the economic growth of Thai land and found that the 10 percent increase in penetration of broadband can lead to the growth of the economy by 0.26 to 0.92-percent. Additionally, the formation of more than 33 new jobs can ensue because of additional connections for broadband.

The study by (Djunaedi & Finance, 2021) purports the influence of digitalization on economic growth as well as human capital through a proxy of the broadband internet. This research incorporates thirty-three provinces of Indonesia for analysis purposes spanning, 9 years for the period 2011 through 2019. The findings of the study purport conclusively that broadband has influenced both the economy & human capital. Broadband has substantially contributed to the human capital when to compared economic growth. Furthermore, the study recommended that government must need to ensure the connectivity of broadband internet to fully reap the socio-economic benefits of broadband. Additionally, to utilize broadband for ameliorating the level of human capital in the economy of Indonesia.

An analysis of (ITU, 2019), incorporated the economies of Asia-Pacific in its study and concluded that throughout the last 6-years from 2011 to 2017, the fixed broadband significantly impacted the economies in Asia-Pacific. Additionally, the study found that the fixed broadband impacts highly on developed economies in the region through yielding 1.4-percent economic growth as a result of increment in fixed broadband by 10-percent hence, its impact is contemplated as "the Return to scale effect." Moreover, the study also found that mobile broadband influenced highly on developing economies through yielding 2-percent economic growth because of an increment in fixed broadband by 10-percent hence, the impact is contemplated as "The diminishing return effect." Based on a panel analysis through incorporating the GMM estimation approach, the study found that the penetration of broadband has a vital role in determining the GDP growth in ASEAN economies Furthermore, the GDP growth can be enhanced through utilizing broadband connections (Ng, Lye, & Lim, 2013).

2.2.3 Effects of ICT regulatory framework

Up to now, there has been a very little amount of literature available analyzing the impact of ICT regulation on the digital economy as we found it next to non-existence in Asian countries. Generally, making efficient changes in regulatory[17]& institutional framework [18]purport indirect impact on the GDP. Government rules & regulations affect the effectiveness of ICT sectors, which subsequently affect the GDP. The empirical findings of (Union, 2021d) purported that all the pillars of the ICT regulatory tracker have a significant impact on mobile & fixed broadband investment. Further, the study concluded that an addition of 10-percent in the pillars of the ICT regulatory tracker[19]leads to an additional investment of 4 to 11-percent in mobile & fixed broadband. Therefore, suggesting that having an autonomous ICT body, and implementing effective regulations can assist in making a better ICT environment hence, enhance the level of investment.

An efficient regulatory & institutional framework[20] is positively associated with increasing investment in telecom sectors, which consequently expands the network coverage, and reduces the prices for end consumers. Moreover, tax reduction and less bureaucratic processes[21] lead to an increase in the capital investment that allows the operators to expand the network coverage through the deployment of network infrastructure subsequently allowing more people to connect digitally (Union, 2021c).

[17] The Regulatory frameworks incorporate factors related to specific regulations & policies.
[18] Institutional frameworks incorporate factors like kinds of governmental authority or body responsible for regulating the digital sector and making & implanting digital policies in a country.
[19] ICT Regulatory tracker's pillars incorporate Regulatory authority, Regulatory mandate, and Regulatory regime & Competition framework.
[20] According to the ITU, the Regulatory institutional framework comprises regulatory authority, regulatory mandate, regulatory regime & competition level.
[21] Bureaucratic processes incorporate the time required for getting permission for the deployment of network infrastructure, right of way, etc.

Moreover, the study (Union, 2021d) found that if the profit tax & the time required for the administrative processes are reduced by the 50-percent, it can significantly lead to an increase in the ICT investment by 14 to 17-percent. These kinds of heavy taxes pressurize and constraint the operators from investing in the network deployment. Furthermore diminishing the bureaucratic & administrative burden can succor the investors through positive stimulation.

For the mobile sector, effective Government and regulator's policies on developing (1) the national broadband plan, (2) allowing for possible spectrum sharing[22], (3) assigning converged licensing framework [23](CLF),[24] (4) effective auctioning & licensing methods (5) setting up an appropriate competition level, (6) openness to international spectrum services these all factors positively contribute to increased investment. This, in turn expands the network coverage, sets low prices for internet services, enhances adaptability hence, which subsequently contributes to the GDP per capita (Union, 2020).

Effective regulations & policies can have a significant impact on the performance of the telecom operators, as the telecommunication sector is the core of the digital economy. Such as developing, a national broadband plan can lead to a 15-percent increase in mobile broadband investment. Adopting convergent licensing can lead to a 10-percent investment. Undertaking shared based spectrum can lead to an 18-percent increase in the investment in mobile broadband. Introducing mobile number

[22] Spectrum sharing mainly occurs when previously licensed bands of the spectrum shared by one or more operators for utilizing multiple technologies and applications to provide services to consumers.
[23] Converged Licensing Framework permits the competitor telecom operators to provide services through employing any technology without asking for a separate license from the regulator for every service. Its conceptualization has been assisting operators efficiently & effectively through the previous several years. It further incorporates two main principles: Technology & Service neutrality.
[24] Auctioning is a process of assigning spectrum through an award mechanism. Always, the best quality, suitable reserve pricing & affordable-assigned spectrum should be prioritized by the Government.

portability can lead to a 14-percent increase in mobile broadband investment. Eventually, the level of competition across the telecommunication sector at the national level can also lead to a 10-percent increase in investment (Union, 2021d). The findings of (Zehle, 2019) suggested that the reframing of the spectrum from 2G network to 3G network increases the growth of GDP per capita. Providing high-speed data through a 3G network tends to influence the economy positively.

Moreover, an Effective competition level supported through the regulatory authority among the operators leads to enhancing the affordability of broadband services. Those economies that stimulate competition can encourage the accessibility of low-cost broadband services. Competition can lead to setting a favorable environment for thriving low-cost broadband services. Such an environment triggers the telecom operators to set up efficient network deployment. It further leads to increase network coverage & decreasing broadband prices (Choudrie et al., 2015).

2.2.4 The impact of ICTs outside the APAC

The study of (Fernandez-Portillo et al., 2020) purports the impact of ICTs on 23 countries of the European Union for the period of 4 years 2014-2017 and; illustrated that the ICT usage and deployment can lead to the growth of developed countries of Europe. This paper employs the Partial Least Square Structural Equation Modelling (PLS-SEM) by following the data framework of the Digital Economic & Society Index (DESI)[25]. The finding of the study suggests that the fixed broadband positively contributes to economic growth along with internet usage, E-commerce & E-government. Hence, ICT has a positive effect on the developed economies of the

[25] DESI is the composite index, that assesses the extent of digitalization in the European economy, it mainly comprises the 5 areas: connectivity, human capital, use of the internet, integration of digital technologies, and digital public service (Commission, 2020).

European Union. Similarly, the study of (Fernandez-Portillo et al., 2019) purports the impact of ICTs on economies of the European Union for the period of 4 years 2014-2017. This employed the partial least square approach to finding results. This study suggested that making investments in ICT deployment could lead to sustainability in the development of the economy.

Some studies (Briglauer & Gugler, 2019; Rohman & Bohlin, 2012; Kongaut & Bohlin, 2017) have analyzed the impact of broadband speed in European economies & OECD economies and found that increasing broadband speed has a significant impact on GDP. The study of (Rohman & Bohlin, 2012) concluded that accelerating the broadband speed can lead to an increase in GDP by 0.3-percent. One more study (Kongaut & Bohlin, 2017) concluded that enhancing speed by 1-percent can lead to a surge in GDP as much as 0.1-percent in low-income economies whereas can lead to a surge in GDP as much as 0.06-percent in high-income economies.

Similarly, the study of (Briglauer & Gugler, 2019) found that a 1-percent increment in the adaptability of basic broadband can lead to economic growth by 0.015-percent while, a 1-percent increment in the adaptability of high-speed broadband can lead to economic growth by 0.004 to 0.005-percent. Consequently, operators must need to ameliorate the network performance and provide the consumers with the Quality of service [26](QoS) & Quality of Excellence (QoE) [27]since; this can contribute significantly to the economy.

[26] Quality of service incorporates that how technically well the network performs and how it affects the user's capability of utilizing the network.
[27] Quality of Experience involves that how many levels of utility, a consumer gets from utilizing the network and its service.

Similarly, the study of (Mayer et al, 2020) analyzed the impact of broadband on economic growth. The study incorporated 29 economies belonging to OECD membership spanning over 4 years period from 2008, quarter 1 through 2012 quarter 4. The study further incorporated the dynamic panel data approach along with the fixed effect model. The empirical findings of the study purported that low broadband penetration with higher network speed significantly influenced economic growth; it further demonstrated that economies such as Turkey, Mexico, Portugal, Hungary, Poland, and the Slovak Republic tend to benefit more from the broadband networks with low penetration. Conclusively, the study suggested that economies with low broadband network penetration need to ameliorate the network quality as well as network speed for incentivizing the economy hence, Governments should ponder upon meliorating the network quality promptly.

The study of (Evangelista et al., 2014) scrutinizes the impact of digital technologies on economic growth in 27-countries of the European Union over four years period from 2014 through 2018 by employing the Arellano-bong GMM estimation technique. This study incorporates three dimensions of the process of digitalization ICT access, ICT usage, and Digital empowerment. Eventually, the study concludes that ICT has contributed more to the growth of employment and labor productivity.

One more study (ŞENKARDEŞLER, 2021) evaluated the relationship between ICTs and the performance of economic growth in Turkey through running correlation analysis. The study comprises 20 years from the period of 2000 through 2020, and it incorporated national income per capita as a proxy of economic growth. The study purported that ICTs have positively & significantly influenced the economic growth of Turkey. Conclusively, the study recommended that government must have to enhance

the internet penetration as demand has become risen especially in the time of Covid-19 to ensure internet connectivity. Therefore, people can be connected digitally to the digital ecosystem for doing their prime activities in this strenuous period.

One more study by (Nair et al., 2020) simultaneously illustrated the short-run and long-run relationship between the ICTs, R&D, and the economic growth in countries of OECD for the period from 1961 through 2018. This study incorporated the (VECM) model as an empirical technique for getting results that is an acronym for the Vector Error Correction Model. This study purports that ameliorating & making investments in ICTs and R&D both affect the economic growth of countries in OECD in a long run. Conclusively, the study recommended that the Government needs to revising ICT policies & needs to make investments in Research and Development (R & D) to bring more advancements in ICTs technologies and thus eventually incentivizing from ICTs technologies & new initiatives.

Digitalization along with education is imperative for economic growth as supported by (Habibi et al., 2020). This study analyzed the impact of digitalization on the economic growth of 24 OECD and 10 Middle East economies for the 18-year of 2000-2017, through disseminating a generalized method of moments estimation (GMM) and the OLS fixed effects model. This study has shown that the ICTs positively affect economic growth, despite the level of development of economies. Secondly, this study found that the ICT significantly influences the economies of both OECD[28] and the Middle East in terms of economic growth but broadband positively affects the growth in the Middle East economies as compared to the OECD economies. Thirdly,

[28] The European Union established the Organization for Economic Co-operation & Development (OECD) in 1960 to achieve economic & developmental goals for its member states. Almost all of its members are wealthy, industrialized nations.

mobile cellular positively affects both the economies of the Middle East and OECD, but mobile cellular affects the Middle East economies at a minimum level; because of the improper infrastructure of the internet.

Similarly, one more study (Myovella et al., 2020) compared Sub-Saharan Africa to OECD economies and further strengthens the evidence that digitalization affects positively the economic growth of both economies. This study analyzed the impact of digitalization on the economic growth of 33 OECD and 41 Sub-Saharan African economies over an 11 years period from 2006 through 2016, through disseminating the Generalized linear Method of Moments estimation (GMM).

Initial analysis of above study found that the ICT significantly impacts the economic growth of both of these economies but, the broadband affects the growth in the Sub Saharan African economies at minimal as compared to the OECD economies. On the contrary, mobile telecommunication highly affects the Sub Saharan African economies as compared to the OECD economies, because developing economies specifically still have to ameliorate their mobile infrastructure and also, people in developing economies rely mainly on the mobile cellular telephones for doing their business and economic activities while; developed economies has already employed advancement in telecommunication technologies.

According to the study by (David & Grobler, 2020), the impact of ICT on economic growth in 46 economies of Africa for the period of 2000 through 2016 was explored. It is clear from a study that the penetration of ICTs has a positive impact on the economic growth in Africa. This study employs the Partial Correlation Analysis (P.C.A) technique for creating a single index, which is named as C.T.I for proxies: Internet accessibility, connected fixed line & mobile line. Moreover, the study incorporates the rate of life expectancy & Gross per capita income as proxies for the

Human development index (H.D.I) and real gross domestic product & GDP per capita as proxies for Economic growth. This study conclusively purports that ICT penetration has a significant influence on the economic growth of economies in Africa besides that mobile technologies have been expanding faster in African economies. Conclusively, the study recommends making more investments in fixed (wired) internet infrastructure.

The study of (Hasbi & Dubus, 2020) illustrates the impact of mobile broadband in developing countries, primarily in Sub-Saharan economies from the period of 2013 through 2017. This study appends that mobile broadband is employed differently according to the specialties of different countries. Mobile broadband seems to be more likely for use against online banking and online social media users, along with those who transfer money via mobile and possesses SIM cards. This study initially concludes that in the developing countries, especially in Sub-Saharan countries students are more likely to use mobile broadband for online education or gathering information; than those who do not own smartphones.

Another factor that influences mobile broadband usage is having a bank account and using mobile money. The first and second discrete choice models with time and region effects are proposed as an econometric approach in this study. This study also includes independent variables such as mobile phone owners, active SIM card owners, social media users, mobile money and bank account holders, as well as socio-demographic factors such as educational level, poverty, and socio-professional class.

A comparable analysis of (Solomon & van Klyton, 2020) evaluated the impact of digital technologies on the economic growth comprising 39 African economies from the period of 2012 through 2016. The study incorporates the ICTs indicators of the

Networked Readiness Index (NRI) for defining the level of digitalization. This study further employs the General method of moments technique (GMM) for empirical estimation and analyzed the impact of ICT in terms of government, business, and individual usage on economic growth in a distinguished way; and concluding that only individual usage has strongly influenced the economic growth in selected African economies.

Another comparative analysis by (Thompson Jr & Garbacz, 2011) illustrated the direct & indirect impact of mobile broadband & fixed broadband on the economy. Initially, this study analyzed the impact of mobile & fixed broadband on the economic growth of both countries holistically, and then secondly carried out an analysis in groups (low-income countries & high-income countries). This study purports that holistically the mobile broadband influenced the economic growth of both sorts of economies not fixed broadband whereas, in low-income vs high-income group mobile broadband influenced low-income group relatively better as compared to the high-income group countries.

Ultimately, the study concluded that the lower-income economies are benefitted more from mobile broadband; as the usage of mobile broadband in low-income countries is merely affordable and mobile services are getting expanded. Therefore, new policies & reforms, as well as initiatives should be launched for incentivizing the mobile industry. Secondly, broadband should be implemented at the national level for the expansion of mobile broadband connectivity in low-income countries and areas for sustaining economic growth.

Conclusively, the prior literature studies investigate that there is a heterogeneous relationship exist between digitalization and economic growth depending on the level of ICT infrastructure & development. Developed economies

have been utilizing more from digitalization at a cheap rate as compared to the developing economies because there is a moderate infrastructure of ICTs available in the developing economies that requisitely need to be upgraded promptly. Hence, there are opportunities available for investments in the developing countries consequently, it will also diminish the cost of utilizing digital technologies in the developing economies and hence bridge the digital gap through providing both internet connectivity and information to the people.

In the past, many developing economies have gained economic development through leapfrogging of digital technologies. As a second conclusion, it is concluded that digital technologies affect more with better human capital, as it provides the laborers/workers with digital skills and learning to utilize the digital technologies effectively and efficiently. Thirdly, mobile broadband is an important tool for digital connectivity in developing countries as it is the cheapest way for internet connectivity. Moreover, it is purported from existing literature that mobile broadband has substantially contributed towards developing economies whereas, fixed broadband has contributed towards developed economies and its prices are better here in developed economies.

However apart, rules & regulations regarding the ICTs influence the digital sector such as digital platform-based companies, internet providers, telecom operators, and mobile companies. Effective ICT rules & regulations positively influence the effectiveness of the ICT sectors in a country such as allocating needed spectrum to allow operators in expanding network coverage this subsequently benefits end consumers, setting rules for deploying underground fiber cables to initiate fixed (wired) broadband, setting the plan for infrastructure sharing among operators, etc.

A theoretical Model based on the extant Literature

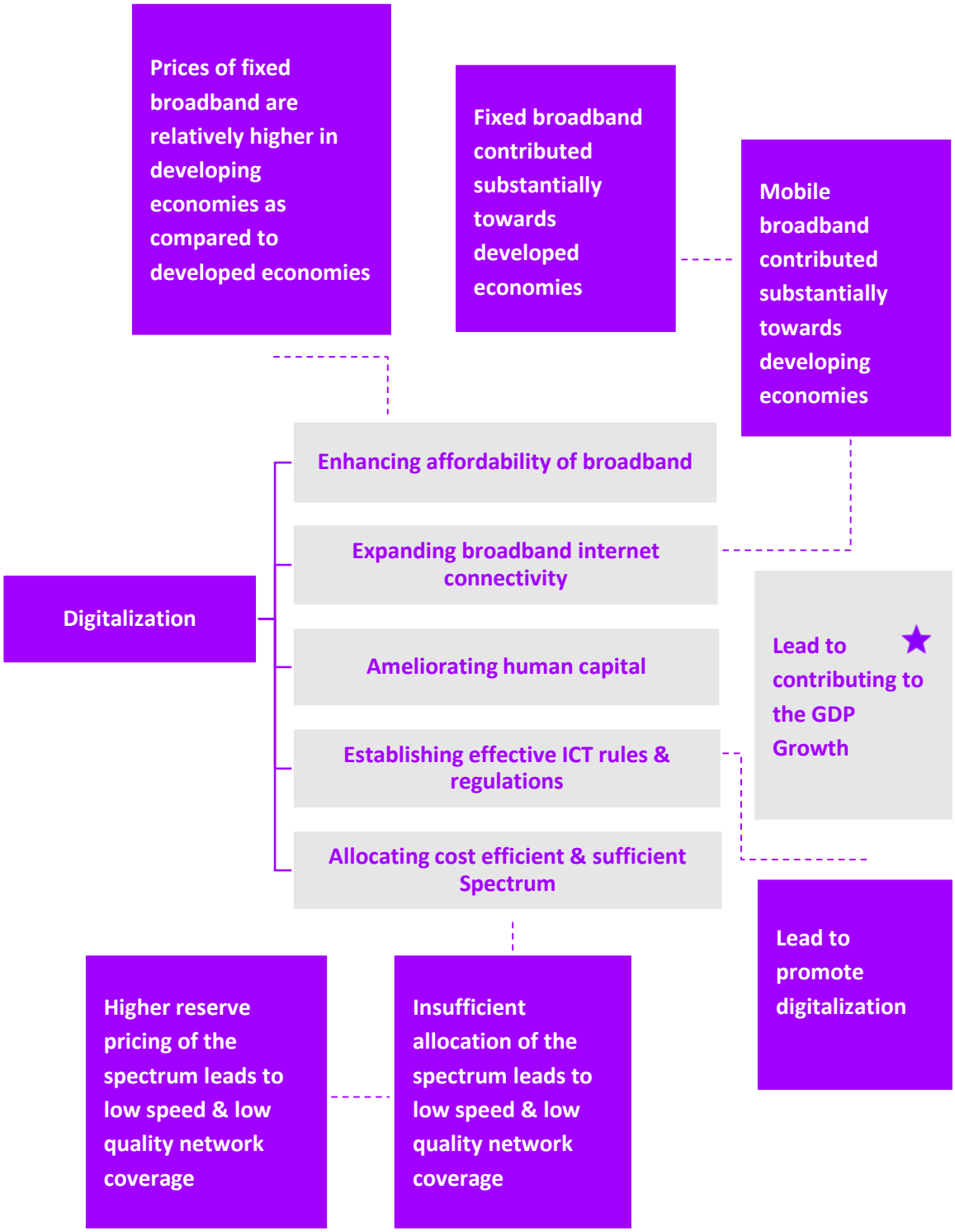


Figure 2.1: A theoretical model established through reviewing the contemporary literature, Source: An extant literature.

2.2.5 Hypotheses

The study proposes following hypotheses**:**

1. Affordability has a positive & significant impact on economic growth.
2. The connectivity has a positive & significant impact on economic growth.
3. The human capital has a positive & significant impact on economic growth.
4. The ICT regulations has a positive & significant impact on economic growth.
5. The network coverage has a positive & significant impact on economic growth.
6. The spectrum has a positive & significant impact on economic growth.

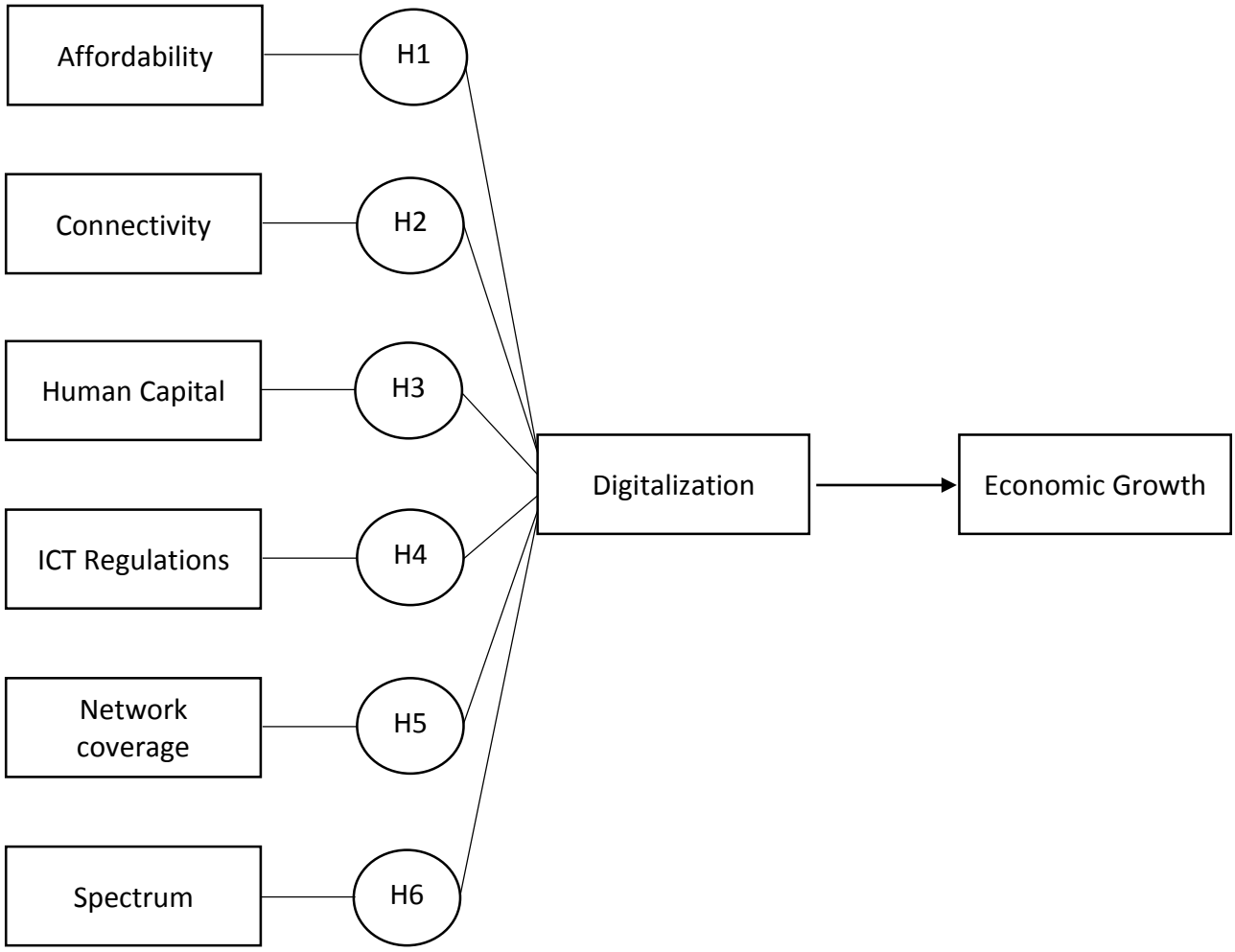


Figure 2.2*:* Theoretical framework & hypotheses development

CHAPTER 3

Data & Methodology

A coherent methodology & how effectively the data are collected & then analyzed is indispensable for productive research. We made a sincere approach to acquire fact-based data for this research and to identify the most appropriate methodology for conducting empirical analysis.

3.1 Data & sampling

To purport our research question of whether Digitalization influences economic growth in developing economies in the Asia-pacific. The statistical model is developed based on secondary data.

3.1.1 Why secondary data?

To conduct this research, data for selected countries at the national level was required. Therefore, collecting primary data for all these selected countries were constrained by resources & time. That is why for conducting this research we relied on secondary data.

3.1.2 Data sources

The empirical data for this research is collected from following databases:

Database	Proxy
International Telecommunication Union (ITU)	ICT
GSMA Mobile Connectivity Index (MCI)	ICT
World Bank Indicators (WBI)	Economic growth

3.1.3 Period of the study

The data is collected for 6 years from the period of 2014 to 2019 for 17 countries in the Asia-Pacific region:

China	Sri Lanka	Malaysia	Thailand	Maldives
Pakistan	Nepal	Cambodia	Iran	
India	Philippines	Mongolia	Bhutan	
Bangladesh	Indonesia	Vietnam	Fiji	

3.1.4 Sample size & limitations

Having accentuated the sample size used in the study initially, this study incorporates the developing economies only. Secondly, the data for some of the economies such as Pakistan, Bangladesh, Nepal, Cambodia, Mongolia, Afghanistan, Samoa, Myanmar, Lao P.D.R, Papua New Guinea, Solomon Island, and Vanuatu is partially or fully unavailable for some of the indicators for ICT in ITU index.

Similarly, GSMA provides data in its Mobile Connectivity Index (MCI) starting from the period 2014 onwards to 2019 only & it is the latest data available in the index to date. Moreover, there is an unavailability of data from some countries in the index. Hence, it exhibits unbalanced nature of data before the year 2013 for selected economies in the (MCI) index.

Therefore, the study incorporated the latest data and only considered those countries whose data is fully available on all reports. Hence, it allowed us to choose fewer numbers of economies & made data available for a short period. That is why the study incorporated only seventeen developing economies & a six-year period, which led to a sample of small size.

3.2 Partial Least Square Structural Equation Modelling (PLS-SEM)

This study incorporates the Partial least square Structural Equation Modelling as an empirical technique (PLS-SEM) for assessing the relationships between constructs. PLS-SEM is a causal-predictive & multivariate second-generation technique practiced for data analysis. PLS-SEM initiate analysis using the variance-based equation modeling. PLS-SEM is frequently characterized by its capability of handling complex structural models, non-normal data, small sampled data & formative constructs (Hair et al., 2014). PLS-SEM can provide evaluations of projects having a small sample of data if many numbers of constructs and considerable numbers of indicators are incorporated into the project or study.

PLS-SEM is composed of two models: the Measurement model or (outer model) and the Structural model or (inner model). The Measurement model further comprises Reflective & Formative measurement models. The measurement model evaluates the relationship between constructs and their indicators. While the structural model evaluates the relationship among the constructs or latent variables. An assessment of PLS-SEM modeling comprises the following crucial steps: (1) specifying the model, (2) an evaluation of the outer model, (3) an evaluation of the inner model (Hair et al., 2019).

3.3 Constructs and their respective Indicators

In this study, the Gross domestic product (GDP) construct has been incorporated as the proxy for economic growth. The GDP construct comprises three indicators or items that are GDP per capita (current US dollars), GDP, PPP (constant 2017 international dollars), and GDP per person employed (constant 2017 PPP dollars). These indicators for GDP are taken into this study by aligning with the following

studies: (Raeskyesa & Lukas, 2019; Fernandez-Portillo et al., 2019; Portillo et al., 2020; Myovella et al., 2020; Habibi et al., 2020). Meanwhile, data for these indicators is collected directly from World Bank Indicators (WBI). However, the constructs and their indicators for the ICT variables are listed below in Table 3.1.

Table 3.1: Catalogue of ICT variables

Code	Constructs & Indicators	Source
1	**Connectivity**	
1a	Mobile Cellular per 100 individuals	ITU
1b	Mobile Broadband per 100 individuals	ITU
1c	Fixed broadband per 100 individuals	ITU
1d	Percentage of individuals using the internet	ITU
1e	Smartphone ownership	GSMA
1f	Server per population	GSMA
1g	International bandwidth per individuals	GSMA
1h	Mobile download speeds	GSMA
2	**Network coverage**	
2a	4G Network	GSMA
2b	3G Network	GSMA
2c	2G Network	GSMA
3	**Affordability**	
3a	Mobile Cellular low usage % of GNI	ITU
3b	Mobile broadband basket (500MBs) % of GNI	ITU
3c	Mobile broadband basket (1.5GB) % of GNI	ITU
3d	Fixed broadband basket (5GB) % of GNI	ITU
4	**Spectrum**	
4a	Digital dividend spectrum (MHz per operator)	GSMA
4b	Spectrum > 1GHz (MHz per operator)	GSMA
4c	Spectrum with 1-3 GHz (MHz per operator)	GSMA
5	**ICT regulatory framework**	

5a	ICT Regulatory Tracker	ITU
6	**Human Capital**	
6a	Education Index	HDI

3.4 Specification of the model

Specifying the model in the general form incorporates:

a) Measurement model: $X = C'\gamma + e$

b) Structural model: $\gamma = B'Y + \zeta$

c) Weighted model: $\gamma = W'X$

3.4.1 Measurement model

The measurement model evaluates the relationship between constructs & indicators. The measurement model comprises 20 indicators and 6 constructs. The measurement model is, therefore proposed as follow:

1) $X_1 = \gamma_1 Connectivity + e_1$
2) $X_2 = \gamma_2 Connectivity + e_2$
3) $X_3 = \gamma_3 Connectivity + e_3$
4) $X_4 = \gamma_4 Connectivity + e_4$
5) $X_5 = \gamma_5 Connectivity + e_5$
6) $X_6 = \gamma_6 Connectivity + e_6$
7) $X_7 = \gamma_7 Connectivity + e_7$
8) $X_8 = \gamma_8 Connectivity + e_8$
9) $X_9 = \gamma_9 Network\ coverage + e_9$
10) $X_{10} = \gamma_{10} Network\ coverage + e_{10}$
11) $X_{11} = \gamma_{11} Network\ coverage + e_{11}$
12) $X_{12} = \gamma_{12} Affordability + e_{12}$

13) $X_{13} = \gamma_{13} Affordability + e_{13}$

14) $X_{14} = \gamma_{14} Affordability + e_{14}$

15) $X_{15} = \gamma_{15} Affordability + e_{15}$

16) $X_{16} = \gamma_{16} Spectrum + e_{16}$

17) $X_{17} = \gamma_{17} Spectrum + e_{17}$

18) $X_{18} = \gamma_{18} Spectrum + e_{18}$

19) $X_{19} = \gamma_{19} ICT\ Regulatory\ framework + e_{19}$

20) $X_{20} = \gamma_{20} Human\ capital + e_{20}$

Here,

X = Indicators or Items

γ = Constructs or latent variables

e = Residuals of indicators

Generally, the measurement model can be expressed as follow:

$$X = C'\gamma + e \qquad (3.1)$$

3.4.2 Structural model

The structural model evaluates the relationship among constructs/factors or latent variables, whereas the structural model equation can be proposed as follow:

$$\gamma_6 = \gamma_1\beta_1 + \gamma_2\beta_2 + \gamma_3\beta_3 + \gamma_4\beta_4 + \gamma_5\beta_5 + \zeta_6 \qquad (3.2)$$

Here,

γ_6 = Endogenous variable

$\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6$= Exogenous variables

β = Path coefficients

ζ = Residuals of constructs or factors

Hence, in the general form above equation can be written as follow:

$$\gamma = B'Y + \zeta \qquad (3.3)$$

The weighted relation of the structural model can then be expressed as follow:

$$Connectivity = \gamma_1\omega_1 + \gamma_2\omega_2 + \gamma_3\omega_3 + \gamma_4\omega_4 + \gamma_5\omega_5 + \gamma_6\omega_6 + \gamma_7\omega_7 + \gamma_8\omega_8$$

$$Network\ coverage = \gamma_9\omega_9 + \gamma_{10}\omega_{10} + \gamma_{11}\omega_{11}$$

$$Affordability = \gamma_{12}\omega_{12} + \gamma_{13}\omega_{13} + \gamma_{14}\omega_{14} + \gamma_{15}\omega_{15}$$

$$Spectrum = \gamma_{16}\omega_{16} + \gamma_{17}\omega_{17} + \gamma_{18}\omega_{18}$$

$$ICT\ Regulatory\ framework = \gamma_{19}\omega_{19}$$

$$Human\ capital = \gamma_{20}\omega_{20}$$

Hence, in the general form it can be expressed as follow:

$$\gamma = W'X \qquad (3.4)$$

Table 3.2: Descriptive statistics of indicators

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
GDP_C_US	4363.44151	3611.498251	11414.20698	743.4133813	3005.759481	0.839130466	2.608290393	12.62248374	0.001815777	102
GDP_PERS_EMP	24560.99647	23261.415	59390.46	5299.27	13300.46669	0.60323256	2.908665712	6.221575165	0.044565842	102
GDP_PPP_C17	2.1602E+12	7.075E+11	2.25E+13	6884234277	4.72924E+12	3.056198979	11.53985465	468.7347364	1.64E-102	102
MC	118.2446078	116.915	186.16	63.13	28.36270427	0.27605766	2.528973418	2.238463814	0.326530504	102
FB	6.142647059	3.85	31.34	0.43	6.113073626	1.913381758	7.415363124	145.0930897	3.11E-32	102
IBG	46.65460784	45.86	62.84	28.19	7.259351043	-0.078359818	3.095107683	0.142827691	0.931076491	102
INTERT	40.20696078	39.9	84.21	6.43	19.01540656	0.204298454	2.191144971	3.490091041	0.174637039	102
MB	58.38705882	54.955	147.52	4.8	31.48872209	0.548141013	3.014012947	5.108630234	0.07774546	102
SO	72.96019608	74.64	97.79	38.92	15.7502633	-0.295187321	2.114967741	4.810253356	0.090254062	102
SPP	51.03872549	51.515	83.07	16.9	14.398781	-0.066035401	2.598840169	0.758080604	0.684518025	102
MDS	21.51784314	17.25	78.73	4.44	15.24833766	1.831221731	6.730054582	116.138897	6.04E-26	102
FBA	4.307843137	3.525	17.28	0.57	3.379022539	1.540651291	5.066346737	58.49791138	1.98E-13	102
MBB1	2.026568627	1.5	9.95	0.45	1.756878135	2.5574198	10.19943766	331.4723189	1.05E-72	102
MBB2	2.662647059	1.935	13.05	0.49	2.489173359	2.423532348	9.127091448	259.3999645	4.70E-57	102
MCU	1.885098039	1.27	9.95	0.27	1.763278194	2.107876523	8.287755965	194.3649818	6.23E-43	102
S1	63.40892157	60.715	100	22.41	19.23460258	0.324160348	2.765624475	2.019819344	0.36425188	102
S2	49.03019608	39.515	100	14.5	27.20424614	0.854138396	2.272706066	14.65045577	0.00065871	102
S3	36.87372549	28.7	98	9.67	22.21856578	1.246254044	3.749771117	28.79270151	5.59E-07	102
2G	95.77735294	98	100	78	5.036845022	-1.687182845	5.180341775	68.59599479	1.27E-15	102
3G	83.74019608	90	100	27.14	17.88394257	-1.587881886	4.704250541	55.20726815	1.03E-12	102
4G	60.42764706	68.715	100	2.34	33.15316132	-0.487499588	1.763700099	10.53600857	0.005153886	102
EI	0.610941176	0.6315	0.764	0.365	0.112277311	-0.338110518	2.012836511	6.085008228	0.047715255	102
ICTREG	64.75323529	61.75	86	34	11.43796173	0.221633608	2.295453059	2.944706926	0.229385	102

Chapter 4

Results & Findings

To assess hypotheses by employing the PLS-SEM technique, an evaluation is conducted through three stages. Initially, we have performed an overall assessment of our model. Secondly, we assessed the measurement model or (outer model). Thirdly, we evaluated the structural model or (inner model) for obtaining hypothesized path coefficient & results.

4.1 Specification of the model

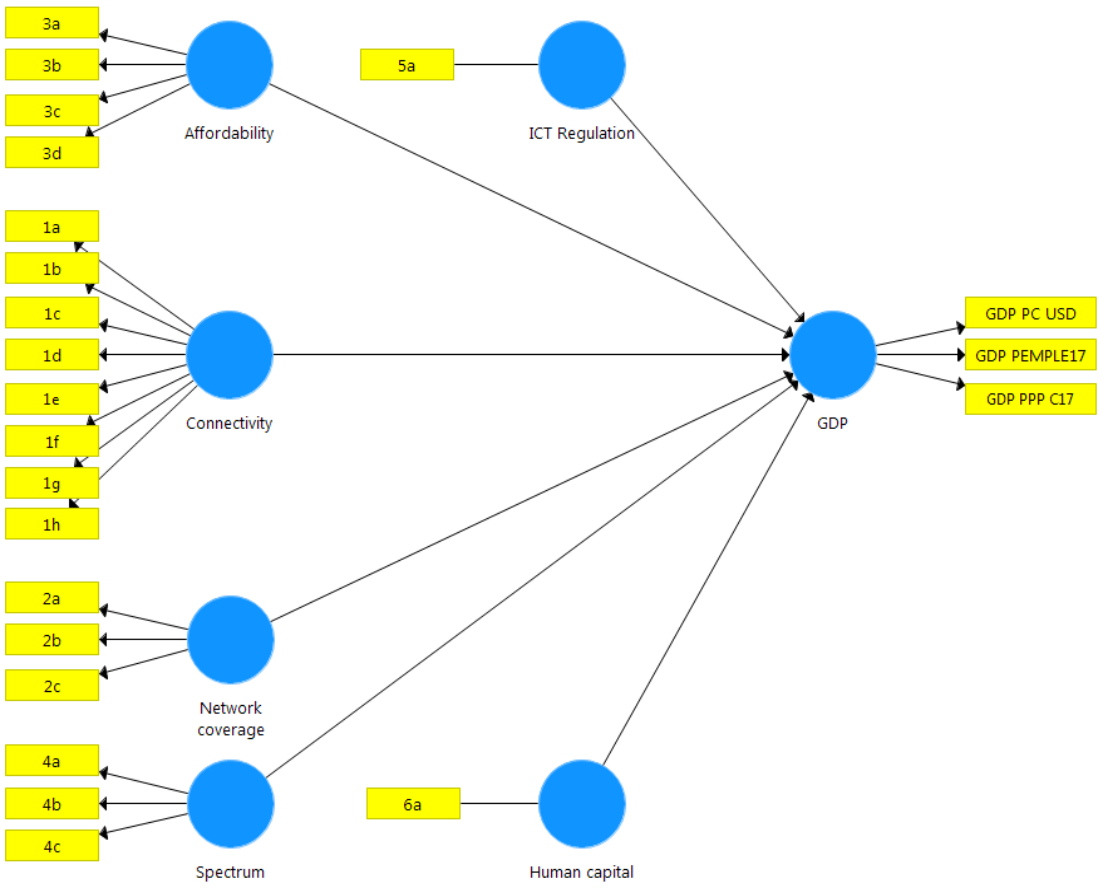


Figure 4.1: A path model mapped through the Smart PLS

4.2 Measurement model

The measurement model purposes assess the outer model by enumerating the reliability & validity of the model. Firstly, we proceed with the reflective measurement model, because in our model the causality points towards indicators or items from constructs or latent variables. The reflective measurement model typically incorporates checking internal reliability & validity and convergent & discriminate validity. As for proceeding with the reflective measurement model, we executed the consistent PLS Algorithm procedure to get the results. While executing the consistent PLS Algorithm, the weighting scheme was set to factor, the maximum iterations were set to 300 iterations, and the stop criterion was set to 10^-7 in a basic setting in the Smart PLS 3.3.3.

4.2.1 Outer loadings

Generally, the first step in the reflective measurement model encompasses eliminating the indicators or items with the lowest outer loading values, to make the model consistent. Only three indicators/items were removed from an overall model, two items (ie, ig) were disconnected from the connectivity construct, and; while the item GDP, PPP (constant 2017 international $) was disconnected from the GDP construct; because of low factor loadings (outer loading > 0.6) (Hair et al., 2019). The value of outer loadings with (below 0.6, but above 0.5) is also valid (Purwanto & Research, 2021). One more study (Hair et al., 2014) acknowledged that outer loadings value above 0.4 is still valid. The outer loading value of GDP PPP (constant 2017 international $) due to which this item was removed later was (0.248) while, the outer loading values of the other two items of GDP construct were above 0.6. The results of the remaining outer loadings can be distinguished in Table 4.1.

Table 4.1: Outer loadings

Connectivity	1a	1b	1c	1d	1f	1h
	0.594	0.691	0.702	0.980	0.691	0.546
Network coverage	2a	2b	2c			
	0.934	0.875	0.551			
Affordability	3a	3b	3c	3d		
	0.740	0.608	0.688	0.795		
Spectrum	4a	4b	4c			
	0.709	0.530	0.987			
ICT regulation	5a					
	1.000					
Human Capital	6a					
	1.000					

Source: Evaluation through Smart PLS

4.2.2 Construct reliability and validity

In a second step, we then evaluated the reliability and internal consistency through assessing composite reliability (CR) and Cronbach's Alpha. Composite reliability, which is commonly known as, McDonald's coefficient, is considered as the most reliable measure for assessing internal consistency & reliability. The Composite reliability value of 0.7 or above is generally acceptable (Dakduk et al., 2019). An alternative measure for evaluating internal reliability is Cronbach's Alpha. If the value of Cronbach's Alpha lies between 0.90-0.70, it is generally considered satisfactory otherwise, the value is considered acceptable if it is between 0.70-0.60. Similarly, the value of Rho-A between 0.90-0.70 is considered satisfactory or good; whereas if the

value lies between 0.70-0.60 then it is acceptable (Hair et al., 2019). The results as seen in Table 4.2, which reveals that all constructs are reliable.

4.2.3 Convergent validity

In the next step & third step in the reflective measurement model, the convergent validity of constructs/factors has been assessed. The convergent validity demonstrates how far latent variable or construct can get converge to elucidate the indicator variance. The construct validity is assessed using the Average Variance Extracted (AVE) measure. As can be distinguished in Table 4.2, the construct with a value of 0.50 or higher is typically preferred.

Table 4.2: Construct reliability & validity

Reflective construct	Cronbach's Alpha	Rho-A	Composite Reliability	AVE
Affordability	0.879	0.809	0.802	0.505
Connectivity	0.860	0.884	0.857	0.510
GDP	0.907	0.909	0.908	0.831
Human Capital	1.000	1.000	1.000	1.000
ICT Regulation	1.000	1.000	1.000	1.000
Network coverage	0.828	0.883	0.841	0.648
Spectrum	0.873	1.047	0.888	0.748

Source: Evaluation through Smart PLS

4.2.4 Discriminant validity

In the fourth step, the discriminant validity has been assessed in the measurement model. It purports that to what extent construct or factor deviates empirically from the other construct or factor (Hair et al., 2019). A Heterotrait Monotrait metric is used for an assessment of the discriminant validity in the measurement model. The HTMT

criterion seems to be the latest approach introduced by (Henseler et al., 2015). This approach to assessing the discriminant validity is more reliable & consistent than that of the Fornell-Larcker approach in detecting shortfalls of the discriminant validity as, the Fornell-Larcker approach may lead to misinterpretation of the results as argued by (Henseler et al., 2015). A threshold value of the HTMT must be below 0.90 (Hair et al., 2019). As can be distinguished in Table 4.3, all of the HTMT values are below 0.90.

Table 4.3: Discriminant validity

	Afford	**CNT**	**GDP**	**HC**	**ICT Reg**	**NC**	**SP**
Afford							
CNT	0.501						
GDP	0.710	0.759					
HC	0.515	0.552	0.673				
ICT Reg	0.129	0.199	0.147	0.076			
NC	0.607	0.823	0.539	0.447	0.172		
SP	0.295	0.500	0.575	0.312	0.287	0.532	

Source: Evaluation through Smart PLS

4.3 Structural model

After assessing the measurement model's reliability & validity. The next step involves assessing the structural model, which is also known as an inner model. Analyzing the structural model entails checking the collinearity among the constructs and between the constructs & indicators through observing inner & outer VIF values. It further incorporates determining the path coefficient or beta value (β-value), a coefficient of

determination (R^2), an evaluation of the predictive relevance of the structural model (Q^2), and estimating the Effect size (f^2) for each path.

4.3.1 Variance Inflation Factor (VIF)

Before commencing with an assessment of the structural model, an issue of collinearity must be focused upon through analyzing the Variance Inflation Factor (VIF) (Hair et al., 2019). The Variance Inflation Factor (VIF) is employed to detect the collinearity issue in the outer & inner model. If the VIF values among the constructs or indicators are above 5 or equal to five then it indicates that there is a serious issue of collinearity. Hence, the redundant are typically removed to overcome the issue of collinearity as acknowledged by the following studies (Hair et al., 2014; Hair et al., 2019; Mansfield & Helms, 1982). As a result, as distinguished in Table 4.4, all of the VIF values in the inner model or constructs are below 5.

Table 4.4: Variance Inflation Factor

	GDP
Affordability	2.020
Connectivity	4.341
E Government	3.965
Human Capital	4.472
ICT Regulation	1.238
Network Coverage	2.332
Spectrum	1.503

Source: Evaluation through Smart PLS

4.3.2 Coefficient of determination (R^2)

The next step is to evaluate the value of R^2 which is also known as in-sample predictive power. It is used to assess the path model's predictive accuracy. A value of R^2 indicates the overall variance and effect size explained by the endogenous variable/construct in the structural model. The R^2 value lies within a range of 0 to 1, with a value closer range to 1 indicating the higher in-sample predictive effect. The R^2 value of 0.75 reflects substantial effect, the value of 0.50 reflects moderate effect while, the value of 0.25 reflects the small effect (Hair et al., 2019). Therefore, the effect of R^2 in our study was found to be substantial, as we procured the R^2 value of 0.792. Moreover, this also means that the six exogenous constructs substantially contribute to the explained variance of the endogenous variable, which is 79.2%.

4.3.3 Cross validated redundancy (Q^2)

A Cross-validated redundancy (Q^2) is also another procedure for predicting the accuracy of the path model. Blindfolding procedure was executed to obtain the value of Q^2. The blindfolding is a procedure based on omitting part of the data matrix and estimating the parameters of the model. The predictive relevancy of the inner model is determined by the value of Q^2, the greater the value of Q^2 will be; the higher the predictive relevancy will be. A value of Q^2 with 0.50 reflects the higher predictive relevancy, the Q^2 value of 0.25 reflects the moderate predictive relevancy while, the Q^2 value higher than zero reflects the small and at the same time indicates the existence of the predictive relevancy in the model (Hair et al., 2019). In our case, the predictive relevancy was found to be higher, as the value of Q^2 was observed 0.679.

4.3.4 Effect size (f^2)

The Effect size (f^2) explains to what extent an exogenous construct or factor influences an endogenous construct or factor. In other words, f^2 determines the effect size for each path. If the f^2 value is above 0.35, it reflects the higher effect size. If the f^2 value lies between 0.35-0.15, it reflects the moderate effect size if the f^2 value lies within the range of 0.15 to 0.02, it reflects the small effect size. The f^2 value with less than 0.02 reflects zero effect size (Hair et al., 2014). The Effect sizes (f^2) of the constructs are shown in Table 4.5.

Table 4.5: Effect size (f^2)

Exogenous construct	**Effect size (f^2)**	**Total Effect**
Affordability	0.986	Large
Connectivity	0.795	Large
Human Capital	0.210	Medium
ICT Regulation	0.158	Medium
Network Coverage	0.534	Large
Spectrum	0.684	Large

Source: Evaluation through Smart PLS

4.3.5 Path coefficient (β) and t-statistics

For validating the hypothesized path, path coefficient & values of t-statistics are evaluated through running bootstrapping procedure & using 5000 re-samples in the Smart PLS version 3.3.3. The value of the path coefficient ranges from +1 to -1, the path coefficient value is nearby -1 reflecting a strong negative relationship, and the value is far by +1 reflecting a strong positive relationship. Moreover, if the t-value is

greater than 1.96 then, the hypothesis is considered significant when preferring two-tailed in the PLS-SEM. Therefore, following that we got our results that are proposed in Table 4.6.

Table 4.6: Path coefficient and t-statistics

Hypothesized Path	**Standardized Beta (β)**	**T statistics**	**P values**
Afford ⟶ GDP	-0.436	4.394	*0.000
CNT⟶ GDP	0.573	2.671	*0.008
HC ⟶ GDP	0.212	2.301	*0.021
ICT Reg ⟶ GDP	0.158	2.075	*0.038
NC ⟶ GDP	-0.441	2.429	*0.015
SP ⟶ GDP	0.353	3.251	*0.001

* is significance level at 5% Source: Evaluation through Smart PLS

a. By evaluating hypothesis 1, we proposed that affordability has a significant and negative influence on the GDP ($\beta = -0.436$, $T = 4.394$, $p < 0.005$), implying that affordability influences the GDP significantly as shown in Table 4.6.

b. By evaluating hypothesis 2, we proposed that the connectivity has a significant and positive influence on the GDP ($\beta = 0.573$, $T = 2.671$, $p < 0.005$), implying that the connectivity influences the GDP significantly as shown in Table 4.6.

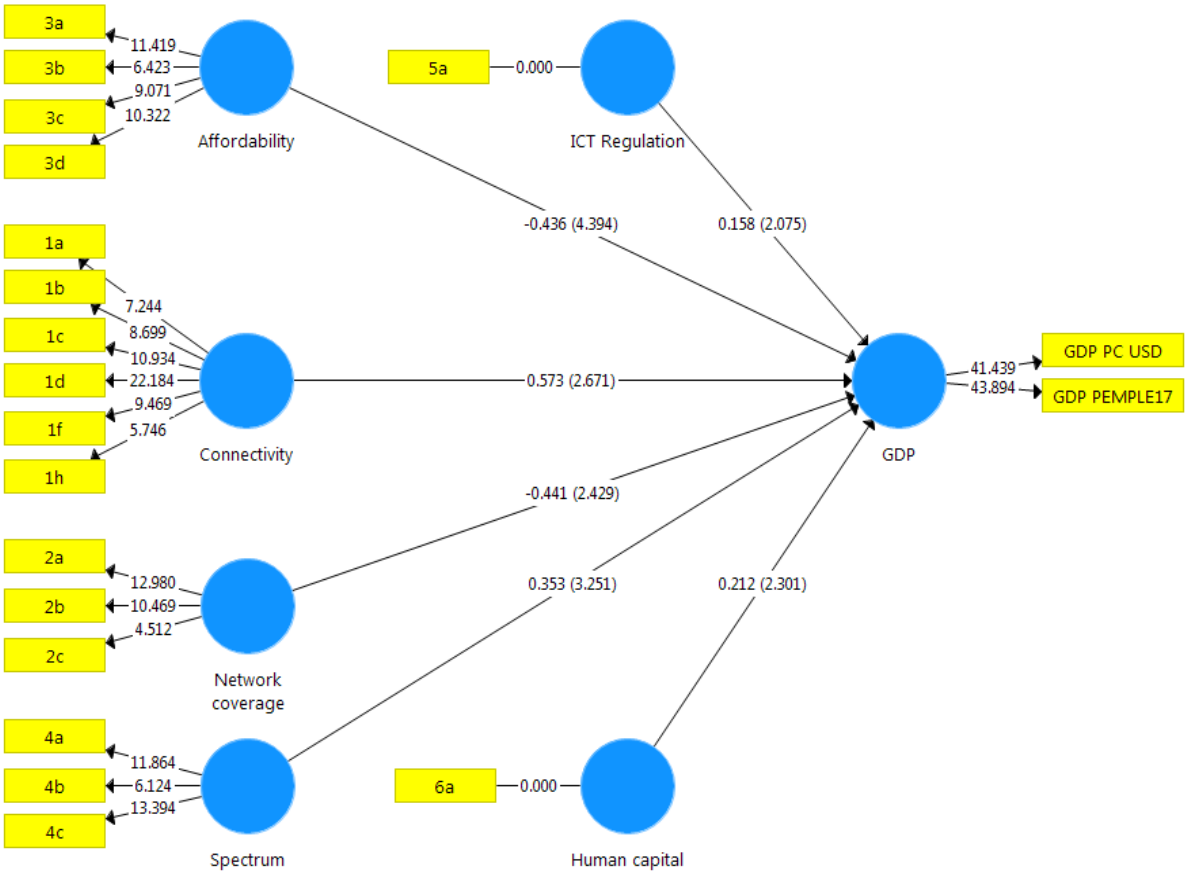
c. By evaluating hypothesis 3, we proposed that the human capital has a significant and positive influence on the GDP ($\beta = 0.212$, $T = 2.301$, $p < 0.0085$), implying that the human capital influences the GDP significantly as shown in Table 4.6.

d. By evaluating hypothesis 4, we proposed that the ICT regulation has a significant and positive influence on the GDP ($\beta = 0.158$, $T = 2.075$, $p < 0.005$), implying that the ICT regulation influences the GDP significantly as shown in Table 4.6.

e. By evaluating hypothesis 5, we proposed that the Network coverage has a significant and negative influence on the GDP ($\beta = -0.441$, $T = 2.429$, $p < 0.005$), implying that the Network coverage influences the GDP significantly as shown in Table 4.6.

f. By evaluating hypothesis 6, we proposed that the spectrum has a significant and positive influence on the GDP ($\beta = 0.353$, $T = 3.251$, $p < 0.005$), implying that the spectrum influences the GDP significantly as shown in Table 4.6.

An estimated path model validating the path coefficient (β) & t-statistics



Source: Evaluation through Smart PLS

Figure 4.2: Results of the hypothesized path model.

4.3.6 The Goodness of Fit (GoF)

A standardized root mean square (SRMS) is one of the approaches to determine the fitness of an overall model. If the threshold value of SRMS is below 0.10 or 0.08, then the goodness of model fit is considered good (Hu & Bentler, 1998). Similarly, according to (Hair et al., 2014), the threshold value of SRMS above 0.06 or 0.08 is considered good. We found the SRMS value of 0.087, as distinguished in Table 4.7. Another common approach to determining Goodness of Fit (GoF) is using the Normed Fit Index (FIT), also known as Bentler and Bonett Index. Its value ranges between 0 and 1. A value closer to 1 is an indication of a better model fit. We observed the NRI value of 0.703, as distinguished in Table 4.7.

Table 4.7: the Goodness of Fit

	Saturated Model	Estimated Model
SRMS	0.087	0.087
d_ULS	1.158	1.158
d_G	0.784	0.784
Chi-Square	384.202	384.202
NFI	0.703	0.703

The Goodness of Fit (GoF)

4.4 Discussion

The higher the value of β would be, then more robustly the exogenous latent construct would affect the endogenous latent construct. In our study, the connectivity has a stronger effect as compared to other constructs as it has the highest β-value that is equal to 0.573. On the same hand, ICT regulation has the least effect on the endogenous latent construct.

Table 4.8: Results & findings

Hypothesized Path	**(β)**	**T statistics**	**P values**	**f^2**	**Decision**
Afford ⟶ GDP	-0.436	4.394	*0.000	0.986	Supported
CNT ⟶ GDP	0.573	2.671	*0.008	0.795	Supported
HC ⟶ GDP	0.212	2.301	*0.021	0.210	Supported
ICT Reg ⟶ GDP	0.158	2.075	*0.038	0.158	Supported
NC ⟶ GDP	-0.441	2.429	*0.015	0.534	Rejected
SP ⟶ GDP	0.353	3.251	*0.001	0.684	Supported

* is significance level at 5% Source: Evaluation through Smart PLS

We then analyzed the value of f^2 to see the effect size of our constructs, along with P-values & t-statistics so that it does not get problematic for readers & us to interpret the results. Effect size (f^2) explains the degree to which an exogenous latent construct or factor influences the endogenous latent construct or factor. In other words, f^2 determines the effect size for each path. The results of (f^2) are proposed in Table 4.7.

4.4.1 Affordability

For affordability, the standardized beta (β) has a negative value and it has a large effect size (β = -0.436, f^2 = 0.986, T = 4.394) additionally, affordability has an adverse influence on GDP as it has a β-value (-0.436). The result was expected as the construct incorporates indicators that constitute the price level of broadband internet in terms of the percentage of monthly GNI. The price level of broadband internet in some countries is comparatively higher than in other countries in a region (Union, 2021). Higher prices of broadband especially fixed broadband, restrict people from utilizing internet services efficiently due to non-affordability. This leads to low penetration of broadband.

An issue of affordability has been problematic for many APAC economies with low GNI & GDP per capita. The high prices of internet services create an issue of affordability for the consumers in developing economies, which consequently restricts them from effectively utilizing internet services especially broadband (Bulturbayevich et al., 2020). It is assumed that increasing the prices of broadband internet may lead to diminishing the affordability level of broadband internet. Consequently, it reduces the internet connectivity and thus influence the GDP adversely. Therefore by aligning with these studies, Hypothesis: 1 is supported as proposed in Table 4.7.

4.4.2 Connectivity

For connectivity, the standardized beta (β) has the highest and positive value and it has a second large effect size (β = 0.573, f^2 = 0.795, T = 2.671). The connectivity highly influences the GDP as it has the highest β-value (0.573) when compared to other constructs. The connectivity construct incorporates primary indicators such as mobile cellular, fixed broadband, mobile broadband, internet usage, mobile download speed &

server per population, international bandwidth. Some studies provide the idea that the ICTs can lead to the economic growth.

Such as studies done on developing economies like (Fernandez-Portillo et al., 2019; Fernandez-Portillo et al., 2020; Myovella et al., 2020; Fateh Habibi & Mohamad Amjad Zabardast, 2020; Raeskyesa & Lukas, 2019; Khan & Majeed, 2020; Ahmed & Ridzuan, 2012; Tripathi & Inani, 2020; Zhang, 2021) acclaimed that ICTs variables significantly influenced the economic growth. Therefore, by aligning with these studies the hypothesis: 2 is supported as proposed in Table 4.7, as our study also found a significant relationship between ICT variables and economic growth.

4.4.3 Human capital

For human capital, the standardized beta (β) has positive value and medium effect size ($\beta = 0.212$, $f^2 = 0.210$, $T = 2.301$). Several studies & theories such as (Romer, 1990; Nelson & Phelps; 1966, Vu, 2011; Silva & Lima, 2015; Klaus Schwab, 2020) supported the idea that human capital tends to enhance the productivity of the labor force through acquiring skills, learning, and technological advancements. Human capital is considered one of the fundamental drivers for economic productivity and prosperity. The usage of ICTs gets improve as the effectiveness of human capital[29] also improves (Vu, 2011). Moreover, it enhances the accessibility to education and learning. An education substantiates as an accelerator for innovation in technological advancements (Romer, 1990).

Such as in the crisis of Covid-19, where businesses are adopting advanced technologies for operating business activities. Simultaneously, many unskilled employees & laborers

[29] Human capital tends to enhance the productivity of the labor force through acquiring skills, learning, and education. Human capital is considered one of the fundamental drivers for economic productivity and prosperity.

are losing their jobs because their skills are mismatching with new emerging technologies. Hence, it is getting problematic for the adoption of tomorrow's technologies because in the end every existing technology is disrupted with upcoming & new technology as purported by (Klaus Schwab, 2020). Modern technologies require up-to-date skills & new IT qualifications to operate. In the digitalization era, advanced technologies will demand workforce, fresher & graduates to obtain compatible digital skills to survive in a future job market especially in technology companies & IT sector. Therefore, individuals with a higher level of updated skills & university degrees are more likely to survive in a future job market (Silva & Lima, 2015). Hence, in line with these theories & studies, hypothesis: 3 is supported as proposed in Table 4.7.

4.4.4 ICT regulation

For ICT regulation, the standardized beta (β) has positive value and medium effect size and ($\beta = 0.158$, $f^2 = 0.158$, $T = 2.075$). Generally, making efficient changes in the regulatory[30] & institutional framework [31]purport positive impact on the GDP such as making favorable policies for the mobile & telecom sector, reducing administrative & tax burden, making an investment, effective spectrum allocation, etc. Government rules & regulations regarding the mobile & telecom sector affect the performance of ICT sectors, which eventually affect the end-consumers and GDP as acclaimed by the study of ITU[32] (Union, 2021d). As a result, hypothesis: 4 is supported as proposed in Table 4.7.

[30] The regulatory frameworks incorporate factors related to specific regulations & policies.
[31] Institutional framework incorporate factors like kinds of governmental authority or body responsible for regulating the digital sector and making & implanting digital policies in a country.
[32] International Telecommunication Union (ITU).

4.4.5 Network coverage

For network coverage, the standardized beta (β) has a negative value and has a large effect size (β = -0.441, f^2 = 0.534, T = 2.429). Mobile broadband benefits developing economies more when compared to the developed economies as acclaimed by (Zhang, 2021; Habibi et al., 2020; ITU, 2019). Through expanding & meliorating the network coverage, the level of accessibility and affordability of the high quality & high-speed mobile broadband internet can be enhanced. That fulfills an increasing demand for network coverage as more & more people are getting connected online and incentivize consumers through the socio-economic benefits of mobile broadband internet as acclaimed by (Mason, 2015; Pau Castells, 2019; GSMA, 2020; Fernandez-Portillo et al., 2020).

Therefore, we acceded with the claim of these studies and rejected hypothesis: 5, which shows that network coverage has a negative and significant influence on the economy. The network coverage adversely influences the GDP, and it was an unexpected outcome. Hence, hypothesis: 5 is not supported, though it has a significant effect as proposed in Table 4.7.

4.4.6 Spectrum

For spectrum, the standardized beta (β) has a positive value and large effect size (β = 0.353, f^2 = 0.684, T = 3.251). As, an effective spectrum allocation, spectrum award & auction pricing through better spectrum management allows operators to secure more investments for expanding the network coverage. Widening the network coverage leads to providing high quality, high-speed, and affordable mobile broadband internet to the unconnected population. Ultimately, it provides socio-economic benefits to consumers & operators that consequently influence the economy positively. A sufficient spectrum allows mobile operators to fulfill the demand for affordable & high-speed broadband

and thus cover the large area. However, trading off with the policy regarding the spectrum for the revenue-maximization for the government or state may cause harm to the economy in the form of unaffordable, low-quality internet connectivity, thus widening the digital divide as acclaimed by (Pau Castells, 2019; GSMA, 2020). Therefore, hypothesis: 6 is supported as proposed in Table 4.7.

4.5 Qualitative analysis

4.5.1 Methodology

Based on the empirical work done on digitalization, a questionnaire was developed to carry on some interviews. The questionnaire was tested through a pilot survey and revisited for errors. The Key respondents were mainly targeted from Telecom companies, and other digital companies. The interviews were carried on by keeping all ethical concerns. Respondents were contacted by phone and email. On getting time from respondents, interviews were done by personal visits and virtually. On getting meaningful insights, responses were linked with quantitative analysis and policies.

4.5.2 Results of qualitative research

Survey results have given deep insights and important findings. Based on findings, recommendations are given in the following section.

The digital revolution in Pakistan and its preparations for the digital transformation:

Respondents emphasized the importance of the digital revolution. One of the respondents said:

"I think there is potential in Pakistan for digital transformation. I am saying it because we have seen that in the period of Covid-19 the usage of broadband internet have increased. During lockdowns, people were sitting in their homes, and in their spare

time people were using the internet in their homes because of outside restrictions. They are using online Apps for interacting like WhatsApp, Facebook. They are using online Apps for doing shopping using E-commerce platforms.

Hence, people have realized the important of these things learned about them during Covid-19. At least, I can say that Covid-19 is an accelerator for digitalization not in Pakistan but in some other countries as well. Pakistan is on an upward trajectory towards digitalization".

Ways to increase internet connectivity in Pakistan:

As digital connectivity is one of the most important pillars of the digital economy. Therefore, to highlight the issue it was focused that what needs to be done for enhancing both fixed & mobile broadband? The majority of the respondents focused that there is a need for increasing network coverage.

"Network coverage has to be increased. Especially, in our rural areas and far places, there is a lot of work to do. I mean, there is a lot of need to expand network coverage so that broadband services can be provided to those people living in far & rural places as well. Secondly, we have to look upon how Government is devising its policy towards expanding network coverage to these areas".

The view of the respondent was:

"I think people in cities have enough network infrastructure it's time for laying infrastructure in rural & far areas. So that, connectivity can be expanded across the whole country".

As one of the respondents was from Telenor. He narrated

"Telenor has been covering remote areas and northern areas as well for long. Tharparkar is an example that is a desert in Sindh. Our roadmap is to get access to those rural & places as well".

Another respondent said government involvement in increasing internet connectivity is very important as government can involve private companies in service delivery.

"The focus of Pakistan's government is on providing internet connectivity for everyone. Due to Covid-19, everyone has switched internet and it has become a need of time".

Reasons of the high cost of utilizing fixed (wired) broadband in Pakistan as compared to its regional countries:

The respondents were asked the possible key reasons behind the higher cost of utilizing fixed (wired) broadband in Pakistan as compared to its regional countries. The respondents agreed with the high cost and gave some recommendations to lower the prices of fixed broadband internet.

"I think 1) cost of doing business 2) lack of infrastructure 3) spectrum auctioning is costly. We know that our cities are becoming expanding day by day horizontally instead of vertically now it is getting challenging for us. It has become difficult & costly for us for PTCL for laying infrastructure of fixed broadband. The process of legislation is complex. You have to take too many permissions for laying infrastructure from many stakeholders; there is a need for the decentralized system".

The main recommendations are as under:

1) Cost of doing business should be made effective.
2) Policies regarding laying network infrastructure need to be looked upon again.
3) An Auctioning of the spectrum needs to be made cheap.
4) Procedures should be made easy for network providers
5) Infrastructure provision should be quick and easy

Role of the Private sector in promoting digitalization in Pakistan:

Mainly the IT sector especially the telecom sector has an important role in promoting digitalization in developing economies like Pakistan and other economies in this region. Therefore, it is important to explore the role of private companies (Telenor) in promoting digitalization in Pakistan.

The private sector respondent highlighted that

"First, we have to see that do our people have adaptability towards using Hi-tech like home automation or IoT. Only early adopters can use these technologies. Now, coming towards us Telenor has launched a few Apps such as Khushaal Watan App for convening farmers, which tells them about weather forecasting, pesticides, fertilizer management. We have also launched the "Digital Birth Registration Initiative" for people residing in far places".

Digital skills adoption in Pakistan:

As new trends are in fashion like (digital Apps) and it is important to know if people have the skills to utilize these Apps easily. A lack of Digital skills are one of the main problems for the slow digitalization of Pakistan. The respondent emphasized:

"We try to make Apps so user-friendly. Such as they can call directly to a particular institution to get information about fertilizers, weather forecasting, etc. secondly, we have recorded audio information in the local language to minimize hurdles. As per digital skills, yes it would take time for people to learn those skills. I think different platforms are providing these skills now so time passes by people will get them".

Heavy Taxation and effect on spending capacity of operator:

From a supply-side perspective, it has been seen that the telecom sector in Pakistan is taxed heavily or disproportionately. Such a situation decreases the spending capacity of the operator & discourages investment to expand network coverage. On inquiring about these challenges and recommendations, the response was:

"The telecom sector is taxed heavily because the Government is always facing an issue of the budget deficit. Then, due to low investment opportunities, we have to compromise on some things such as your quality of network becoming poor. We cannot expand much because it is already costly as I said above this leads to lower penetration of both kinds of broad bands. Now, due to companies requiring profitability they have to pass through the portion of the cost to end consumers, which increases the prices of our services".

Affordability issues:

Excessive burden on the telecom sector eventually affects end consumers in form of high prices of telecom services & mobile broadband. Therefore, this creates an issue of affordability of these services. The question was asked to what extent these all hurdles; create an affordability issue & what needs to be done to resolve this issue?

The respondent said

"We have to pass through some chunk of taxes to end consumers that eventually increase the prices of our services. For the ease of consumers, we try to introduce some low cost packages and you can see some lower MBs packages are free for some time. Therefore, this is how we try to facilitate our customers".

Managing spectrum in Pakistan:

One question was about how does the spectrum is managed in Pakistan? What is the thought process behind the managing spectrum in Pakistan? Is spectrum available in accord with demand in a sector?

The respondent told that

"Talk about spectrum, do not know why the government does not release spectrum. Enough spectrum is available but it is useless if it is not being auctioned appropriately. It needs to be handled accurately. There is a demand from our side but there is no supply of spectrum at the right prices and at right time. The Government needs to devise its policy towards spectrum because I said due to lack of spectrum we cannot be able to expand the network that is why people have to face hurdles in form of the slow speed of network & poor quality network".

On asking about how spectrum is generally priced & awarded among operators in Pakistan? What is an approach & roadmap behind it? How it can be improved according to your recommendations?

The response of one respondent was

"When there is not enough spectrum available then auctioning pricing becomes automatically increases. Such as if, there is no sufficient spectrum available then we all operators have to bid for that enough spectrum. Such as during the last spectrum auctioning, we need a spectrum, Zong required spectrum but eventually, Ufone won the bid".

The Government hires international consultants for making the roadmap of the spectrum according to international standards, which is mostly not suitable for Private companies. So sometimes, it creates many hurdles for following the roadmap accordingly.

Moreover, when there is not enough spectrum it lowers the competition among operators, which is a bad thing if there would not be effective competition.

One of the recommendations from private sector representatives was that

"An auction prices of spectrum needs to be set low. It should be managed according to the local environment so that local operators can utilize it effectively".

Recommendations on what the government need to do to promote digitalization in Pakistan:

The overall recommendations from qualitative part areas under

1) Network coverage has to be increased in rural & far places.
2) Freelancing should be increased & approachable for the youth.

3) New digital start-ups & incubations need to be promoted & made.
4) E-commerce should be promoted & made Accessible widely.
5) Things regarding ICT need to be regulated effectively.
6) Public-Private partnership should be encouraged
7) Facilitation programs for common people to learn new skills will be useful.

Chapter 5

Conclusion & Recommendations

This study emphasizes the impact of digitalization on economic growth in the Asia Pacific. The study incorporates 17 developing economies in the Asia Pacific, spanning 6 years period from 2014 to 2019. The findings of the study suggest that overall digitalization has a significant impact on the economic growth of developing economies in Asia-Pacific by taking into account the following supported ICT factors all of which represent digitalization are affordability, connectivity, ICT regulation, network coverage, and spectrum. Based on the findings, this study apprises a few recommendations that have been enumerated below.

5.1 Main findings of the study

5.1.1 Affordability

The findings suggested that affordability has a significant impact on the economic growth in developing economies in the Asia Pacific. Today, the majority of people in many developing & low-income economies in the Asia Pacific still cannot afford broadband services because of the high prices of broadband and low income. Many people and students with low-income & in the far places are unable to connect digitally and coordinate with the digital ecosystem due to the unaffordability of broadband internet subject to their higher prices, especially for fixed broadband.

5.1.2 Connectivity

Overall, our finding suggested that connectivity has a significant impact on the economic growth in developing economies in the Asia Pacific. Therefore, the government must have to ensure connectivity through expanding network coverage, increasing broadband access, and building robust internet infrastructure.

5.1.3 ICT Regulation

The finding suggested that the ICT regulatory tracker [33]has a significant impact on the economic growth in developing economies in the Asia Pacific. This suggests that all developing economies should have an effective ICT regulatory framework for stimulating digitalization across economies, which consequently benefits the economy. Individually, Pakistan has performed well in ICT regulatory tracker following India (G4) so far which makes it the 4th Generation operator among developing economies across the Asia Pacific. While economies like Maldives, Indonesia, China, Srilanka, Nepal, Bhutan[34], have not performed effectively.

5.1.4 Spectrum

Regulators need to effectively manage the spectrum, as it is an exiguous resource. Regulators in the Asia Pacific especially developing economies need to instigate and publish a preferable roadmap for operators through which mobile operators can be brought up to date regarding spectrum policies.

Poor spectrum pricing insignificantly affects almost all developing economies in the Asia Pacific. Subsequently, it creates issues like low quality & unaffordable broadband services, hurdling the rollout of network infrastructure especially 4G, and then obviously for the 5G, it will create hurdles in the long-term.

Following that, spectrum auctioning is the effective mode of assigning spectrum to operators. However, mobile operators cannot be incentivized through auctioning if the prices of spectrum auctioning are inflated artificially. That eventually creates

[33] ICT Regulatory tracker's pillars incorporate Regulatory authority, Regulatory mandate, and Regulatory regime & Competition framework.

[34]https://tracker.gen5.digital/country-cards

deterioration to end consumers, unavailability of the spectrum to operators despite its demand by operators, and favoritism towards the specific operator.

5.2 Policies & Recommendations

Based on the findings of the study, here are the few recommendations that are listed below:

5.2.1 A policy towards affordability of broadband

The study concludes following recommendations towards ensuring the affordability of broadband that are listed below:

a. The Government should increase the level of affordability of broadband by instantly lowering prices of broadband services.

b. The Government must be responsible for and ensure the execution of the UN target for affordable broadband, which apprises that by 2025 all developing economies should make entry-level broadband affordable to their citizens. The cost of an entry-level broadband connection should not exceed 2 percent of the monthly GNI per capita.

c. The infrastructure for the fixed (wired) broadband must be developed & ameliorated. In many developing economies particularly Pakistan, the Philippines, Indonesia & Cambodia, here fixed broadband prices are relatively higher when compared to other developing economies in the region. In these economies, fixed broadband infrastructure may not yet upgrade subject to the low fiberization of fiber optics cable, administrative & bureaucratic issues such as delays in approvals, gaining the permission & right of way for digging the ground for laying fiber optics cable for fixed broadband hence; these all issues subsequently lead to increasing the prices of fixed broadband internet.

5.2.2 A policy towards the connectivity

The study purports the following recommendations towards the connectivity that are listed below:

a. The Government must need to ensure the national broadband plan to enhancing the fixed and mobile broadband connectivity to both rural and urban areas so that the digital divide can be diminished.

b. The Government should strive to enhance internet connectivity in terms of fixed and mobile broadband through incentivizing & encouraging investments in ICT hard infrastructure.

c. Increasing the spectrum allocation that leads to expanding the network coverage, resulting in affordable, high quality & high-speed broadband.

5.2.3 A policy towards the ICT Regulation

The study purports the following recommendations towards the ICT Regulations that are listed below:

a. An implementation of the national broadband plan must be ensured progressively for expanding broadband connectivity.

b. An administrative & bureaucratic burden must be reduced such as reducing the amount of time for resolving administrative activities like Govt. approvals, stakeholder concerns, disputes resolution, etc. Gaining the permission & right of way for fabricating mobile towers for harboring telecom devices & equipment, digging land for laying underground optical fiber cables for broadband connections particularly for the fixed (wired) broadband, using public & private property for installing telecommunication devices & equipment. Therefore, administrative & bureaucratic burdens must be reduced.

c. The Government & regulators must collaborate to devise a strategic plan for effective infrastructure sharing among mobile operators. Spectrum sharing allows multiple operators to share the same band and allows telecom operators to maximize their profit in an effort to allow more investments in the future for the network deployment for expanding the network coverage. Consequently, it will benefit end consumers thereby incentivizing the national economy. Hence, all operators should be given a right to infrastructure sharing until the competitive environment is not affected adversely.

5.2.4 A policy towards the spectrum

The study purports the following recommendations towards the ICT Regulations, now what Government & regulators must need to execute are mentioned below:

a. A well-thought-out mechanism for auctioning the spectrum should be well planned.

b. Affordable reserve prices for spectrum auctioning must be prioritized.

c. Auctioning must not be identified as an opportunity for revenue-maximization by the state.

d. A roadmap for the future auctioning of the spectrum must be designed & implemented through collaboration with regulators. Just like, when and how much spectrum the Govt. is going to allocate in the coming future as many operators in the Asia-Pacifc lack confidence as well as predictability due to an absence of proper spectrum plan by regulatory authorities.

e. The spectrum should be accessible to operators promptly well with market demand.

f. The supply of spectrum must not be artificially confined for the competition purposes such as limiting the spectrum for new entrants and while, deteriorating the performance of existing operators simultaneously.

g. The Government & regulators must set low reserve prices for spectrum licensing and avoid generating revenue from spectrum licensing. Especially in developing economies where Govt misapprehends it that revenue generation through spectrum licensing can lower a country's debt burden. Therefore, operators would be able to provide high-speed & high-quality broadband services at affordable prices to end consumers

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Appendix

Interview questions for the qualitative analysis

Q1: Where do you see Pakistan in terms of the digital revolution? Is Pakistan ready for the digital transformation? What do you think, is Pakistan ready for this change or not?

Q2: what do you think how internet connectivity can be increased in Pakistan, as digital connectivity is one of the most important pillars of the digital economy. What needs to be done for enhancing both fixed & mobile broadband?

Q3: A cost of utilizing fixed (wired) broadband in Pakistan is comparatively higher than its regional countries. What can be key reasons behind its higher cost? What are your recommendations to lower the prices of fixed broadband internet?

Q4: we have seen mainly the IT sector especially the telecom sector has an important role in promoting digitalization in developing economies like Pakistan and other economies in this region. So, how the telecom sector or (Company name) is playing its role in promoting digitalization in Pakistan?

Q5: From a supply-side perspective, we have seen that the telecom sector in Pakistan is taxed heavily or disproportionately. Which decreases spending capacity of operator & discourages investment to expand network coverage. Tell us about these challenges & how do you try to overcome these challenges? Kindly give your recommendations.

Q6: Following the above question we know that excessive burden on the telecom sector eventually affects end consumers in form of high prices of telecom services & mobile broadband. Therefore, this creates an issue of affordability of these services. If you tell us to what extent these all hurdles, create an affordability issue & what needs to be done to resolve this issue?

Q7: How do you see government policies regarding promoting digitalization in Pakistan? To what extent are you satisfied with Government policies regarding the telecom sector. Policies that can give a smooth path to the telecom sector for promoting digitalization & provide better services?

Q8: What do you think, how does the spectrum is managed in Pakistan? What is a though process behind the managing spectrum in Pakistan? Is spectrum is available in accord with demand in a sector?

Q9: Could you tell us about how spectrum is generally priced, awarded or distributed among operators in Pakistan? What is an approach & roadmap behind it and how it can be improved according to your recommendations?