DIGITAL ECONOMY OF PAKISTAN AND SERVICES EXPORTS PERFORMANCE

By

Samia

PIDE2022FMPHILEAF01

Supervised By

Dr. Uzma Zia

Senior Research Economist

PIDE School of Economics

Pakistan Institute of Development Economics

2025

Author's Declaration

I, Samia, hereby state that my MPhil thesis titled **"Digital Economy of Pakistan and Services Exports Performance"** is my work and has not been submitted previously by me for taking any degree from the Pakistan Institute of Development Economics or anywhere else in the country/world.

At any time, if my statement is found to be incorrect even after my Graduation, the university has the right to withdraw my MPhil degree.

Date: 05-05-2025

Signature

Pakistan Institute of Development Economics

Pakistan Institute of Development Economics, Islamabad

PIDE School of Economics

CERTIFICATE

This is to certify that this thesis entitled: **"Digital Economy of Pakistan and Services Exports Performance"** submitted by **Ms. Samia** is accepted in its present form by the School of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Economics and Finance.

Supervisor: Dr. Uzma Zia Signature: _____

External Examiner: Dr. Umaima Arif Signature: _____

Head,
PIDE School of Economics: Dr. Iftikhar Ahmad Signature: _____

ABSTRACT

Service exports are crucial to Pakistan's economy since they generate foreign exchange earnings while highlighting the country's potential in industries such as information technology, finance, and tourism. Furthermore, they stimulate economic diversity and employment creation, increasing worldwide competitiveness. This study explores Pakistan's digital economy and its impact on service exports. Using the ARDL model, the study uses annual data from 1993 to 2023 and attempts to build a comprehensive Digital Economy Development Index (DEDI) for Pakistan to assess its impact on service exports. The findings show that, over time, DEDI has had a significant and beneficial effect on service exports, underscoring the importance of digital transformation in increasing trade performance. Conversely, financial depth has a negative and significant long-term impact on service exports, demonstrating inefficiencies in the financial sector's integration with service commerce. While domestic lending to the private sector has an insignificant impact on services exports in both the long term and the short term. The REER has a positive and significant effect in the short term. To maintain export growth, these findings highlight the necessity of a deliberate focus on supporting digital economy projects. Based on these results, this study recommends helping the digital economy flourish and increasing connectivity for companies engaged in service exports, investing in high-speed internet, data centers, and cloud computing infrastructure. Put in place extensive training programs for digital skills to provide workers with the technological know-how they need to prosper in a digital economy.

Keywords: Digitalization, Digitization, Digital Economy, Services exports, Connectivity, Trade performance, Digital Transformation

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ARDL	Autoregressive Distributed Lag
BRICS	Brazil, Russia, India, China, South Africa
DEDI	Digital Economy Development Index
DE	Digital Economy
Dcr	Domestic Credit to Private Sector by Banks
DOI	Digital Opportunity Index
GATs	General Agreement on Trade in Services
GATT	General Agreement on Trade and Tariffs
ITC	International Trade Commission
ITU	International Telecommunication Union
ICT	Information Communication Technology
IoT	Internet of Things
IDI	ICT Development Index
NRI	Network Readiness Index
NNTT	New New Trade Theory
ReeR	Real Effective Exchange Rate
TINA	Trade Intelligence and Negotiation Adv
UNCTAD	United Nations Conference on Trade and Development
WEF	World Economic Forum
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

1.1 Background

The exchange of services[1] is an essential component in stimulating economic expansion, creating job prospects, and promoting engagement in value-added networks. In contrast to the trade in tangible goods, wherein physical commodities are exchanged, trade in services involves transactions primarily involving the transfer of services rather than material products. These services span a spectrum of sectors, including but not confined to banking, insurance, telecommunications, education, consulting, and tourism. Its trade involves a variety of services, including professional services, financial services, transportation, tourism, information technology, education, healthcare, entertainment, and environmental services.

In 2022, the global exports of services reached a value of $7.1 trillion, which accounted for 7.1% of the world's GDP and contributed to 23% of the total world trade, including both goods and services. When compared to the pre-pandemic era, all primary service sectors exceeded their 2019 values, except for travel and construction (UNCTAD, 2023). According to the World Development Indicators, wealthier nations exhibit a higher percentage of services in their GDP compared to less affluent countries. The economic history of developed nations and the current trend in some developing countries strongly indicates that the services sector expands with the rise in per capita income, in proportion to other sectors of the economy.

It has been remarked that within the modern digital age, the structure of service trade has undergone substantial evolution due to technological progress and the widespread proliferation of digital platforms. Digital technology has transformed the services sector by reducing barriers of cost and distance. Multiple correlations exist between service trade dynamics and the advent of the digital era. A significant portion of the resources reallocated from conventional industries during the COVID-19 pandemic was allocated to digital services, which emerged as a powerful catalyst for accelerated growth (Ganichev & Koshovets, 2021). Online services have been instrumental in

[1] interchange of intangible economic activities among different countries

mitigating the risk of epidemic transmission, regulating human movement, and fostering consistent economic expansion. As ICT and emergent technologies such as the IoT, big data, and cloud computing gain traction, they are increasingly regarded as the "engine" of economic development (Zhang, Pan, Feng, & Qin, 2022).

According to the ITC report (2022), BRICS nations[2]are now major participants in the international services market, with rapid growth over the past two decades contributing notably to the economic effectiveness of the BRICS group. In 2020, services trade accounted for 5.5% to approximately 12% of the GDP of BRICS countries, comparable to or slightly higher than the United States' figure of 5.6% in the same year. However, it still falls behind leading European countries such as France (18.7%) and Germany (16%). In 2020, based on data from the WB, the BRICS countries collectively represented 10% of the total global services exports and 13% of the total global services imports.

Recent studies by the ADB (Helble & Shepherd, 2019) and the WB (Cirera et al., 2021) underscore the increasing importance of integrating a services-oriented policy agenda into broader development strategies, emphasizing the need to not only focus on manufacturing for development but also assess the performance of the services sector, considering the intricate connections between the two domains. While it may be premature to discuss "services-led development," it is relevant to discuss "services-facilitated development" or the strategic utilization of the services sector to enhance medium-term growth prospects.

The digital economy has significantly boosted service trade in Pakistan through various avenues, and a rise in digital trade opportunities is observed, with the ICT services sector showing substantial growth. E-commerce and digital financial services have experienced significant expansion, contributing to a 38% increase in services exports (ITC). It has generated new opportunities for Pakistan in terms of employment and the advancement of business. Foreign investments in digital sectors have revolutionized conventional industries, enhancing their operational efficiency. The motivation for this research stems from the opportunity to contribute to academic and policy discourse on how developing countries such as Pakistan can strategically

[2] BRICS nations- Brazil, Russia, India, China and South Africa

use the digital economy to boost service exports, foster innovation, and strengthen their economic resilience in a rapidly changing global landscape.

1.2 Research Problem

Despite being a key driver of economic growth globally, Pakistan's services sector remains underdeveloped and underexplored. While many economies have transitioned from manufacturing to a more technology-driven services sector, Pakistan has yet to integrate digital technology into its services industry fully. There is a limited understanding of how digital advancements are shaping this sector, impeding its potential for growth and competitiveness. The lack of a systematic assessment of digital technology's role in the services sector has resulted in missed opportunities for economic transformation and policy development.

1.3 Objectives

1. To explore the nexus between digital technology adoption and service exports and assess the state of digital technology adoption in Pakistan's economy.

1.4 Research Questions

1. What is the influence of the digital economy on Pakistan's service exports?
2. How does the adoption of digital infrastructure affect services trade?

1.5 Significance

Services trade plays a key role in some aspects of development and holds immense potential for economic growth and export competitiveness. While contributing over 61% to GDP, services trade can drive economic growth by creating employability. This also reduces dependence on the exports of traditional goods and makes the economy more resilient. Export Services offer a significant opportunity to diversify our export base. Sectors like IT, professional services, and tourism can tap into global markets and attract foreign exchange. Focusing on knowledge-intensive services promotes innovation, skill upgrades, and the adoption of technology.

The link between digital technology, its adoption, and services exports is critical for the development of Pakistan's economy. Digital technologies, including online visual services, mobile apps, artificial intelligence, and cross-border e-commerce, play a substantial role in boosting

exports by creating new opportunities and providing access to international markets. The adoption of digital technology enables Pakistani businesses to streamline operations, reduce costs, and enhance their competitiveness in the global market. According to a report, Pakistan's IT services exports have expanded 2.7 times since 2014, making up 35 percent of all service-sector exports in 2023. This shows the significance of service exports in the economy[3].

1.6 Organization of the Study

The study is organized into 6 chapters. In the first chapter, the study topic is introduced, and research objectives and research questions are discussed. in the second chapter, the previous literature on the current topic is reviewed. The third chapter consists of the significance of the services trade. The fourth chapter consists of the model, methodology, data span, and sources. The results and discussion are carried out in the fifth chapter. Chapter six contains conclusion and the policy recommendations drawn from the research.

[3] Kalbe Ali (2024)- Dawn News

CHAPTER 2

LITERATURE REVIEW

Since the mid-1980s, a significant amount of research has emerged on the topic of trade in services. A significant portion of this is influenced by regional trade agreements and the interventions by the World Trade Organization. Nevertheless, there is a growing body of research that concentrates on the consequences of unilateral liberalization of the services sector. For a comprehensive understanding of the digital economy and services trade (exports), this review will examine the determinants of services trade and the transformative role of digital technology. The traditional determinants have shaped the service trade, but with the use of digital platforms and e-commerce, a new landscape has emerged, which makes it necessary to see how digital adoption has shaped services exports. Digital infrastructure (broadband connections, digital devices, Cell phones) makes digital trade possible. Therefore, reviewing studies across the mentioned themes provides a framework to assess the extent to which digital technology adoption affects Pakistan's service exports.

The determinants of service trade encompass numerous factors that influence the exchange of services between countries. These determinants can include regulatory frameworks, economic conditions, technological advancements, service demand, and trade policies. Additionally, factors like export competitiveness, natural resources, consumer demand, trade policies, economic growth, exchange rate, technological advancements, and demographics can influence an economy's balance of trade in goods and services (WTO, 2010). Most of the developed nations are highly services imported countries. Trade imbalances in services do not inherently signify an economic setback. Instead, the importation of services facilitates enhanced efficiency for domestic businesses in global value chains, leading to significant benefits for consumers. Looking at the cost side of the service sector on a global scale, the costs associated with the services trade are elevated, being twice as high as those observed in the trade of goods.

2.1 Studies Related to the Determinants of the Services Trade

Numerous factors affect the imports and exports of services. Internationally, a huge number of literature is done to find out the determinants of modern services exports other than digital

technology. Roy et al. (2024) explore the factors that influence ICT-enabled service commerce, with an emphasis on the comparative significance of physical and human capital. Forty-five significant service trading nations are incorporated into the analysis, in addition to distinct country divisions classified according to their ICT-service trade balance. Net ICT-enabled service exports are significantly impacted by variables including mobile connectivity, global demand, expanding manufacturing sectors, foreign investment, and enhanced business environments. This is in stark contrast to conventional services like transportation and travel, where net exports are significantly influenced by broadband and mobile connections. There are various indicators of digital connectivity or the digital economy, but in this study, only mobile connectivity is used. This study lacks the crucial factors of digital connectivity that enhance the services trade.

The study by Tran (2022) empirically utilizes a cross-sectional, panel dataset with 64 countries over the period 1979 to 2020, estimating the model through the use of Ordinary Least Squares (OLS) regression. These variables are GDP, REER, population size as well as Asian-specific interaction terms that form the empirical framework. Using theoretical consists, this concept relates to trade theories as well as the behavioral response of firms in conditions of exchange rate fluctuations, which consists of constraints such as hedging constraints. Research findings show that traditional theory is wrong, that there is an inverse relationship between REER and export growth, but Asian nations benefit from such an increase because of cost advantage and GVCs. Fluctuations in REER do not seem to affect exports greatly and thus may present offsetting opportunities for the risk-averse exporters. The paper argues that Asian exporters enjoy a cost advantage through import competition, but this advantage may be threatened in the long run due to the rising raw material production capabilities of these economies. Some of the solutions identified in the study involve enhancing the quality of the product, refining branding techniques, and ultimately leveraging comparative advantages to boost export factors. This study only focuses on the REER. Other variables, like digital infrastructure, are ignored. Digital infrastructure diversifies services trade, extends markets, and minimizes trade costs.

GDP per capita, trade openness Foreign Investment are among the potential factors affecting the growth of the services sector in certain developed nations. However, in chosen developing economies, the contributing factors include GDP per capita, innovations, foreign investment, and

trade openness. Notably, innovations have a substantial impact on the expansion of the services sector specifically in selected developing economies (Salam et al., 2018). The primary determinants of India's increase in advanced services exports were investigated by Sahoo and Dash (2014). The research indicates that India's exports of contemporary services are influenced by a variety of factors, including global demand, exchange rates, merchandise exports, physical infrastructure, intellectual capital, and financial development.

Eichengreen and Gupta (2013) investigated the factors influencing the performance of the services sector for sixty developing nations, including India, spanning from 1980 to 2008. Their research highlights several significant determinants such as the exporter country's per capita income, market size, global demand for services exports, merchandise exports, infrastructure development, foreign direct investment, and human capital. This study only focuses on the traditional trade indicators and ignores the digitally deliverable services. It also ignores the modern ways wo trading services.

Nasir and Kalirajan (2013) investigate the factors influencing the contemporary export performance of East and South Asia economies between 2002 and 2008. Their estimations reveal that emerging nations in South Asia and the ASEAN region exhibit significantly lower levels of export potential realization compared to North America and Europe. Furthermore, the findings highlight the worth of factors such as the quantity of Emerging nation ICT infrastructure quality and the caliber of graduates are crucial factors that affect the export performance of contemporary services.

Using the conventional gravity model, Van der Marel and Shepherd (2013) examined the variables affecting services trade between APEC members between 1995 and 2008. Their research identified market size, participation in regional trade agreements, geographical distance, regulatory restrictions, and shared language as key influencers of service trade. The world trade had moved from the traditional trade model to the contemporary trade models, but this study only talked about the traditional ways of trading.

Van der Marel (2012) investigates the factors influencing comparative advantage in the context of services trade. By employing a panel fixed effects model with data from 23 OECD countries, the research reveals that factors such as trained labor force, institutional quality ICT-related capital stock, and a favorable governing environment are key determinants of comparative advantage in

services trade. This study only focuses on a few of the determinants of modern trade; others, like digital connectivity and infrastructure, are not examined.

Another study by Kandilov and Grennes (2010) investigated the determinants of service exports. This study used the data of 35 exporters and nine importers' countries over the period 2002 to 2004. According to the study findings, the significance of geographic distance varies significantly depending on the kind of service export. While geography plays a significant role in the export of construction services, it has little effect on services linked to computers. Nonetheless, trade across a wide variety of service categories is influenced by the relative quality of legal institutions. Similarly, this study only focuses on traditional trade models. Nowadays, services are delivered digitally to trading partners. There is no need for a person to go personally to a country to provide his/her services; it could be delivered online, for example, consultancy services, financial services, etc.

Shingal (2010) examines numerous factors influencing the trade in services across twenty-five exporting and fifty-three importing nations spanning five years from 1999 to 2003. The primary conclusions drawn by Shingal indicate that factors such as tele density, trade restrictions, and human capital exert significant influence on bilateral services trade.

Nyahoho (2010) delves into the significance of factor intensity in shaping trade patterns across disaggregated service sectors. More precisely, an extraordinary correlation can be observed between the export of ICT services and human capital. Furthermore, it has been observed that sectors including construction services and public works, ICT, and royalties and license fees demonstrate favorable correlations with the strength of R&D. Ceglowski (2006) estimated the gravity model for twenty-eight countries. According to this analysis, geographic and linguistic proximities play a positive and substantial role in establishing the extent of services trade between two countries. Also, the level of merchandised trade has a substantial effect on the service trade.

Similarly, Kimura and Lee (2006) examined how several factors affected bilateral trade in services as opposed to bilateral trade in products. The study's main research question is: What factors influence bilateral services trade in comparison to bilateral goods trade when analyzed employing the gravity model approach? The assessment relies more on the strength of the impact exhibited by the factors, including GDP, population, geographical distance, adjacency, RTAs, and economic

freedom on trade. This paper uses a sample of 467 dyadic export and import pairs of 10 developed countries and their trading partners both within and outside the OECD for the years 1999 and 2000. Analytically, the empirical part of the paper uses the standard gravity model regression with disaggregate equations for the services trade and goods trade to estimate elasticities of key variables of interest simultaneously. The empirical results show that the specialized gravity model is more accurate at predicting services trade than goods trade based on higher adjusted R^2 values. Several studies find geographical distance to have a stronger negative impact on services trade than on goods trade, probably because physical distance significantly affects services or has high transport or communication costs. Finally, another element appears relevant and influential, and even more so if it comes to services: economic freedom. In addition, it is established that being a member of a regional trade pact increases both the service and the goods trade and that the two flows are positively associated. The paper also finds that when nations open up their economies to liberal policies in the area of economic reforms, service trade is likely to be more buoyant than product trade implying the growing importance of the service sector in the world economy. There are important implications of this insight for policy, the major of which is that economic freedom and trade barriers can improve services trade for the better growth of the economy. Research by Barcenilla and Molero (2003) examined the factors that influenced service export flows for 15 European nations between 1976 and 2000. With a coefficient greater than one for eleven of the fifteen countries, their study demonstrated the importance of foreign revenue. Price and exchange rates were found to be important determinants in elucidating services exports, in addition to foreign income.

All the studies theoretically and empirically investigated the effect of different factors on the services trade and found a variety of factors influencing trade in services like skilled labor force, ICT-related capital stock, institutional quality, favorable regulatory environment, human capital, tele density, and trade restrictions.

2.2 Studies Related to the Digital Transformation in Service Trade

Much of the rapid expansion of the service sector can be credited to the development of the digital sector. Emerging digital service forms include digital animation, online audio-visual services, and digital publishing. By removing the limitations linked with face-to-face transactions in the tertiary

sector (services sector), they have improved the tradability of services, accelerated the development of novel service frameworks, and expanded trade models and objectives. Concurrently, the platform economy has decreased costs associated with information exchange and collection, increased trade efficiency and information parity, and lowered transaction costs and barriers. The increased trade opportunities and the growth of developing countries have opened up new service trade markets and created demand for SMEs service trading firms to engage in global trade.

Han et al. (2023) investigated the impact of the DE on service exports. The work focuses on how the digital economy influenced the competitiveness of service exports of 75 countries throughout 2010-2019. To test the link between digitalization and service trade performance, the authors built the Digital Economy Development Index. The study applies a ternary margin decomposition to analyze the effects on total, unit, and category margins of services exports. The outcomes imply robust evidence that the digital economy increases the competitiveness of Services Exports by increasing all three margins. Notably, the relative effect is even stronger for low and middle-income economies and industries with low levels of ICT use, which posit that digitalization enables trade convergence between developed as well as developing countries. To ensure that the results are credible, the authors perform a range of endogeneity tests and replace the core explanation variables that support their findings. One of the major strengths of the paper is the disaggregation of the services exports in the ICT and non-ICT sectors, thereby making it easier to see how the digital economy impacts different industries differently. The policy recommendations of this study focus on upgrading digital assets, fostering digitization, and upgrading, especially in developing countries, to enhance GSE exports. In general, this paper has a good structure with good evidence supported by literature. Still, it could delve more into the interaction between service imports and the development of the digital economy and discuss prospects for differences within countries at different regional levels.

Jiang and Jia (2022) use data from 71 nations from 2005 to 2019 to analyze the effect of digital service levels on DST exports. Their study uses a two-way fixed-effect panel model to assess the impact of digital service levels on international trade using Porter's diamond model to explore the key determinants of DST exports. The study shows that digital service levels increase DST exports

in high-income nations. Such nations take advantage of highly developed laws and infrastructure that favor the provision of cross-border digital services in industries like banking, health, and education. High-income nations have made adjustments to fit into digital trade by reducing barriers in physical trade and establishing widespread digital ecosystems.

According to the research, the main adverse effects of digitalization on middle-income nations are regulatory difficulties, lack of digital skills, and poor infrastructure. Mostly, it is limited only to domestic markets, and the digital gap in most countries restricts them from undertaking full international trade in the field of digital resources.

The research by Jang Jia further reveals that the digitization of DST exports has no significant benefits for low-income nations. Low levels of digital infrastructure and illiteracy, along with incompatible legal frameworks, render such nations unable to take part in digital trade. The restrictions imposed by these limitations further prohibit them from using digitalization to increase economic growth. The study shows that government intervention is greatly needed to address these disparities. Governments of mid and low-income countries need to invest more in digital infrastructure and education to bridge the digital divide. Regulatory reforms and international cooperation are highly essential to develop a conducive environment for digital trade. This process could be assisted by the high-income nations with technical assistance and knowledge exchange.

To guarantee that all nations may profit from digital trade and close the digital divide, the study emphasizes the significance of inclusive global policy. Broadening the research scope to include the diversification of exports of services, Gnangnon (2020) investigates the "Effect of the Internet on Services Export Diversification", focused on the impact of the Internet on services export diversification across 131 countries (1995-2014). This paper's aim is, therefore, to investigate and confirm internet access's empirical relationship with services export diversification and analyze how dimensions such as innovation, merchandise exports, FDI, and export product concentration moderate the relationship. Analytically, it deploys a dynamic panel dataset and applies a two-step Generalized Method of Moments (GMM) to overcome endogeneity and persistence in exporting behavior. Based on the theoretical context, the foreign trade theories were taken as a framework of analysis, in which ICT, innovation, and trade openness occupied a central place. The control variables are the level of internet connection (main independent variable), real per capita income,

trade integration, population, financial market, and governance. The dependent variables instrument services export diversification using Herfindahl and Theil indices. In an empirical analysis, the results show that increased Internet use enhances diversification in service exports strongly and more so in LDCs. Innovation and trade openness are revealed as two key influences that help to enhance this impact. The primary conclusion sums up the need for improved digital environments and corresponding policies: it is crucial to achieve the potential of internet connectivity for the promotion of international trade in services, especially in developing countries.

S. K. Gnangnon and Iyer (2018) investigated the correlation between the availability of Internet connection and a country's engagement in the global services trade market. Using a data set covering 175 countries for the period 2000–2013, the paper also introduces the concept of 'Internet Distance,' which compares a country's internet usage against the global average. The main prediction here is that narrowing this internet–related gap is crucial for countries, especially those located far afield from markets, to participate in the trade of CS. According to the analysis of the paper, the result indicates that reducing the internet distance has a positive effect on to export of the services sector for the countries under analysis, particularly on the developed Countries with higher Gross Domestic Product per capita. Further, the research also shows that information technology has a positive influence on international trade by overcoming geographical barriers to trade integration. To avoid endogeneity, the authors employ fixed effects, feasible generalized least squares (FGLS), and system GMM estimators. Although, as a significant contribution to existing literature, the paper points to the importance of examining the internet's role in the reduction of barriers to trade in services, the choice of the aggregate measure of internet usage might fail to capture specific country peculiarities of digital infrastructure development. The paper also offers policy implications regarding the optimization of the digital environment that might help decrease trade costs and bring more developing countries into the global market. However, more could have been said about the within-country digital divide and the possible contribution of national regulations on the likely effects of the Internet on trade could have been done. In general, the paper is a valuable contribution to the existing body of knowledge that focuses on the digital economy and international trade.

The study by Wang and Li (2017), titled "ICT's effect on trade: Perspective of comparative advantage," delves into the influence of ICT on commerce from the perspective of comparative advantage. According to the research, when policy recommendation is utilized to bring down transaction costs, then comparative advantages are formed and thus facilitate the growth of the international business. The Chinese government, through its various agencies, has developed several policies to enhance the fast growth of cross-border e-commerce to enhance the flow of international trade in China. However, prior theoretical and empirical literature has not quantified the marginal effect of these policies on international trade growth despite analyzing the role of cross-border B2C E-Commerce on trade distance and consumers' welfare. To fill this research gap, the paper analyses the implications of cross-border e-commerce for China's international trade using the theoretical framework of TCE complemented by the traditional comparative advantage model. Information costs, negotiation costs, transportation cost, tariffs, and middlemen costs have been discussed here with a detailed analysis. The study shows the conditions under which e-commerce can enhance cross-border trade, for negative impacts of tariff and transport costs are controlled. Cross-border e-commerce was found to have a positive impact on the growth of China's international trade annually, and this positive impact does not have an annual increment. it may maybe because of the weak implementation of the beneficial trade policies and contraction of the global trade

Another study, Information and Communications Technology and Trade in Emerging Market Economies, written by Liu and Nath (2013) analyzes how ICT influences the international trade flows of EMEs. Using a panel dataset of forty EMEs from 1995 to 2010, the authors analyze the effects of ICT infrastructure and usage on exports and imports, employing four key ICT indicators: The four variables to measure telecom investment growth include international Internet bandwidth, Internet subscription per 100 people, Internet hosts per 100 people. Therefore, this study discovers that ICT use, internet subscriptions, and internet hosts positively affect export and import in EMEs. This paper recommended the fact that not only ICT infrastructure but also ICT technologies seem to fuel trade growth in these economies. This fact explains the need for policies that support the ICT agenda that is pivotal to enhancing International Trade. It is also clear from the analysis that ICT has an even greater impact on goods exports as opposed to services exports might be due to the type of service exported by these countries. The paper's empirical analysis is sound, with the

author using fixed-effects models and sensitivity analysis to control endogeneity issues with the use of lagged dependent variables and GMM. The analysis shows that the growth of ICT usage lowers the costs of transactions by improving information collection, analysis, and transfer within the international business environment. Altogether, the paper has a significant research contribution to existing literature, owing to the chosen aspect of trade trade-enhancing role of ICT in EMEs. However, it could further the heterogeneity of ICT effects of varied sectors and the impact of digital policies on the enhancement of usage of ICT in trade. Furthermore, the use of total trade, which has been adopted into the study, can be further supported by the analysis of bilateral trade for a deeper understanding of the effects of ICT.

Similarly, an investigation into the connection between internet use and foreign service commerce was carried out by Choi (2010). The results showed that a country's trade in services rises by about 2 to 4 percent for every doubling of its internet usage. This implies that increased levels of service commerce between nations are directly correlated with better internet access. The report highlights how improved communication, speedier transactions, and increased connectivity with international markets are made possible by growing internet infrastructure, which eventually boosts trade in several service industries, including healthcare, education, and banking.

Because it makes it simpler for service providers to connect with clients around the world, the Internet is essential in lowering trade barriers. Online marketing, digital platforms, and virtual interactions are now crucial tools for companies looking to reach a wider audience. According to Choi's research, nations with high internet penetration rates are better equipped to do cross-border business, especially when it comes to digital services. Businesses find it more appealing to operate internationally due to the simplicity of remote service delivery, which lowers expenses and boosts productivity.

The study also emphasizes how crucial it is for governments to implement laws that support digital literacy and internet accessibility. Because companies may use digital tools to enhance their operations and offer their services internationally, nations that make investments in internet infrastructure are likely to see growth in their service industries. For example, the growth in internet usage has greatly helped sectors like online education, consultancy, and information technology.

Increasing internet connectivity can help poor nations increase their service exports, according to

Choi's research. These nations can engage more actively in international trade by enhancing their digital connectedness, getting beyond long-standing obstacles like geographic remoteness and expensive transit. According to the study, digital trade has the potential to revolutionize economies that are prepared to adopt new technologies and foster an atmosphere that is conducive to digital enterprises. This research shows how digital connectivity can improve international trade and recommends that to promote economic growth, policymakers should give internet infrastructure investments a top priority. In the end, expanding internet access benefits both established and developing economies by improving communication and opening up new avenues for companies to trade services across borders.

Freund and Weinhold (2002) analyzed the effects of the Internet on international service commerce. The findings explain the role that the Internet plays in global trade and present new opportunities to companies tapping into local and foreign markets. The survey reported that the Internet served as a means of linking other country buyers with sellers, facilitating transactions, and developing networks. This research shows actual proof that an increase in global internet-related variables does have a big effect on US service trade. For instance, in this study, it was observed that if such factors increased by 10%, then the US service exports would increase by 1.7%, and service imports would also increase by 1.1%. This means that the Internet increases the ability of firms to link with global buyers and suppliers; hence, total trade activity increases. The results study indicate how crucial internet access is to nations that aim to develop their service industries through international trade. The fact that the Internet reduces most communication problems and can reduce transaction costs allows firms to produce services more efficiently as well as access a greater global marketplace. The areas most reliant on digital communication - such as consulting, education, and banking - have benefited the most from the new digital paradigm.

From the review, it is observed, DST exports cannot be promoted solely based on digitization. A nation needs the right workforce, legislation, and infrastructure to exploit the potential of digital trade. There is a dire need for middle- and low-income countries to have more targeted approaches so that they may bridge the digital divide and innovate further.

Several studies have explored measuring indicators of DED and analyzing the influence of DE on the magnitude of service freight. These studies always suggest a positive association between DE and the expansion of service trades. Nonetheless, current research exhibits certain limitations that need to be addressed. In addressing the prevailing research objectives, prior studies have concentrated on individual nations like China, the US, or members of the OECD, thereby lacking a holistic viewpoint. The gap also exists in assessing the effectiveness of digital policies, understanding barriers to digital adoption, and analyzing services export challenges and opportunities. There are skill gaps through education and training programs, examine market access issues, and evaluate the state of digital infrastructure and connectivity. Understanding the impact of e-commerce, entrepreneurship, data privacy, and the socioeconomic implications of the digital economy is much needed. To bridge this void, this research thoroughly examines the various aspects to offer a more comprehensive analysis as it will develop an enhanced and all-encompassing DE measurement system to investigate the outcomes of the DE on services trade, with a particular emphasis on the economy of Pakistan.

CHAPTER 3

PAKISTAN's ECONOMIC PILLAR: SERVICES

3.1 Current Scenario of Services Sector in Pakistan

This chapter explores how policies and institutional frameworks shape the services trade sector of Pakistan. The review is done to assess the barriers and opportunities that facilitate services trade of Pakistan. Likewise, an analysis of global service export trends is necessary to comprehend Pakistan's situation. With over $1 trillion in 2023, the United States is the greatest exporter of services, according to data from the TINA Trade in Services database maintained by the United Nations ESCAP. With $584 billion, the UK comes in second, while India, a neighbor, recorded $336 billion. In contrast, Pakistan's 2023 service exports were $7.5 billion. The State Bank of Pakistan has divided service trade into eleven categories[4]International agreements and frameworks facilitate it, with the GATS founded by the WTO serving as a key framework for member countries to liberalize trade in services.

Cross-border trade (Mode 1)[5], in which foreign organizations request services from Pakistani providers without having to be physically present, is probably how the majority of Pakistan's service exports are carried out. This emphasizes how crucial telecommunications are as a service delivery channel. Even though Pakistan's service exports increased by an average of 6% between 2019 and 2023, the nation's market share has not increased. Pakistan's ICT sector exports, on the other hand, have grown by 20% on average every year over this time, while its share of the global market has only climbed by 0.25%. In contrast, India reported exporting more than $250 billion worth of ICT and other business-related services in 2023, with an annual growth rate of 14% and an 8% gain in market share. Although cross-border trade is the main way that India exports its

[4] The 11 categories of service trade according to the SBP division include Telecommunications, computer and information services, other business services, personal, cultural, and recreational services, government goods and services, maintenance and repair services, transportation, travel, construction, insurance and pension services, financial services, and fees for the use of the intellectual property.

[5] Mode 1 is one of the classifications of the mode of service supply by WTO under the GATS agreement. It refers to the supply of a service from one country to another without the need for the service provider to be physically present in the country of consumption.

services, foreign commercial involvement in the services industry has grown in significance as FDI has surged recently.

Similarly, if we look at China's position, a considerable amount of China's services is provided through the presence of foreign business companies, despite the fact that its service exports are not as substantial as its product exports. This makes it possible for China to control and limit service flows inside its boundaries, something that smaller, unofficial entities engaged in cross-border trade could find more challenging. The ICT industry in China has also done well, expanding at a rate of 14% a year on average during 2019 and 2023.

This is how globally the services sector's contribution to the GDP has increased over time. It is evident from the data that the services sector's share of the GDP increased over time, reaching 59.9% in 2017. Additionally, the services sector accounts for 34.2% of the total employment (WDI, 2017). In 2022, the service sector was still a highly contributing sector to the GDP. The service sector showed a growth of 6.2% in 2022 (Pakistan Economic Survey, 2022-23). The services sector exhibits a higher growth rate compared to both the industry and agriculture sectors. As to the World Bank, Pakistan's services export stands at 6,544,020,000 in BOP, current US$, while its services import amounts to 10,587,126,000 in BOP, current US$. Pakistan's exports as a proportion of its GDP amount to 9.06%, while its imports as a proportion of GDP stand at 17.99%.

3.2 Digital Economy and the Service Exports of Pakistan

The digital transformation[6] has impacted several sectors of Pakistan's economy, including transport, finance, education, healthcare, agriculture, and manufacturing. Firms that have invested in digital technologies, including cloud computing, big data, and artificial intelligence, have shown heightened growth rates in their information technology exports. Initiatives like the Digital Silk Road between China and Pakistan have promoted e-commerce and business opportunities. Chinese investments and technological advancements have contributed to the growth of Pakistan's digital economy.

[6] Digital transformation is the integration of digital technology to alter services or businesses, such as replacing manual procedures with digital ones or modernizing old technology.

The services sector contributes 61.5% to Pakistan's GDP and is experiencing significant growth due to digitization, creating new trade opportunities. Jobs in professional services, particularly freelancing, are dynamic, with Pakistan ranking among the top ten fastest-growing freelance markets globally with 47 percent growth. Most Pakistani freelancers are software developers, representing a significant share of global freelance developers (10.5 percent). Pakistan is also recognized as the fourth-largest supplier of freelancing services. The country's digital space is active with social enterprises engaging in various digital activities.

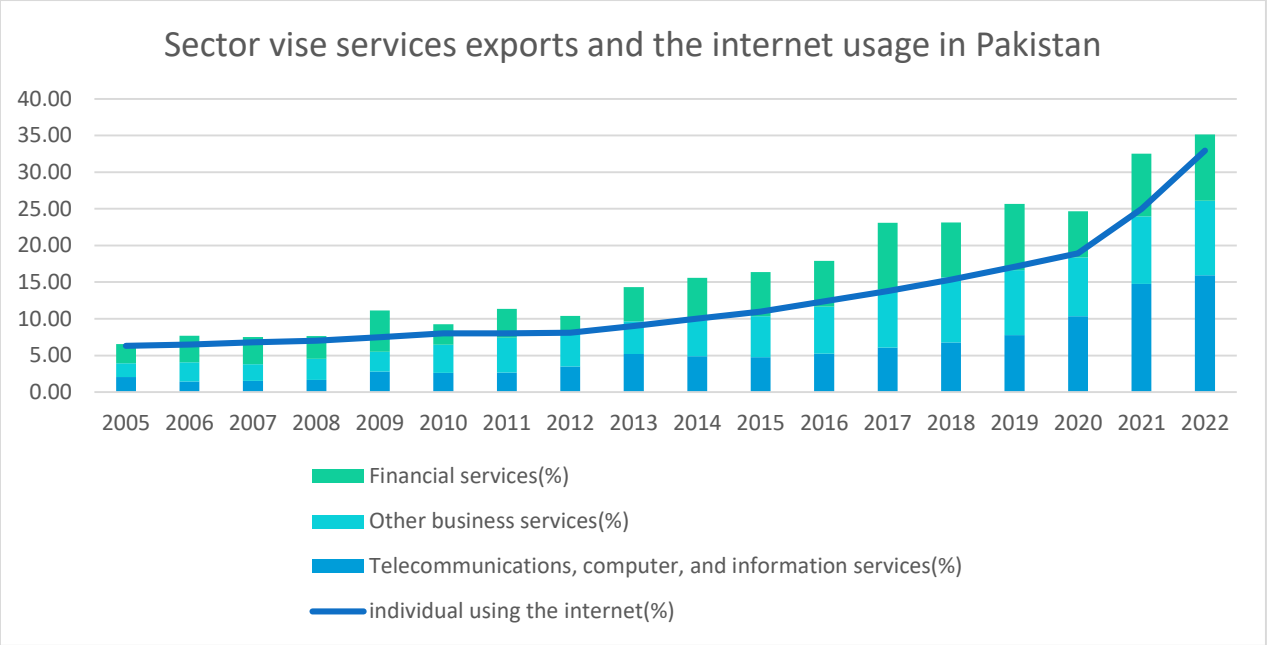

Figure 3. 1: Service exports and Internet usage in Pakistan

Source: International Trade Centre

Similarly, the ICT services sector in Pakistan has shown an average annual growth of 10.8% from 2010 to 2019. Computer services have experienced substantial growth in their proportion of total ICT services, with an average yearly increase of 17%. Pakistan exports more than 50% of its ICT services to the US, with the UK, United Arab Emirates, and Canada being the next largest importers. Despite these significant exports, there remains substantial potential for intra-regional trade within the region.

The launch of 3G and 4G technology indeed gave a significant boost to the digital economy[7]. The deployment of fiber optic and wireless internet infrastructure, because of the introduction of 3G and fixed 4G services, played a crucial role in strengthening the economies. Research has shown that mobile technology upgrades, including 2G, 3G, and 4G, have generated additional returns and have been drivers of GDP growth. According to research, a 10% increase in mobile adoption rates might result in a 0.5%–1.2% boost in GDP, as was the case between 2000 and 2017. By enabling economical and effective transactions for people, companies, and governments, mobile technology and digital finance are becoming important drivers of GDP growth in developing nations like Pakistan. By 2025, the widespread use of digital finance in developing countries could increase GDP by $3.7 trillion and create up to 95 million new jobs across a range of industries.

Giving small businesses and billions of unbanked individuals access to financial services through mobile technologies is another aspect of this revolutionary potential that would foster social progress and economic prosperity. Digitalization is expected to increase Pakistan's GDP per capita by three to five percent during the next three years. Technological advancements, including mobile internet, cloud computing, artificial intelligence (AI), big data, fintech, IoT, advanced robotics, and additive manufacturing, have a lot to offer Pakistani businesses.

Pakistan's efforts at digital transformation are seen in the rapid growth of its IT exports and technology start-ups. Government rules, central bank programs, readily available expertise, and the pandemic effects have all contributed to these businesses' recent notable growth. IT exports, which primarily consist of software services, grew from $0.29 billion in FY13 to $2.1 billion in FY22, making them a substantial contributor to foreign exchange earnings.

Additionally, the ecosystem of tech start-ups has expanded dramatically, with foreign investors driving the funding and transaction counts that increased from $37.5 million and 29 deals in 2019 to $347.4 million and 70 deals in 2022. This upward trend reflects the growing confidence and enthusiasm in Pakistan's emerging technology sector, even though it still lags behind several of its regional rivals like India and China in telecom measures.

.

[7] The digital economy includes the economic activities that develop from connecting persons, businesses, devices, data, and processes using digital technologies.

To guarantee steady export growth, Pakistan must offer its service exporters—including freelancers and IT companies—stable and dependable internet connectivity. ICT companies will be able to use more effective digital tools and provide higher-quality services with faster and more dependable internet support. Pakistan's average mobile broadband speed is ranked 101st out of 111 countries, while its fixed broadband speed is ranked 145th out of 162 countries in the Speedtest Global Index. India's speed of mobile internet is ranked 16th in the world, while the United Arab Emirates leads the globe in both media. Major cities in Pakistan, such as Lahore and Karachi, have low internet speeds, which puts information and communication technologies exporters at a serious disadvantage.

3.3 Digital Policies of Pakistan: An Overview

Between 2018 and 2021, Pakistan implemented significant digital policies to support economic growth, foster innovation, and improve connectivity. These tactics strongly emphasized the need for digital transformation to reach sustainable development objectives and improve citizen services.

3.3.1 Digital Pakistan Policy 2018

To enable the nation to take advantage of the potential presented by the digital age, the Digital Pakistan Policy of 2018 established a comprehensive framework. Increasing the availability of broadband, boosting IT exports, and promoting entrepreneurship and innovation were among the top priorities. Digital inclusion and economic prosperity were made possible by this strategy's emphasis on cybersecurity, IT education, and e-governance. It also underlined the importance of international cooperation and private-sector involvement.

The strategy places a strong emphasis on working with stakeholders, developing smart cities, and promoting IT-driven solutions to use technology to address local issues. It expects the development of a comprehensive digital ecosystem that combines cutting-edge apps, content, and technology to establish Pakistan as a major player in the global digital revolution. The approach emphasizes the creation of a knowledge-based economy through the use of digital tools to accelerate socioeconomic advancement (Digital Pakistan strategy, Ministry of IT and Telecom 2018).

3.3.2 Digital Pakistan Vision 2021

Building on the 2018 policy, the Digital Pakistan Vision of 2021 sought to drive digital transformation in all industries. This vision extended to incorporate digital payments, e-commerce innovation, and financial inclusion. It emphasized the integration of digital technologies with education, healthcare, and government. The 2021 project prioritized skill development, digital literacy, and bridging the digital divide to empower underserved areas.

Both initiatives show Pakistan's commitment to responding to a quickly changing global digital landscape, promoting inclusive growth, and harnessing technology to boost global competitiveness.

3.4 Pakistan’s Free Trade Agreement with China and GATs

Examining Pakistan's and India's pledges under the General Agreement on Trade in Services (GATS) reveals variations in market access restrictions. Although Pakistan's system is easier and more comprehensive than India's, it's important to enable the flow of temporary skilled labor, such as executives and professionals, to increase service exports. While India includes more specific classifications like business visitors, intra-corporate transferees, and professionals, Pakistan's GATS obligations center on the temporary admission of executives and professionals. Nonetheless, Pakistan's Free Trade Agreement (FTA) with China provides more categories and flexibility, including business visitors, service salespeople, and experts not included under GATS. Compared to its FTA with China, Pakistan's GATS obligations are more limited. Under GATS, WTO members have commitments and particular commitments to services trade, just as with goods trade. Pakistan notably permits foreign equity involvement on a case-by-case basis instead of under clear rules and legislation. Developed nations and more recent trade agreements also progressively include compliance requirements, existing wage standards, and policies to limit the replacement of local labor, which could restrict market access.

3.5 Services Trade in Developing Nations and the Role of WTO

The WTO plays an important part in facilitating the adoption of digital services and promoting trade in developing countries through its agendas, advocacy, and capacity-building initiatives. Its efforts are reflected in governing digital trade for liberalizing digital services and Information

Technology by encouraging digital infrastructure and technology transfer. E-commerce issues are also covered in its programs, focusing on data flows, cybersecurity, and efforts to integrate developing countries into the digital economy. The WTO usually supports capacity-building programs (e.g., Enhanced Integrating Training [2019-2022]), the Aid for Trade initiative, and digital trade facilitation tools under the Trade Facilitation Agreement8. It also tries to help developing countries by reducing trade barriers and providing special provisions in trade agreements. Harmonizing standards in digital services to connect firms with global value chains is also a trait offered by the WTO. Similarly, the WTO collaborates with international organizations (World Bank, International Telecommunication Unit) to improve infrastructure, digital skills, and affordable access for SMEs and marginalized groups in developing countries.

As reported in WTO (2023), Digitalization is transforming communication, production, governance, and trade by driving growth, lowering costs, developing innovation, and promoting inclusivity. Cross-border digital services are considered the fastest-growing part of international trade. It has a growth rate of 8.1% annually (2005–2022), surpassing goods and other services exports, reaching 54% of total services exports. While developed economies dominate this sector with the support of WTO, growth is obvious in some developing countries. Although the least developed countries still lag behind.

Digital trade's success depends on fast, affordable digital infrastructure and skills, but one-third of the global population, mostly in low-income economies, remain disconnected. High tariffs on ICT equipment, restrictions on enabling services, and inadequate competition in telecoms hinder growth. Governments must create enabling regulatory environments to build trust, support cross-border transactions, and encourage a competitive environment. Improved digital connectivity and effective policies significantly reduce trade costs and facilitate sustainable digital trade (WTO, 2023).

To summarize, the services sector has emerged as a critical economic pillar for Pakistan, contributing significantly to its GDP and export revenue. Despite obstacles such as trade deficits in services and reliance on conventional sectors like transportation and travel, possibilities for growth exist in IT services and business process outsourcing. In recent years, Pakistan's service

[8] entered into force on 22 February 2017

exports have increased but are still overshadowed by imports.

Participating in Free Trade Agreements (FTAs) can improve market access for Pakistani service providers. However, current FTAs must be used more efficiently to enhance exports. The World Trade Organization (WTO) also plays an important role through frameworks such as GATS (General Agreement on Trade in Services), which establishes rules for lowering trade barriers and increasing transparency.

CHAPTER 4

METHODOLOGY

This chapter covers the econometric models to achieve our objectives and a review of relevant theories. To achieve our first objective, this study used the Entropy weight calculating method, and for the second objective ARDL methodology is followed. Then, the theoretical framework and relevant theories are discussed.

This research covers the following quantitative and qualitative aspects.

- A comprehensive literature review of prior studies on the digital economy and services exports, determinants of services exports, and the specific case of Pakistan.
- Brief review of existing policies and regulations related to the DE and services trade in Pakistan.
- For a quantitative study, the collection of data on the digital economy and services exports in Pakistan is measured. An index is developed by the Entropy method. The comparison of PCA and Entropy method was studied, and Entropy is more suitable due to its data dimensionality and assigning weights to each indicator separately.
- The ARDL estimation technique is employed to analyze the collected data to identify the determinants of service trade. This study also analyzes the impact of the digital economy on service trade.
- Conducted visits to interview relevant ministries with service experts to gather more detailed information. These interviews let this study analyze more deeply the challenges and opportunities faced by the digital economy and services exports in Pakistan.

4.1 Economic Theories

Early economists viewed services as non-tradable, with a focus primarily on goods trade. This perception persisted for decades after GATT was established. The emergence of new trade theories challenged traditional views, emphasizing the importance of firms rather than sectors in understanding services trade.

4.1.1 Poter's Theory of International Competitiveness Advantage

Michael Porter's theory (1979) of international competitiveness advantage, as outlined in his work "The Competitive Advantage of Nations," focuses on the concept that a nation's competitiveness in an industry is influenced by numerous factors. Four essential characteristics make up the "diamond" of national advantage, which is the center of Porter's thesis.

According to Porter's thesis, four key characteristics work together to create a national climate that is conducive to the formation of businesses, the growth of competitive capabilities, and the attainment of international leadership. The theory underscores how important sector-specific factors, strategic investment, and innovation are in identifying a country's competitive advantage in a certain industry. To maintain a competitive edge in the global market, Porter also highlights the critical role that governments and businesses play in promoting innovation, improving factors and demand circumstances, and supporting local demand.

4.1.2 New Trade Theory and Services Trade

Frameworks that highlighted increasing returns to scale and network effects in international trade were introduced by the introduction of new trade theory in the 1970s and 1980s, which was followed by the development of the New New Trade Theory (NNTT) in the 21st century. By showing how increasing returns could improve trade among similar countries, regardless of their production levels or resource endowments, these ideas challenged the widely held notion that returns to scale are constant. The NNTT highlighted the critical role that businesses play in global commerce, focusing on economies of scale, specialization, and niche markets as critical elements that enable the exchange of services between countries.

4.1.3 Trade in Intermediate Products

An important development in services trade theory is the increasing significance of trade in intermediary items and services, propelled by declining trade costs and advancements in information and communication technology. This change has produced activities such as outsourcing, vertical specialization, global value chains, and global sourcing, thereby transforming the structure of international trade and globalization. The focus is shifting towards digitalization, which has become a crucial factor influencing global trade.

In essence, the most relevant theory is Poter’s Theory of International competitiveness because Porter's theory emphasizes that a country's competitiveness is dependent on its ability to develop and improve its industries. This is consistent with how developments in digital technology might drive innovation in Pakistan's services sector, thereby increasing its competitiveness for export.

4.2 Measuring the Digital Economy

The study measures a comprehensive digital economy development index based on the Digital Opportunity Index (DOI), established by the ITU, as a principal metric to assess digital accessibility and connection because of the limited data of the index as the study is using the data from 1993 to 2023The DOI includes essential aspects such as digital access, utilization, and affordability. The current measurement is based on ten universally acknowledged and accepted fundamental ICT indicators. These indicators encompass measurements related to mobile and fixed telecommunications coverage, the cost-efficiency of ICT services, usage intensity, and their socio-economic effects. The study will also include the IDI, released by the ITU, to facilitate a comprehensive review of the digital environment. The IDI evaluates ten indicators within three dimensions: infrastructure, research and innovation, and skills application, establishing an ICT assessment framework. The study added and eliminated some of the indicators due to the data limitation. The entropy approach is employed for weighted index calculation, yielding scores from 0 to 1 to fully evaluate digital opportunities and connectivity fully, ensuring precision and objectivity.

DOI is an internationally agreed ICT index that is considered a composite metric to assess countries' access to and use of ICT. It is based on 11 ICT indicators, which are grouped in 3 clusters: opportunity, utilization, and infrastructure. ITU released the Digital Opportunity Index (DOI) for three years, from 2005 to 2007. The DOI measured the opportunity for individuals in different countries to benefit from access to ICT. It was later replaced by more comprehensive indices, such as the ICT Development Index (IDI). In 2009, the ITU introduced the ICT Development Index (IDI), which expanded upon the DOI by incorporating additional indicators to provide a more comprehensive assessment of ICT development across countries.

The ICT Development Index is a complex indicator that was first developed in 2009 by ITU. It aims to measure the development of the ICT sector. The Index was based on 11 indicators, which

was successfully released till 2016. But these 11 indicators were soon considered outdated. In 2017, it was proposed to include 14 indicators instead of 11 indicators, but due to the data availability and data quality issues, the revised index was not released. After that, several attempts were made between 2019 and 2020 to release fully new indicators-based index but did not achieve consensus. In 2022, a new methodology was proposed based on the concept of universal and meaningful connectivity. It was approved in 2023, and a new version of the index was released at the end of the year 2023. The results of the earlier version and the results obtained from the new methodology are not comparable because of the different methodologies. This new methodology will remain valid for four years.

Table 4. 1: Construction of the Digital Economy Development Index

Total index	**Sub index**	**Third-level indicators**
DEDI	Infrastructure investment	Fixed telephone subscriptions (per 100 people)
		Power supply (percentage of population)
		Secure internet server (per million people)
	R&D & skill environment	Patent applications (nonresidents)
		Patent applications (residents)
		School enrollment, secondary (% gross)
		School enrollment, tertiary (% gross)
	Degree of application	Individuals using the internet (% of population)
		Fixed broadband subscriptions (per 100 people)
		Mobile cellular subscriptions (per 100 people)

4.3 Entropy Method

The entropy weight method was proposed by Shannon and Weaver in 1947, and in 1982, Zeleny made several further developments in this method. The Entropy Weight Method is employed to

determine the objective weights of various responses. This method utilizes probability theory to assess the uncertain information (entropy), enabling it to evaluate the significance of each response without incorporating the preferences of the decision maker. This method is based on the principle that indicators with higher weights provide more valuable information than those with lower weights (Kumar et al., 2021).

The entropy method is remarked for its superior accuracy relative to PCA, especially as the dimensionality of the dataset increases, which results in more accurate entropy measurements. This method's capacity to remove human bias in indicator weight assignment, which enhances the objectivity of evaluation results, is a significant benefit over subjective weighting methods. As a result, in recent years, the Entropy Method has become increasingly popular in decision-making processes (Wu & Wang, 2022).

There are certain disadvantages to this approach. One key drawback is that the Entropy Weight Method's computations may be affected if a dataset has a large number of zero values. Since zero values don't add to the overall variability or differentiation of the data, they may skew the results. As a result, the actual relationships between variables might not be adequately represented by the standardization procedure.

This distortion means the resulting weights (or index weights) assigned to certain indicators might be disproportionately high, even if those indicators do not vary much. In other words, an indicator might receive a high weight in the final index despite not providing significant information or differentiation among responses. Secondly focuses solely on the numerical differences between indices and does not take into account their ranking or order (Zhu, Tian, & Yan, 2020).

The procedure commences with the formulation of objectives via a decision matrix, succeeded by the computations of the normalized decision matrix. It then assesses the probability of each attribute or response occurring, calculates the entropy value for each attribute, and determines the degree of divergence (average information contained) for each response. Finally, it computes the entropy weights based on these evaluations. The following are the steps included in this method to compute the weights (Kumar et al., 2021).

***Step 1*:** Normalization of the choice matrix arrays (performance indices) to derive project outcomes Pij

$$P_{ij} = {X_{ij}}\Big/{\sum_{j=1}^{n} X_{ij}} \quad \textbf{(4.1)}$$

Here, X is the matrix of all indicators.

Step 2: Calculation of the entropy metric for project results utilizing the subsequent equation

$$E_i = -\frac{\sum_{j=1}^{n} P_{ij} ln p_{ij}}{ln(n)} \quad \textbf{(4.2)}$$

Step 3: The index series calculations are based on the entropy weights.

$$W_i = \frac{1-E_i}{\sum_{i=1}^{n}(1-E_i)} \quad \textbf{(4.3)}$$

Step 4: Based on the entropy weights, calculations of the index series.

$$index = X_1W_1 + X_2W_2 + X_3W_3 \ldots\ldots\ldots\ldots + X_nW_n \quad \textbf{(4.4)}$$

4.4 Theoretical Background

This section discusses the variables used in conducting this study and the theoretical basis of the ARDL model.

4.4.1 Digital Economy Development Index

In the DEI, digital technology infrastructure, its application, R&D, and skill environment metrics are used. These elements facilitate and promote the trade of a country (Li et al., 2023). This implies that the development of DE in any country can significantly boost service exports. Investments in digital infrastructure, including broadband internet, data centers, and international bandwidth, reduce geographical barriers and enhance accessibility for global trade. This connectivity enables businesses to deliver services digitally, including IT, financial, and educational services, to international markets efficiently. High-quality digital infrastructure enables speedier communication, more efficient procedures, and automation. This lowers transaction costs and improves service delivery efficiency, increasing export competitiveness on a worldwide scale (Di et al., 2022).

4.4.2 Financial Depth (M2/GDP)

This ratio sheds light on the economy's liquidity for both investment and consumption. The advancement of the financial sector is a fundamental factor influencing the export supply. It positively impacts a country's exports. For example, the firms that can access affordable financing are better positioned to meet their working capital requirements, including trade financing, and to invest in technological advancements and innovative activities. Consequently, these firms are more capable of exporting or increasing their export volumes. Underdeveloped financial markets adversely affect trade (Sahoo & Dash, 2014).

4.4.3 Domestic Credit to Private Sector by Banks

Increased access to credit from banks and other financial institutions for the private sector suggests greater opportunities for business expansion and development. A well-developed financial system facilitates the export of services by alleviating financial constraints (Becker and Greenberg, 2003).

4.4.4 REER

ReeR is a measure that represents the value of a country's currency compared to a weighted average of several currencies adjusted for inflation differences. It indicates a nation's international competitiveness by reflecting how changes in exchange rates and relative price levels affect the purchasing power of the currency. When the Real Effective Exchange Rate appreciates or rises, it reduces the competitiveness of domestic exports in international markets, leading to a decline in export demand. This means that there is a negative nexus between ReeR services exports of a country and vice versa (Sahoo et al., 2015).

4.5 Methodology for Measuring the Impact of Digital Economy on Services Export

Granger (1981) and Engle and Granger (1987) were the first to introduce the concept of cointegration and gave estimation techniques and tests to assess the existence of long-run relationships among variables. Their seminal work laid the groundwork for comprehending how non-stationary time series might be linked by a stable, long-term equilibrium, giving researchers the means to more thoroughly examine these connections. To investigate the dynamic interactions between the variables, this study utilized time series data from 1993 to 2023 using the ARDL model. The ARDL model, which was first presented by Pesaran, Shin, & Smith (2001), is especially useful for examining situations in which the dependent variable is affected by both the

current and lagged values of one or more independent variables, as well as by its own lagged values.

The ARDL model enables researchers to identify both short-term and long-term effects. ARDL can be utilized even when the variables are integrated at varying levels, notably I0 (stationary) and I1 (non-stationary). The ARDL model may manage a combination of stationary and non-stationary variables; however, it is incapable of accommodating variables that necessitate a second difference to attain stationarity.

To explore the effects of the DE on the service exports of Pakistan, we used the following model referencing (Han et al., 2023). Although there are various models that are estimated in literature, like Standard Gravity Models, Revealed Comparative Advantage, etc., this is the most relevant model in literature. This study included two variables: Domestic credit to the private sector and financial depth from (dash, 2015) as the indicators of financial development.

Firstly, Common Factor Analysis is performed and finds that ARDL (1) is the appropriate model (equation 4.5). Hence started with the Generalized Unrestricted Model (GUM) ARDL (1) and applied restrictions on the insignificant parameters.

$$\boldsymbol{Serexp_t = \beta_0 + \beta_1 Serexp_{t-1} + \beta_2 DEDI_t + \beta_3 DEDI_{t-1} + \beta_4 ReeR_t + \beta_5 ReeR_{t-1} + \beta_6 DCr_t + \beta_7 DCr_{t-1} + \beta_8 Fin\_depth_t + \beta_9 Fin\_depth_{t-1} + \mu_t} \quad \textbf{(4.5)}$$

GUM is an ARDL (1). After excluding the insignificant parameters, equation 4.6 represents a parsimonious model (1,0,1,0,1) (restricted) subject to residual analysis.

$$\boldsymbol{Serexp_t = \beta_0 + \beta_1 Serexp_{t-1} + \beta_2 DEDI_t + \beta_3 ReeR_{t-1} + \beta_4 DCr_t + \beta_5 Fin\_depth_{t-1} + \mu_t} \quad \textbf{(4.6)}$$

$Serexp_t$ = Services Exports of Pakistan in current $US

$Digindex_t$ = Digital Economy Development Index

$ReeR_t$ = Real Effective Exchange Rate

DCr_t = Domestic Credit to Private sector by bank (% of GDP)

Fin_Depth_t = Financial Depth is calculated as M2/GDP

In equation 4.5, delta shows the first difference estimators, *l'* shows the optimal lag length, β's are the parameters, and μ is the error term. The equation indicates that the Service exports of Pakistan measured in the current $US, are the dependent variable, which is affected by the digital economy, exchange rate, domestic credit to private sectors by banks, and financial depth (regressors).

Initially, the F-test is conducted to assess the existence of a long-term relationship among the variables. The calculated F-statistics are then compared to the critical values established by (Pesaran et al., 2001). If the computed F-statistics falls outside the lower upper bounds of these critical values, it indicates the cointegration between the variables. Additionally, the Akaike Information Criterion (AIC) is utilized to determine the optimal lag order, as a lower AIC suggests the most suitable lag length. To examine the long-run relationship, we propose two hypotheses. The null hypothesis, which asserts the absence of long-run relationships, is expressed as.

$H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

This suggests that the variables do not have a long-term relationship. Conversely, the alternative hypothesis is formulated as:

H_1: At least one beta is significantly different from zero

This suggests that the variables do not have a long-term relationship.

4.6 Data Sources

This study utilized data on services exports for Pakistan over the period of 1993-2022. The statistics on exports of services are sourced from the WDI. The data for the DEDI and other variables are taken from the WB database and the ITU database.

CHAPTER 5

RESULTS AND DISCUSSION

This chapter demonstrates the main results of the quantitative and qualitative analysis. The quantitative analysis calculates DEDI and explores the effect of the digital economy on the services exports of Pakistan. It examines short-term and long-term cointegration by applying the ARDL technique. The necessary unit root, correlation, and stability tests are also reported. The qualitative analysis explores various aspects of the services exports of Pakistan.

5.1 Quantitative Analysis

The first aspect of the study is to calculate the digital economy development index as explained in the previous chapter and assigning weights to components of the index.

Table 5. 1: Digital Economy Development Index weights

	Weights (indicators)	**Weights(sub-indices)**
Infrastructure investment		0.388
Fixed telephone subscriptions (per 100 people)	0.014	
Power supply (percentage of population)	0.001	
Secure internet server (per million people)	0.372	
R&D & skill environment		0.116
Patent applications (nonresidents)	0.014	
Patent applications (residents)	0.091	
School enrolment, secondary (% gross)	0.008	
School enrolment, tertiary (% gross)	0.001	
Degree of application		0.494

Individuals using the Internet (% of the population)	0.135	
Fixed broadband subscriptions (per 100 people)	0.208	
Mobile cellular subscriptions (per 100 people)	0.150	

Table 5.1 shows weights for each indicator and then for each sub-index calculated by entropy methods.

5.2 Impact of Digital Economy on Services Exports

This study employed the ARDL approach to examine the short-term and long-term relationship between Pakistan's services exports and the digital economy, exchange rate, domestic credit, and financial depth. Before doing a cointegration analysis, it is imperative to ascertain the stationarity characteristics of each variable incorporated in the study. The Augmented Dickey-Fuller (ADF) test, developed by Dickey and Fuller in 1979, is utilized to evaluate the integration order of variables. It is essential to confirm that none of the variables are integrated of order two, as indicated by I (2). The table below presents unit root tests for each variable.

Table 5.2 indicates that the variables serexp, digital-index, ReeR, and DCr exhibit non-stationarity at their levels, although attain stationarity after their first differences. The financial depth seems to be stationary at both its level and first difference. Therefore, the application of the ARDL approach is appropriate.

Table 5. 2: Unit Root Test

Variable	**ADF**	
	Level	**First Difference**
Serexp	0.467	-9.509*
Digital-Index	0.749	-4.389*
ReeR	-2.470	-4.190*
DCr	-1.495	-4.620*
Fin_depth	-2.990**	-7.101

**describes significance at 5% and * describe at 1% level

After conducting the unit root test, the second step analyzes the long-run association between the service exports and other regressors using the ARDL model. In the ARDL framework, the selection of the appropriate lag length is crucial. We utilized the Akaike Information Criterion (AIC) to determine the most suitable lag structure. The optimum lag length indicated by AIC is two. To check the presence of the long-term relationship among variables, we have to compare the computed F-statistic of ARDL from Pesaran et al. (2001) with the upper bound critical values of Narayan (2005).

Table 5. 3: Long-Run Cointegration Test

Test Statistic	**Value**	**K**
F-statistics	**4.151**	**4**
Significance	**I0 Bound**	**I1 Bound**
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Table 5.3 shows the calculated F-statistics and the critical bound values. Since the computed F-statistic (4.151077) exceeds the upper bound critical value at 2.5%, 5%, and 10%, significance levels, we reject the null hypothesis of no cointegration among the variables. The results indicate that there is a statistically significant long-term relationship among the variables.

The long and short-term relationship between service exports and the three sub-indices of the DEDI is also assessed. The long-term cointegration test results, short-term ECM results, and long-term bounds test results are given in Appendix A. The long-term results show that the sub-index which is named Degree of Application (Index3) has a strong positive relationship with the exports service. The other two sub-indices have insignificant Impacts in the long term.

Table 5. 4: Long-Run Results of the ARDL Model

variables	**Selected Model: ARDL (1, 0, 1, 0, 1)**		
variable	**Coefficients**	**t-statistic**	**Prob.**
DEDI	0.063	2.719	0.013
ReeR	-0.094	-1.260	0.221
DCr	-0.172	-1.129	0.272
Fin_Depth	-0.434	-1.727	0.099

We utilized the ARDL model to analyze Pakistan's time series data from 1993 to 2023 to achieve the objective of finding the relationship between the digital economy of Pakistan service exports. The long-run results from the ARDL model estimation are presented in Table 5.4. The findings indicate a positive and significant relationship between service exports and the digital economy, suggesting that advancements in the digital economy contribute to enhancing a country's service exports. These results are consistent with the study by Li et al., (2023), who also identified a positive correlation between service exports and digital economic progress. Investments in digital infrastructure, including broadband internet, data centers, and international bandwidth, reduce geographical barriers and enhance accessibility for global trade. This connectivity enables businesses to deliver services digitally, including IT, financial, and educational services, to international markets efficiently. High-quality digital infrastructure enables speedier communication, more efficient procedures, and automation. This lowers transaction costs and improves service delivery efficiency, increasing export competitiveness on a worldwide scale (Di et al., 2022). These results are also consistent with the results of Zhang et al., (2022), who recognized digital technologies as engines of economic development."

However, financial depth has a negative and significant impact on service exports. According to Sahoo et al. (2015), the development of the financial sector plays a vital role in enhancing a country's capacity to supply exports, positively influencing trade, but in contrast, underdeveloped financial markets can hinder trade performance. In Pakistan, financial depth negatively affects

service exports due to Pakistan's underdeveloped financial system. In Pakistan, financial depth (M2/GDP) is frequently used as a metric of liquidity, however, lending is biased toward the government and major businesses rather than the services sector (SBP, 2023). Instead of facilitating the exports, Pakistan's financial system is discouraging the exporters.

Additionally, domestic credit provided to the private sector by banks and the real effective exchange rate (REER) exhibit a negative but statistically insignificant relationship with service exports in the long run. The government absorbs a considerable percentage of banking credit to finance its fiscal shortfalls. This leaves little funding for private businesses, particularly service-oriented SMEs (small and medium-sized enterprises), which require capital to expand and export their services. In 2023, the government received 65% of all bank loans in Pakistan, with only 35% going to the private sector, including services. The service sector, which frequently comprises startups, freelancers, and IT enterprises, struggles to secure funding for innovation, scaling, and entering export markets (PES, 2024).

Table 5. 5: Diagnostic Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.123	**Prob. F (2,18)**	0.884
Obs*R-squared	0.392	**Prob. Chi-Square**	0.821

The LM test is used to determine whether the regression model's residuals exhibit autocorrelation or serial correlation. We can conclude that there is no evidence of serial correlation in the regression model's residual at standard significance levels (e.g., 5% or 1%), as table 5.5 demonstrates that both the F-statistic and the Obs*R-squared provide high p-values (0.8845 and 0.8216 respectively).

Table 5. 6: ARDL Short-Term Results (ECM)

Variable	Coefficient	t-Statistic	Prob.
D(SEREXP (-1))	-0.483	-3.913*	0.000
D(DCR)	0.090	1.696	0.105
D(REER)	0.043	1.996*	0.059
CointEq(-1)*	-0.279	-5.579	0.000

*Describe the significance of variables at a 5% level

The short results from the ARDL Error Correction Regression, presented in table 5.6, indicate that there is a positive and significant relationship between the exchange rate and export services. These results are in line with the results presented by Tran (2022), who also explained a positive relationship between services exports and real effective exchange rates. The author emphasizes that the Real Effective Exchange Rate (REER) typically has a negative effect on the growth of service exports. However, because of certain regional dynamics, this effect seems to be positive in the case of Asian countries. One reason for this could be that a stronger currency makes it more affordable for service providers to invest in foreign technology and expertise or buy necessary inputs, which raises the standard and efficacy of their products and services. For example, nations like the Philippines and India frequently depend on foreign cybersecurity systems, cloud-based infrastructure, and sophisticated software tools in the IT services industry. The cost of purchasing these technologies can be decreased by a stronger currency, increasing their ability to provide top-notch IT solutions on a global scale. In the same way, nations with thriving tourism sectors, such as Thailand and Malaysia, gain by importing luxury services, hotel management systems, and expensive equipment to satisfy international standards. This compensates for the possible loss of competitiveness brought on by fluctuations in exchange rates by allowing them to offer superior services at competitive pricing. These illustrations support the principle of comparative advantage by showing how export growth can be fueled by access to high-quality inputs in the services sector.

The coefficient of domestic credit to the private sector is positive but insignificant. A positive relationship indicates that more domestic credit to private sectors by banks can increase service exports, however, the effect is insignificant. The error correction term (CointEq (-1)) is negative

and highly significant ($p < 0.01$). This indicates that approximately 27.93% of any short-run deviation from the long-run equilibrium can be corrected in the next period, confirming a strong adjustment mechanism back to equilibrium aftershocks.

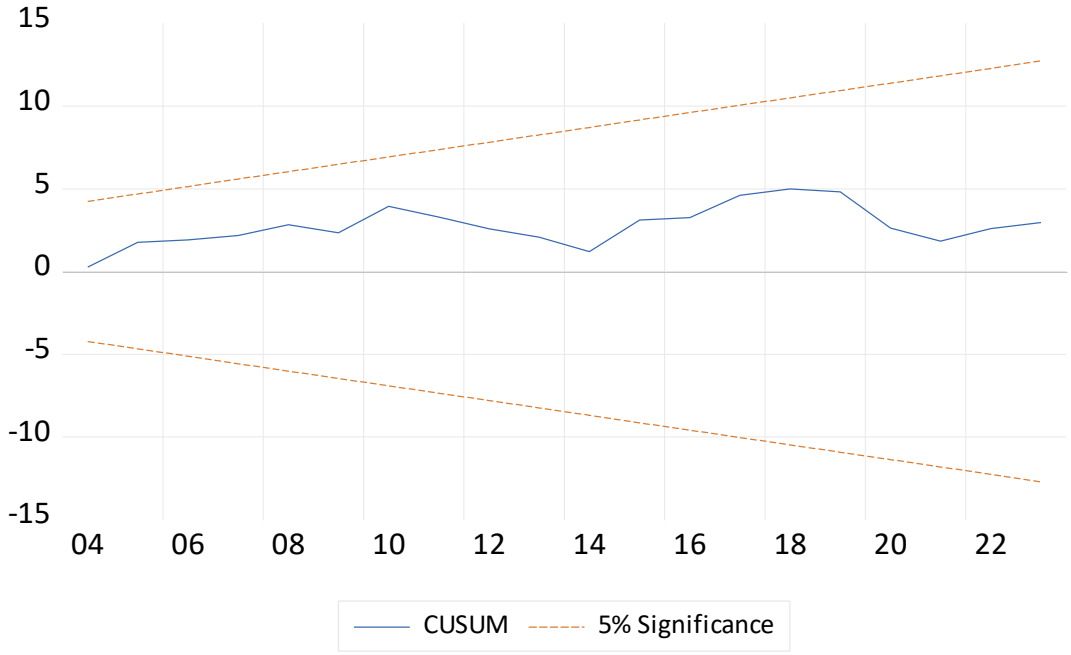

Figure 5. 1: CUSUM Stability Diagnostic Test

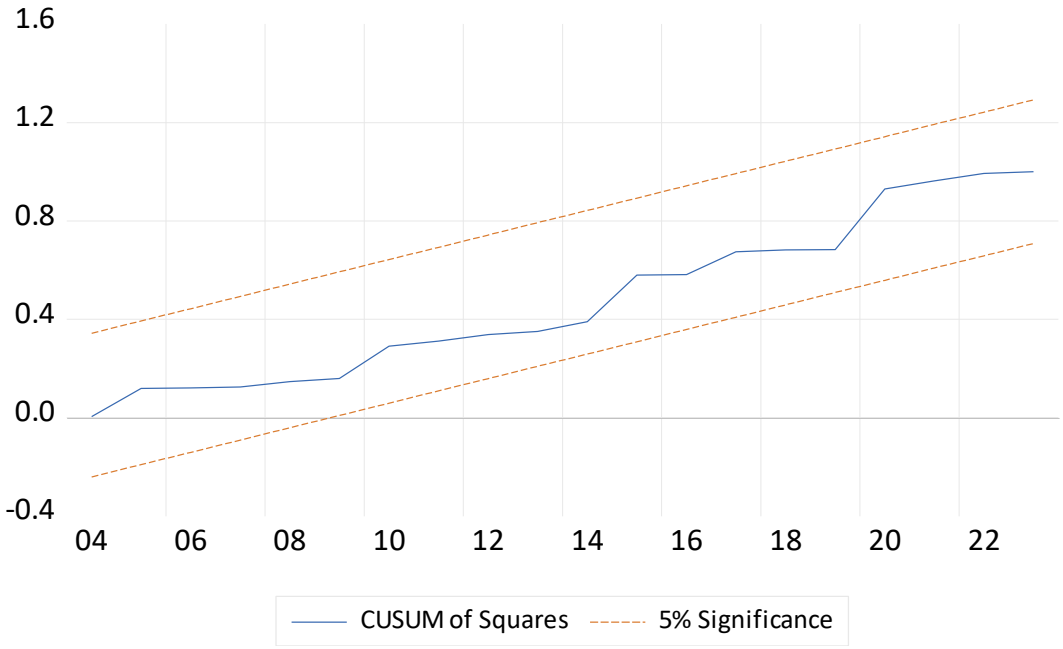

Figure 5. 2: CUSUM Square

The model stability has been evaluated using CUSUM and CUSUM-Square tests. These tests ensure that the ARDL model's parameters are consistent and do not vary over time. They also identify structural breaks or changes in the relationships being studied, which may require model re-specification or consideration of additional variables. The test statistics for both CUSUM and CUSUM Squares are within critical bounds, which shows that the model is stable over time.

5.3 Qualitative Analysis

This section tries to explore qualitative information to see the influence of the digital economy on Pakistan's service exports and to assess how the adoption of digital infrastructure affects services trade. For the qualitative analysis, the visits were made to explore information from digital economy experts, IT experts, and the Ministry of Commerce.

5.3.1 Digital Economy Expert

Pakistan is behind the neighboring countries in digitalization due to a lack of decision-making. The country adopted digital means, but along with that, the manual system was kept alive. Currently, we are trying our best, but we are not fully digitized. We are carrying on both systems in the parallel domain. It has been realized that digitalization is beneficial for Pakistan. Along with

the advantages digital economy is also whipping out human capital, specifically unskilled labor. Therefore, it creates unemployment for humans, but new dimensions can be explored. It has been noted that robotics have become common as Unilever, Opler, and Nishat have moved to robots. Moving towards new technology will improve productivity. IoT is another important factor that is impacting service exports. These challenges are also highlighted by SBP (2019) as adopting digitalization in a timely manner is crucial for staying ahead of technological trends. Digital transformation is accelerating and continuous. The fourth industrial revolution is faster than previous technologies, which took decades to create and spread globally. Inaction or late activity might result in substantial costs (SBP Report, 2019; PBC Report, 2022)[9].

5.3.2 Pakistan Software Export Board (IT Industry Experts)

The importance of the IT industry and its role in the economy cannot be ignored. The problem in Pakistan is not letting IT service exports flourish. In Pakistan, some initiatives are taken, like the business legal framework (registration) is now automated. The process is now less time-consuming. Businesses now register with SECP, PSEB (call centers and freelancing), FBR (for NTN), and STZs online. IT readiness report is another initiative to get digital. SIFC IT park in Islamabad (innovation) is approved.

Some hindrances are there, e.g., full retention is not provided earlier, and only 35% of online earnings from abroad could be transacted in Pakistan (SBP policy). Still, now this percentage has increased to 50%. There are a lot of problems in generating revenues from services exports; for example, economy is undocumented, and informal systems exist. There is a need for ease of doing business by stabilizing the exchange rate, eliminating extra taxes, creating political stability, etc. It is felt that there are less attractive benefits from the government for doing business. More government facilities are still required. Overall, while steps have been taken to promote the technology industry (e.g., automated registration processes), resolving broader economic issues remains crucial for maximizing export opportunities (Byline Report)[10].

5.3.3 Services Trade Expert (Commerce Ministry)

[9] SBP-special section, https://www.sbp.org.pk/reports/quarterly/fy19/First/Special-Section-2.pdf
[10] Byline – Why is information technology important.

Information communication services and computer services are the main sources of revenue generation in Pakistan's services exports. Our export services are currently showing better results in terms of trade. The services trade deficit is less than the goods trade deficit, hence, the country must focus on services exports. These results are in line with the data by OEC data. According to OEC data in 2019, Pakistan supplied $5.77 billion worth of services. Pakistan's top services exported in 2019 were other business services ($1.47 billion), computer and information services ($1.29 billion), government services ($1.21 billion), transportation ($854 million), and personal travel ($492 million) (OEC data Portal), (PBC Report, 2021)[11].

In conclusion, there are both opportunities and challenges on Pakistan's path to utilizing its digital economy to boost service exports. Exports of IT services have increased significantly in the nation, due to government programs like DigiSkills and freelancing. However, because of a dual system of manual and digital procedures, Pakistan still lags behind its neighbors in terms of complete digitalization. Lack of qualified IT workers, poor infrastructure, erratic regulations, and unstable economic conditions are some of the main obstacles.

[11] OEC data portal, https://oec.world/en/profile/country/pak

CHAPTER 6

CONCLUSION & RECOMMENDATIONS

In comparison to imports, exports are the most critical component of international commerce, as they are directly associated with the expansion of the economy. Taiwan, China, Malaysia, and South Korea are among the numerous Asian economies that have experienced economic development because of their increased services exports. Developed economies are progressively governed by services so the importance of service exports cannot be denied.

The impact of DE on service exports in Pakistan has been profound and multifaceted. Over the recent years, particularly since 2014, Pakistan has witnessed significant growth in IT service exports which have increased by 2.7 times and now constitute approximately 35% of total service exports. This growth is largely attributed to the advancements in digital technologies that have enabled Pakistani businesses to reduce costs, streamline operations, and improve their competitive edge in the global market.

This analysis developed a thorough digital economy development index for Pakistan by using the Entropy method. The influence of DED on service exports in Pakistan is estimated for the long term and short term. To achieve the objective of this study, the ARDL model has been applied to the time series data from 1993 to 2023 for Pakistan. Empirical results from the long-run ARDL model indicate that there is a positive and significant relationship between the digital economy development and service exports of Pakistan. If the digital environment (digital connectivity, digital logistics, training of hard skills, digital infrastructure, cloud computing) of the country expands/improves, it will bring improvement in services exports. The financial depth negatively and significantly affects the exports of services. It shows the country's financial system is underdeveloped and non-supportive of services exports. The results also indicate underdeveloped digital infrastructure, limited access to credit for exporters in the services sector, lack of investment in the services sector, and weak policy options available. The other variables such as REER and domestic credit to the private sector by banks are negatively affecting the service exports of Pakistan. However, the results are statistically insignificant in the long term. While, in the short run, real effective exchange has a positive influence on the services exports. While all the other

variables are statistically insignificant. The domestic credit to the private sector by banks is negatively affecting service exports due to high interest rates that stop the service exporters from accessing finances. Small and medium enterprises, new startups, and freelancers find it difficult to get loans due to strict conditions for newcomers and lack of credit records in past years.

The above-discussed results recommend that the development of the DE has facilitated the emergence of new service delivery models, including cross-border e-commerce and mobile applications, which are expected to contribute an additional PKR 1.8 trillion to Pakistan's annual export value by 2030 (SBP). Despite these positive trends, a significant skill gap exists, with around 80% of IT graduates lacking the necessary industry-relevant skills.

Recommendations

By adopting suitable steps, the hurdles in services exports can be tackled, for this, the study recommends the following steps.

1-Pakistan needs to develop improved financial policies for the services sector trade, and improved access to credit for service exporters.

2- The country must develop the digital economy framework, and digital logistics and should introduce workable financing solutions (digital payment mechanism-SadaPay; liquidity to meet expenses, banking sector expansion, risk management & cyber security, insurance, SME lending facility) to improve the competitiveness of Pakistan’s service exports.

3- The exchange rate should be carefully watched, and its overvaluation should be avoided.

4- Facilitate the digital economy to increase connectivity for companies engaged in service exports, investing in high-speed internet, data centers, and cloud computing infrastructure.

5- Extensive training programs should be introduced for digital skills to provide workers with the technological know-how and to facilitate the digital transformation of service exports.

REFERENCES

Atif, R. M., Haiyun, L., & Mahmood, H. (2017). Pakistan's agricultural exports, determinants and its potential: an application of stochastic frontier gravity model. *The Journal of International Trade & Economic Development*, *26*(Shingal), 257-276.

Bandiera, O., Caprio, G., Honohan, P., & Schiantarelli, F. (2000). Does financial reform raise or reduce saving? *Review of Economics and statistics*, *82*(Chatelain & Ralf), 239-263.

Barcenilla and Molero , J. J. S. e. f. e. e. f. t. E. U. (2003). Service export flows: empirical evidence for the European Union. *3*.

Becker and Greenberg, D. J. S. o. B., University of Chicago. Becker, B., Chen, J.,. (2003). The real effects of finance: evidence from exports. *2*(1), 1-28.

Breitung, J., & Pesaran, M. H. (2005). Unit roots and cointegration in panels.

Ceglowski, J. J. R. o. w. e. (2006). Does gravity matter in a service economy? , *142*, 307-329.

Choi, C. J. E. L. (2010). The effect of the Internet on service trade. *109*(2), 102-104.

Cirera, X., Cruz, M., Davies, E., Grover, A., Iacovone, L., Cordova, J. E. L., . . . Reyes Ortega, S. J. T. W. B. R. O. (2021). Policies to support businesses through the COVID-19 shock: A firm level perspective. *36*(1), 41-66.

Di, Y., Zhi, R., Song, H., & Zhang, L. J. F. i. P. (2022). Development and influencing factors of international trade in digitally deliverable services. *13*, 908420.

DPP-2018(https://mob.gov.pk/Downloads/Policy/DIGITAL_PAKISTAN_POLICY(22-05-2018).pdf)

Eichengreen, B., & Gupta, P. J. O. E. P. (2013). The two waves of service-sector growth. *65*(1), 96-123.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

entropy weights method for multi-objective optimization in machining operations: A critical review. *Journal of* 92-121.

Freund, C., & Weinhold, D. J. A. E. R. (2002). The Internet and international trade in services. *92*(2), 236-240.

Ganichev, N., & Koshovets, O. J. S. o. R. E. D. (2021). Forcing the digital economy: how will the structure of digital markets change as a result of the COVID-19 pandemic. *32*, 11-22.

Gnangnon, S. K. J. J. o. E. I. (2020). Effect of the internet on services export diversification. *35*(3), 519-558.

Gnangnon, S. K., & Iyer, H. J. T. P. (2018). Does bridging the Internet Access Divide contribute to enhancing countries' integration into the global trade in services markets? , *42*(1), 61-77.

Granger, C. W. (1981). Some properties of time series data and their use in econometric model specification. *Journal of Econometrics*, *16*(1), 121-130.

Han et al., J. T. P. (2023). The effect of the digital economy on services exports competitiveness and ternary margins. *47*(7), 102596.

Helble, M., & Shepherd, B. (2019). *Leveraging services for development: prospects and policies*: Asian Development Bank Institute.

ITC-2022(https://intracen.org/file/itcannualreport2022eng-interactive20junepdf)

Jiang, M., & Jia, P. J. T. (2022). Does the level of digitalized service drive the global export of digital service trade? Evidence from global perspective. *72*, 101853.

Kimura, F., & Lee, H.-H. J. R. o. w. e. (2006). The gravity equation in international trade in services. *142*,

Kumar, R., Singh, S., Bilga, P. S., Jatin, Singh, J., Singh, S., . . . Pruncu, C. I. (2021). Revealing the benefits of *Materials Research and Technology*, *10*, 1471-1492. doi:https://doi.org/10.1016/j.jmrt.2020.12.114

Kumar, R., Singh, S., Bilga, P. S., Jatin, Singh, J., Singh, S., . . . Pruncu, C. I. (2021). Revealing the benefits of entropy weights method for multi-objective optimization in machining operations: A critical review. *Journal of Materials Research and Technology*, *10*, 1471-1492. doi:https://doi.org/10.1016/j.jmrt.2020.12.114

Li et al., Y. J. T. P. (2023). The effect of the digital economy on services exports competitiveness and ternary margins. *47*(7), 102596.

Li, H., Han, J., & Xu, Y. (2023). The effect of the digital economy on services exports competitiveness and ternary margins. *Telecommunications Policy*, *47*(7), 102596.

Liu and Nath, H. K. J. E. M. F. T. (2013). Information and communications technology and trade in emerging market economies. *49*(6), 67-87.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied economics*, *37*(17), 1979-1990.

Nasir, S., & Kalirajan, K. J. A. W. P. (2013). Export performance of South and East Asia in modern services.

Nyahoho, E. J. G. E. J. (2010). Determinants of comparative advantage in the international trade of services: An empirical study of the Hecksher-Ohlin Approach. *10*(1). services: An empirical study of the Hecksher-Ohlin Approach. *10*(1).

OECD-Report(https://www.oecd.org/trade/topics/services-trade/)

PDE-Report(https://accesspartnership.com/agay-barho-empowering-pakistan-digital-economy/)

PES-2023(https://www.finance.gov.pk/survey_2023.html)

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Pesaran, M. H., Shin, Y., & Smith, R. J. J. J. o. a. e. (2001). Bounds testing approaches to the analysis of level relationships. *16*(3), 289-326.

Petri, P. A., Plummer, M. G., & Zhai, F. (2012). *The Trans-pacific partnership and Asia-pacific integration: a quantitative assessment* (Vol. 98): Peterson Institute.

Roy et al., S. J. T. J. o. I. T. (2024). Determinants of service trade: How information and communication technology-based services are different? *, 33*(1), 2-28.

Sahoo and dash, J. J. o. P. M., Dash, R. K., & Mishra, P. P. J. R. g. i. I. (2015). Determinants of India's service exports. *107*. .

Sahoo and dash, J. J. o. P. M. (2014). India's surge in modern services exports: Empirics for policy. *36*(6), 1082-1100.

Sahoo and dash, J. J. o. P. M. (2014). India's surge in modern services exports: Empirics for policy. *36*(6), 1082-1100.

Salam et al., H. J. T. P. D. R. (2018). The Determinants of Services Sector Growth: A Comparative Analysis of Selected Developed and Developing Economies. 27-44.

SBP-2023(https://www.sbp.org.pk/reports/half/arFY23/SpecialSection.pdf)

Shingal, A. J. A. a. S. (2010). How much do agreements matter for services trade?

Sinha Roy, A., Aditya, A., Chattopadhyay, S. J. T. J. o. I. T., & Development, E. (2024). Determinants of service trade: How information and communication technology-based services are different? , *33*(1), 2-28.

Sultan, N. (2013). Knowledge management in the age of cloud computing and Web 2.0: Experiencing the power of disruptive innovations. *International journal of information management*, *33*(Shingal), 160-165.

Tran, V. (2022). Examine the effects of real effective exchange rates on export growth: A closer look into Asian Developing Economies. In *Proceedings of the Jepson Undergraduate Conference on International Economics* (Vol. 4, No. 1, p. 2).

UNCTAD-2021(https://unctad.org/publication/digital-economy-report-2021)

UNCTAD-2023(https://unctad.org/publication/trade-and-development-report-2023)

Van der Marel, E. (2012). *Determinants of comparative advantage in services*. Retrieved from

Van der Marel, E., & Shepherd, B. J. T. W. E. (2013). Services trade, regulation and regional integration: Evidence from sectoral data. *36*(11), 1393-1405.

Wang, Y., & Li, J. J. E. L. (2017). ICT's effect on trade: Perspective of comparative advantage. *155*, 96-99.

WTO-2020(https://www.wto.org/english/res_e/publications_e/anrep20_e.htm)

WTO (2023). Digital trade and development, Available at, https://www.wto.org/english/res_e/booksp_e/dtd2023_e.pdf

Wu, M., & Wang, Y. (2022). Which objective weight method is better: PCA or entropy?

Zhang, L., Pan, A., Feng, S., & Qin, Y. J. P. o. (2022). Digital economy, technological progress, and city export trade. *17*(6), e0269314.

Zhu, Y., Tian, D., & Yan, F. (2020). Effectiveness of entropy weight method in decision-making. *Mathematical Problems in Engineering*, *2020*(1), 3564835.

Appendix A

Long-Run Cointegration Test

Test Statistic	**Value**	**K**
F-statistics	**4.1330**	**4**
Significance	**I0 Bound**	**I1 Bound**
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Long-Run Results of ARDL Model

variables	**Selected Model: ARDL (2, 0, 1, 0, 1)**		
variable	**Coefficients**	**t-statistic**	**Prob.**
Index1	8876.261	0.8777	0.3905
Index2	-3591.959	-1.0424	0.3097
Index3	148668	5.0271	0.0001
DCr	-28013.28	-0.4667	0.6457
Fin_Depth	-84679.47	-1.1537	0.2607
REER	-39706.46	-1.3537	0.1909

Three sub-indices (Index1, Index2, and Index3) of the aggregate DEDI are taken to find regression results. Index1 (infrastructure investment) is the first sub-index of DEDI and consists of three indicators, Fixed telephone subscription, secure internet service, and power supply. Index2 (R&D

and skill environment) is the second index and Index3 (Degree of application) is the third sub-index.

ARDL Short-Term Results (ECM)

Variable	**Coefficient**	**t-Statistic**	**Prob.**
D(DCr)	108782.2	2.0753*	0.0511
D(REER)	45645.63	2.2072*	0.0391
CointEq(-1)*	-0.8728	-6.6811	0.0000

Note: * Indicates the significance at 1% level of significance

Appendix B

Robustness checks for the index calculation methodology