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A Digital Bridge to Global Markets: Impact of The Digital Economy on Service Exports in Pakistan

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Abstract

Service exports play a big role in bringing in foreign exchange and helping developing countries diversify their economies. This study investigated how Pakistan's digital economy shaped its service exports from 1993 to 2023. The Autoregressive Distributed Lag (ARDL) model had been used to build a new Digital Economy Development Index (DEDI), using the entropy weighting method, to get a full picture of digital progress. There observed a strong, positive long-term link between the DEDI and service exports. Financial depth has a negative long-run effect. The Real Effective Exchange Rate (REER) has a positive short-term influence, that showed that currency shifts can help service producers get the imported inputs. The study also checked for cointegration and model stability. Digital infrastructure pushes the sector forward, but a poorly functioning financial system holds it back. So, policymakers need a two-pronged approach: invest heavily in digital infrastructure, training, and connectivity, and at the same time, overhaul the financial sector to make credit more accessible for service-based SMEs and freelancers.

Keywords: Digital Economy, Service Exports, ARDL, Entropy Method, Pakistan, Financial Development, Digital Transformation

1. Introduction

The architecture of the global economy has undergone a profound transformation over the past half-century, marked by the twin engines of service sector and digitalization. The services sector has evolved from a peripheral component to the dominant force in global output and trade, accounting for over two-thirds of world GDP and serving as the primary source of employment in most nations (World Bank, 2023). Concurrently, the rapid ascent of digital technologies has dismantled traditional barriers to trade, giving rise to a new paradigm where data is the lifeblood and digital platforms the central arteries of global commerce. This confluence has created unprecedented opportunities for economic development, particularly for emerging economies seeking to leapfrog traditional industrial pathways and integrate into the high-value segments of the global value chain.

International trade in services, valued at a staggering $7.1 trillion in 2022 and constituting 23% of total world trade, is no longer confined to tourism and transportation (UNCTAD, 2023). It now encompasses a vast and growing ecosystem of digitally deliverable services, including information technology (IT), financial and insurance services, professional consulting, education, and telecommunications. The General Agreement on Trade in Services (GATS) under the World Trade Organization (WTO) has provided a framework for this expansion, but it is technology that has

been the true disruptor. Digitalization reduces the "friction of distance" inherent in many traditional services, enabling a consultant in Karachi, a software developer in Lahore, or a graphic designer in Islamabad to deliver their expertise instantaneously to clients in New York, London, or Singapore. As noted by the WTO (2023), cross-border digital services are the fastest-growing segment of international trade, expanding at 8.1% annually from 2005 to 2022, significantly outpacing goods trade.

For developing nations, this digital-services nexus represents a strategic avenue for sustainable development. It offers a path to economic diversification, reducing dependence on volatile commodity exports and low-value-added manufacturing. It fosters the creation of high-skilled employment, promotes innovation, and enhances resilience to external shocks, as vividly demonstrated during the COVID-19 pandemic when digital services provided a critical buffer against economic collapse (Ganichev & Koshovets, 2021). The paradigm is shifting from "industrialization-led development" to what is increasingly recognized as "services-facilitated development," where a dynamic services sector acts as a productivity multiplier for the entire economy (Cirera et al., 2021).

Within this global context, Pakistan presents a compelling yet paradoxical case study. On one hand, its services sector is the undeniable pillar of the domestic economy, contributing approximately 61.5% to the national GDP and employing a significant portion of the workforce (Pakistan Economic Survey, 2022-23). The nation also possesses a demographic dividend—a large, young, and English-speaking population—and has demonstrated remarkable potential in specific digital niches. Pakistan ranks among the top ten fastest-growing freelance markets globally and is the fourth-largest supplier of freelancing services, with software developers constituting a significant share of this workforce (ITC, 2022). The IT and IT-enabled services (ITeS) sector has been a standout performer, with exports growing from $0.29 billion in FY13 to $2.1 billion in FY22, now accounting for 35% of all service exports (SBP, 2023).

On the other hand, this promising performance obscures deeper, structural challenges. Pakistan's overall service exports remain modest, standing at a mere $7.5 billion in 2023, dwarfed by regional peers like India, which exported over $250 billion in services the same year. A persistent services trade deficit highlights an economy that consumes more foreign services than it sells. This underperformance points to a critical research and policy gap: a fragmented understanding of the precise mechanisms through which Pakistan's ongoing digital transformation influences its service export capacity. While initiatives like the "Digital Pakistan Policy 2018" and "Digital Pakistan Vision 2021" outline ambitious goals, their impact remains unclear in the absence of robust, empirical evidence.

The existing academic literature, while establishing a general positive correlation between digitalization and trade (Freund & Weinhold, 2002; Choi, 2010), often suffers from limitations when applied to the Pakistani context. Many studies rely on single metrics like internet penetration, failing to capture the multidimensional nature of the digital economy, which encompasses infrastructure, skills, and actual usage. Furthermore, the role of complementary factors, particularly the financial sector, is often overlooked. A developed financial system is theorized to facilitate exports by providing essential credit and risk management tools (Sahoo & Dash, 2014). However, in an environment like Pakistan's, where financial depth may be coupled with inefficiencies and credit misallocation, its interaction with the digital economy could yield counterintuitive results.

1.1 Research Objectives

This study aims to fill this gap by addressing two core research questions:

1. To analyse the influence of a comprehensively measured digital economy on Pakistan's service exports.
2. To analyse the financial depth, domestic credit, and the exchange rate interact with digitalization to affect services trade.

1.2 Significance of Research

By answering these questions, this research aims to provide policymakers, academics, and industry stakeholders with a nuanced, evidence-based understanding of the digital drivers of export competitiveness. The findings will inform targeted strategies to not only accelerate digital infrastructure deployment but also to address the critical, and often neglected, financial and macroeconomic enablers required for Pakistan to fully harness its potential in the global digital marketplace. The primary contribution of this study is the construction of a robust Digital Economy Development Index (DEDI) for Pakistan using the objective entropy method, providing a nuanced measure of digital progression. We then employ the ARDL bounds testing approach to quantify the long- and short-run relationships between the DEDI, financial variables, REER, and service exports.

2. Literature Review

The exploration of services trade has evolved significantly, paralleling its growing importance in the global economy. Early economic thought, heavily influenced by the dominance of goods trade, often relegated services to the category of "non-tradables." However, the late 20th and early 21st centuries witnessed a paradigm shift, catalyzed by technological advancement and formalized through frameworks like the General Agreement on Trade in Services (GATS). This literature review synthesizes the key strands of research relevant to this study, tracing the evolution from the traditional determinants of services trade to the transformative role of the digital economy, while also examining the critical, yet underexplored, interface with financial sector development.

2.1. Theoretical Foundations and Traditional Determinants of Services Trade

The theoretical underpinnings of services trade initially extended the frameworks developed for goods. The Heckscher-Ohlin model and theories of comparative advantage were adapted, with factors like human capital and physical infrastructure becoming key determinants of a country's service export profile (Melvin, 1989). Later, the "New Trade Theory" introduced economies of scale and network effects, which are particularly relevant for services characterized by high fixed costs and low marginal costs, such as software and financial services (Krugman, 1979). Porter's (1990) theory of competitive advantage further enriched the discourse by emphasizing the role of factor conditions, demand conditions, related industries, and firm strategy in shaping a nation's export competitiveness, a framework highly applicable to the services sector.

Empirically, a substantial body of work has identified a core set of determinants influencing services trade. Gravity models, borrowed from goods trade, have been widely applied, confirming that market size (proxied by GDP), geographical proximity, and shared language significantly impact the volume of bilateral services flows (Kimura & Lee, 2006; Van der Marel & Shepherd, 2013). Beyond these, factors such as a skilled labor force (human capital), regulatory quality, and the level of foreign direct investment (FDI) have been consistently highlighted as critical drivers (Eichengreen & Gupta, 2013; Van der Marel, 2012). For instance, Nasir and Kalirajan (2013) found that the quality of ICT infrastructure and graduates were crucial for the modern service export performance of East and South Asian economies. However, a common limitation in this earlier body of work is its focus on traditional service categories and a relative neglect of the specific mechanisms through which digitalization was beginning to reshape trade.

2.2. The Digital Transformation in Services Trade

The advent of the Internet and digital technologies marked a watershed moment, creating a new sub-field of research focused on digital trade. Seminal work by Freund and Weinhold (2002) provided early empirical evidence, demonstrating that growth in foreign Internet usage led to a significant increase in U.S. service imports and exports, as the Internet reduced information asymmetries and lowered entry costs. Choi (2010) reinforced this at a broader level, finding that a 10% increase in Internet usage was associated with a 2-4% growth in services trade

As digitalization deepened, research moved beyond simple connectivity metrics to conceptualize the "digital economy" as a multifaceted phenomenon. Later studies began constructing composite indices to capture this complexity. For example, Han et al. (2023) developed a Digital Economy Development Index and found that it robustly enhanced service export competitiveness by simultaneously expanding the variety (extensive margin), quantity (intensive margin), and quality (quantity margin) of exports. Their research importantly noted that these effects were even more pronounced for low and middle-income economies, suggesting a "catch-up" potential through digitalization. This is supported by Gnangnon (2020), who found that Internet use significantly promotes services export diversification, particularly in Least Developed Countries (LDCs), with innovation and trade openness acting as key reinforcing factors.

However, the benefits of the digital economy are not automatic or uniformly distributed. Research by Jiang and Jia (2022) reveals a stark digital divide. They found that while high levels of digital service drive digital service trade exports in high-income nations, middle and low-income countries face significant hurdles, including regulatory difficulties, a lack of digital skills, and poor infrastructure. This highlights that digital readiness is a function of more than just hardware; it requires a conducive ecosystem. The concept of "Internet distance"—the gap between a country's internet usage and the global average—was introduced by Gnangnon and Iyer (2018), who argued that narrowing this gap is crucial for countries to participate effectively in the global services market.

2.3. The Intermediary Role of the Financial Sector

A parallel and crucial strand of literature focuses on the role of the financial sector in facilitating trade. Well-established theory posits that financially developed economies possess a comparative advantage in sectors reliant on external finance (Rajan & Zingales, 1998). Becker and Greenberg (2003) extended this to exports, arguing that financial development alleviates liquidity constraints, enabling firms to cover the sunk costs of entering foreign markets, such as marketing, establishing distribution networks, and adapting products to foreign standards. A deep and efficient financial system provides crucial services like trade finance, risk management, and working capital, all of which are essential for exporters (Sahoo & Dash, 2014).

However, the specific interaction between financial development and services exports, particularly in the digital age, is less explored. Services firms, especially SMEs, startups, and freelancers in the IT sector, often have intangible assets and lack collateral, making them more vulnerable to financial constraints than traditional manufacturing firms. Therefore, while theory suggests a positive relationship, the nature of the service sector may make it more sensitive to the quality and allocation of financial resources, not just the overall depth of the financial system. In countries where the financial system is characterized by credit misallocation like heavy lending to the government or a few large conglomerates.

2.4 Synthesis and Identification of the Research Gap

The reviewed literature establishes three key pillars:

1. **Traditional and New Determinants:** Factors like human capital, regulation, and infrastructure are foundational to services trade performance.
2. **The Digital Catalyst:** The digital economy acts as a powerful, multi-dimensional enabler that reduces trade costs, creates new service categories, and can help developing countries bridge competitiveness gaps.
3. **The Financial Enabler:** A well-functioning financial system is theorized to be a critical support structure for export activities.

The determinants of services trade have evolved from traditional factors like GDP, distance, and language (Kimura & Lee, 2006; Van der Marel & Shepherd, 2013) to include digital infrastructure. Seminal work by Freund and Weinhold (2002) found that the Internet significantly increased U.S. service trade, a finding corroborated by Choi (2010), who showed a 2-4% increase in services trade for every doubling of Internet usage.

Recent studies emphasize a more holistic view of the digital economy. Gnangnon (2020) demonstrated that Internet usage promotes services export diversification, particularly in LDCs. Han et al. (2023), using a multi-country DEDI, found that the digital economy boosts service export competitiveness by expanding the variety, quantity, and quality of exports. However, the benefits are not automatic; Jiang and Jia (2022) highlight that regulatory hurdles, skill gaps, and poor infrastructure can negate the advantages for middle and low-income nations.

Concurrently, financial sector development is a well-established determinant of export capacity (Sahoo & Dash, 2014). A deep and efficient financial system provides the necessary credit and liquidity for firms to invest, innovate, and enter international markets. However, the specific interaction between digital and financial development in the context of services exports, especially in a country with a potentially misallocated financial system like Pakistan, remains underexplored.

2.5 Research Gap

Yet, a significant gap exists at the intersection of these pillars. While studies like Han et al. (2023) expertly model the impact of a composite digital index on services trade, they often do so in a multi-country framework that may obscure country-specific institutional realities, such as the structure of the financial sector. Conversely, country-specific studies on Pakistan's services exports have often focused on traditional determinants or the IT sector in isolation, lacking a comprehensive digital economy index and a simultaneous econometric assessment of the financial sector's role. This study seeks to fill this void by investigating the simultaneous impact of a holistically measured digital economy and key financial variables on Pakistan's service exports. It posits that in the Pakistani context, the positive force of digitalization may be significantly mediated or counteracted by the structure and inefficiencies within its domestic financial system, a nuanced relationship that prior studies have not fully captured.

3. Research Methodology and Data

3.1. Digital Economy Development Index (DEDI) Construction

To move beyond single metrics like internet penetration, we construct a composite DEDI using the entropy weighting method. This objective method assigns higher weights to indicators that transmit more information, minimizing subjective bias. Our DEDI comprises three sub-indices:

i. Infrastructure Investment: Fixed telephone subscriptions, secure internet servers, power supply.
ii. R&D & Skill Environment: Patent applications (resident/non-resident), secondary/tertiary school enrolment.

iii. Degree of Application: Individuals using the Internet, fixed and mobile broadband subscriptions.

3.2 Data Sources

Data for these indicators and other variables were sourced from the World Bank and International Telecommunication Union (1993-2023).

3.3. Empirical Model

To analyze the impact, we specify the following long-run model:

$$\Delta Serexp_t = \int DEDI_t\,, +REER_t, +DCr_t, +Fin\_Depth_t$$

where:

Serexp`: Service exports (current US$)

DEDI`: Digital Economy Development Index

REER`: Real Effective Exchange Rate

DCr`: Domestic Credit to Private Sector by Banks (% of GDP)

Fin_Depth`: Financial Depth (M2/GDP)

We employ the ARDL cointegration approach (Pesaran et al., 2001), which is robust with a mix of I(0) and I(1) variables, as confirmed by Augmented Dickey-Fuller tests. The general ARDL(p, q1, q2, q3, q4) model is:

$$\Delta SerexP_t = \propto_0 + \sum_{i=t}^{p} \Delta SerexP_{t-i} + \sum_{j=0}^{q1} \gamma_j \Delta DEDI_{t-j} + \cdots + \delta_1 SerexP_t + \delta_2 DEDI_{t-1} + \delta_3 REER_{t-1} + \delta_4 DCr_{t-1} + \delta_5 Fin\_Depth_{t-1} + \mu_t$$

The parsimonious model selected via AIC was ARDL(1, 0, 1, 0, 1). The existence of a long-run relationship is tested using an F-test on the lagged level variables.

4. Results and Discussion

4.1. Unit Root Results

The entropy weighting assigned the highest importance to the "Degree of Application" sub-index (0.494), followed by "Infrastructure Investment" (0.388), highlighting the primacy of actual usage and connectivity. Unit root tests confirmed that no variable was I(2), validating the use of the ARDL approach.

Table 5.2: Unit Root Test

Variable	ADF (Level)	ADF (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 * describes at 1% level

4.2. Cointegration and Long-Run Results

The F-statistic of 4.151 exceeded the upper critical bound at the 5% significance level (Table 5.3), confirming a stable long-run relationship among the variables.

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

The results of the ARDL Bounds Testing approach confirm the presence of a long-run cointegration relationship among the variables included in the model. The calculated F-statistic (4.151) exceeds the upper critical bounds (I1) at the 10%, 5%, and 2.5% significance levels, indicating strong statistical evidence to reject the null hypothesis of no long-run relationship. Although the F-statistic falls between the lower and upper bounds at the 1% significance level, the overall results remain robust across conventional significance thresholds. This suggests that the variables move together over the long run and adjust toward equilibrium when short-run deviations occur. Therefore, ARDL long-run estimation and the associated error correction model (ECM) are appropriate for further analysis.

Table 1: Long-Run ARDL Estimates

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

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

The long-run results (Table 1) reveal a statistically significant and positive relationship between the DEDI and service exports. A 1-unit increase in the DEDI leads to a 0.063-unit increase in service exports, affirming that digital transformation is a key driver of export competitiveness in Pakistan. This aligns with theory, as digital infrastructure reduces trade costs and enables efficient cross-border service delivery (Li et al., 2023).

The most striking finding is the significant *negative* impact of financial depth. This suggests that the growth of liquidity (M2/GDP) in Pakistan's economy is not effectively channelled to support service exporters. This can be attributed to a crowding-out effect, where significant bank lending to the government (65% in 2023) starves the private sector, particularly SMEs and startups in the services industry, of essential capital.

Domestic credit and the REER show an insignificant negative relationship in the long run.

4.3. Short-Run and Diagnostic Results

The short-run Error Correction Model (ECM) results (Table 5.6) show a positive and significant impact of the REER, consistent with Tran (2022). This may reflect the regional phenomenon where a stronger currency lowers the cost of imported software, cloud services, and other high-tech inputs essential for producing competitive service exports.

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

variable	**Coefficients**	**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 error correction term (CointEq(-1)) is -0.279 and highly significant, indicating a rapid adjustment to long-run equilibrium, with about 28% of any disequilibrium corrected within one year.

Diagnostic tests

Model stability was assessed using the CUSUM (Cumulative Sum) and CUSUM-Square tests. These tests are vital for ensuring that the ARDL model's parameters are consistent throughout the study period, helping to identify any structural breaks or shifts in the underlying relationships. The results confirm the model's reliability, as the test statistics for both CUSUM and CUSUM Squares fall within their critical bounds, indicating that the model is stable over time.

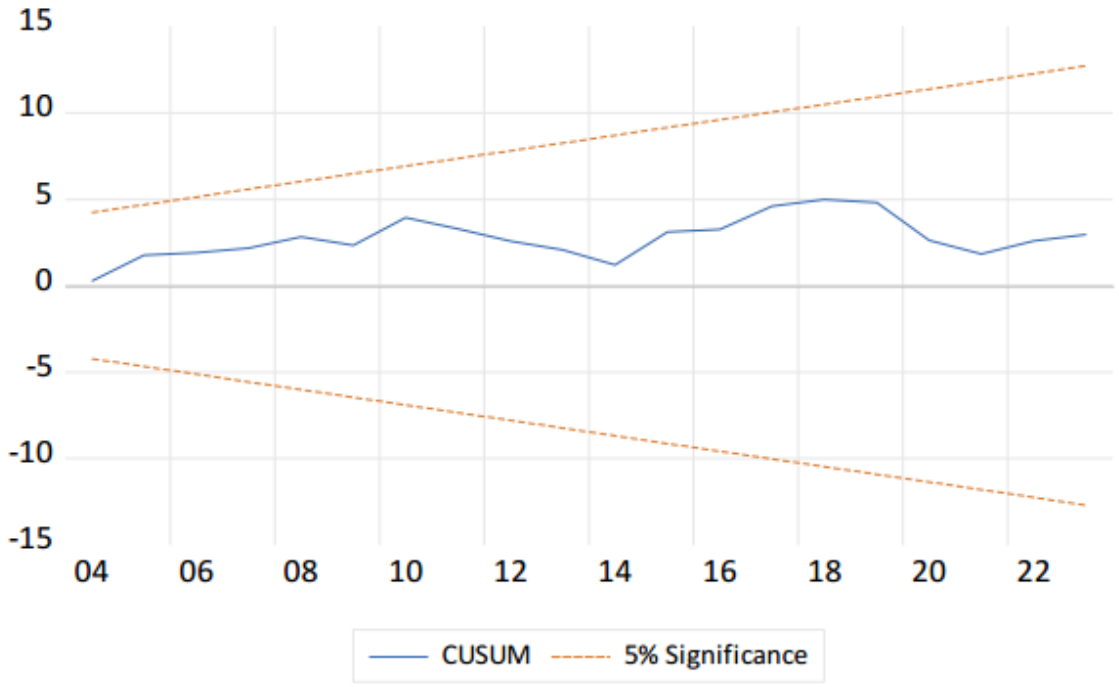

Figure 5. 1: CUSUM Stability Diagnostic Test

Diagnostic tests confirmed no serial correlation (Breusch-Godfrey p-value: 0.884), and the CUSUM and CUSUMSQ tests affirmed model stability.

Table 5. 5: Diagnostic Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.123	**Prob. F (2,18)**	0.885
Obs*R-squared	0.192	**Prob. Chi-Square**	0.821

The LM test (Lagrange Multiplier test) was conducted to check for autocorrelation (or serial correlation) in the regression model's residuals. As shown in Table 5.5, the high p-values for both the F-statistic (0.8845) and the Obs*R-squared (0.8216) indicate that we cannot reject the null hypothesis. Therefore, we conclude there is no evidence of serial correlation in the residuals at standard significance levels (such as 5% or 1%).

5. Conclusion and Policy Recommendations

This study provides robust empirical evidence that the digital economy acts as a powerful catalyst for service exports in Pakistan. The constructed DEDI offers a validated tool for policymakers to track digital progress. However, the study uncovers a critical impediment: the domestic financial system, in its current state, is a drag on export performance rather than an enabler.

Therefore, a synergistic policy approach is necessary:

- Accelerate investment in high-speed internet and data centers to improve global broadband rankings.
- Massively expand training in high-demand areas like AI and cybersecurity to close the skill gap.
- Restructure the financial sector to provide specialized credit channels and incentives for banks to support service exports, while promoting digital finance solutions.
- Maintain a stable and competitive exchange rate to ensure long-term export competitiveness

Achieving sustainable growth requires strategically building the digital infrastructure while fundamentally reforming financial foundations. By pursuing this synergistic approach, the services sector can fully integrate into the global digital marketplace.

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