Role of Digital Financial Inclusion on Economic Growth: Evidence from South Asian Countries

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Abstract
This study examines the role of digital financial inclusion (DFI) in fostering economic growth across three South Asian countries: Bangladesh, Pakistan, and Nepal. Utilizing data from the World Bank and the IMF, the Generalized Method of Moments (GMM) has been employed to analyze the impact of DFI on GDP growth. The findings demonstrate that a one-unit increase in the Digital Financial Inclusion Index causes a 48.32-unit increase in GDP per capita, demonstrating digital financial services' crucial role in enhancing economic productivity. The study also considers the influence of several economic variables, including foreign direct investment, trade, inflation, and government expenditure, to provide a comprehensive view of the factors contributing to economic growth. The results highlight the transformative potential of digital financial services in increasing economic participation and suggest that strategic investments in digital infrastructure and supportive regulatory frameworks are critical for maximizing these benefits. This research contributes to the understanding of how digital financial services can act as catalysts for economic development in emerging markets, offering insights for policymakers and stakeholders aiming to harness the benefits of financial technology.

Keywords: Digital Financial Inclusion, GDP, Technology, Economic Growth

1. Introduction

Digital financial inclusion (DFI) is the delivery of affordable financial services to sections of disadvantaged and low-income segments of society, facilitated by digital platforms. It encompasses a range of financial services that are accessible and convenient, especially for the unbanked and underbanked population, allowing them to participate fully in the formal financial system Demirgüç-Kunt et al., 2017). South Asia presents a unique canvas where digital financial services have shown substantial penetration in recent years due to the widespread adoption of mobile technology and internet access. Despite these advancements, the region still faces a stark digital divide, with varying levels of financial inclusion across different countries (World Bank, 2024). This uneven landscape offers ground for exploring how digital financial services can catalyze economic activities by integrating a larger segment of the population into the formal

financial sector (Parvin and Panakaje, 2022). In South Asia, where a large portion of the population lacks access to traditional banking services, digital financial inclusion offers a revolutionary opportunity to bridge this divide. Modern digital infrastructures work as a key factor in increasing the public's access to formal financial services (Naumenkova et al.,2019). It enables individuals and businesses to engage in financial activities that were previously unattainable, leading to significant gains in overall economic productivity (Banna, 2020). By providing access to financial services such as savings accounts, loans, and payment services via digital platforms, DFI facilitates economic activities that spur broad economic productivity. The integration of digital platforms in financial services fosters inclusion and enhances the efficiency and scope of financial transactions (Asif et al. 2023) , leading to greater economic empowerment and sustainability.

Digital financial inclusion directly influences economic growth through several mechanisms. Increased access to financial services encourages savings and investments, smooths consumption, and enables financial planning, which is critical for economic stability and growth (Anakpo et al.2023). DFI supports SMEs by providing easier access to credit and more effective cash flow management tools, which are essential for business expansion and sustainability (Parvin & Panakaje, 2022). Research shows that DFI can significantly accelerate GDP growth in developing countries by integrating a larger segment of the population into the formal economy, thereby enhancing overall economic productivity (Khera et al., 2021).

One of the pivotal enablers of this inclusive digital transformation is the expansion of internet access across the region (Telukdarie & Mungar, 2023), which is crucial for the deployment and effective use of digital financial services. As illustrated in Figure 1, the growth in internet usage from 2012 to 2022 in Bangladesh, Pakistan, and Nepal reflects a significant digital leap forward. This trend highlights the increasing availability of the internet and its potential to support digital financial services that are pivotal for economic inclusion and growth.
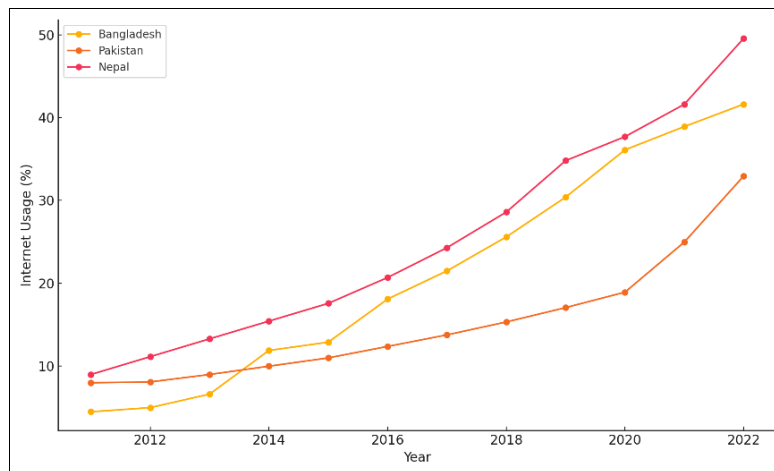

Figure 1. Internet Use over Time by Country
Source: Author's Analysis

This paper will explore how digital financial inclusion impacts economic growth in South Asia, examining the direct and indirect effects of enhanced financial access on GDP. By assessing both the opportunities and challenges presented by digital financial inclusion, this study aims to provide a detailed understanding of its role in economic development and propose strategic recommendations for maximizing its benefits. The subsequent sections will further discuss the mechanisms through which digital financial inclusion impacts economic parameters.

2. Literature Review

The Method section describes in detail how the study was conducted, including conceptual and operational definitions of the variables used in the study, Different types of studies will rely on different methodologies; however, a complete description of the methods used enables the reader to evaluate the appropriateness of your methods and the reliability and the validity of your results, It also permits experienced investigators to replicate the study, If your manuscript is an update of an ongoing or earlier study and the method has been published in detail elsewhere, you may refer the reader to that source and simply give a brief synopsis of the method in this section. Digital financial inclusion (DFI) has been increasingly recognized for its transformative effects in developing economies, as evidenced by the foundational work of Demirgüç-Kunt et al. (2017). The study investigated the global impact of digital financial inclusion, particularly highlighting its transformative effect in developing economies. Their research documented the significant enhancements that digital financial inclusion brings to the accessibility, efficiency, and breadth of financial services. The study found that digital technologies facilitate a rapid transaction process, reduce operational costs by diminishing the reliance on physical infrastructure, and expand the reach of financial services to underserved and remote areas thereby stimulating economic activity and growth.

Following up on these insights, Ozili (2021) found the significant impacts that digital financial inclusion (DFI) had on economic systems, particularly highlighting its role in enhancing macroeconomic stability and growth. His research emphasized how DFI increased savings, investment, and consumption levels across various demographics. These factors are vital for economic resilience, elevating overall economic activities and financially empowering individuals and businesses. The author noted that by widening access to financial services, DFI helped to integrate a more extensive section of the population into the formal economy, which is crucial for sustainable economic growth and equitable wealth distribution. The study also pointed out that the expansion of DFI could lead to a more stable economic environment by diversifying financial participation and reducing the vulnerability to financial crises. This study suggests the proliferation of digital financial services as a strategic means to foster economic development and mitigate inequality.

Ahmad et al. (2021) investigated the impact of digital financial inclusion (DFI) and human capital on economic growth across different provinces in China. The research innovatively combines digital financial metrics with educational factors to create a comprehensive analysis of growth dynamics. The study's findings suggest that increased digital financial inclusion and improved human capital significantly contribute to provincial economic growth. The researchers

highlight the critical role that both technological integration in finance and educational advancements play in fostering economic development.

Himanshu Sharma & Antonio Díaz Andrade (2023) investigated the role of digital financial services (DFS) in human development. The study conducts a systematic literature review covering studies from the year 2000 to 2020, identifying six overarching themes: contextual conditions, technological skills and financial literacy, consistent trust, shaping financial behavior, energizing economic activities, and supporting financial inclusion. These themes highlight the impact of DFS on enhancing access to financial services globally, which in turn contributes to human development by fostering economic activities and financial inclusivity. The study underscores the importance of technological skills and financial literacy as critical enablers of DFS, which are essential for promoting broader economic participation and resilience. This comprehensive analysis provides insights into the complex interplay between technology and economic development.

Tay et al. (2022) examined the role of digital financial inclusion in advancing sustainable development, especially during the COVID-19 pandemic. The paper highlights the importance of digital financial services in providing essential financial access to underserved populations, which is crucial for economic stability and poverty alleviation. By analyzing various literature, the study emphasizes that enhancing digital financial inclusion aligns with the Sustainable Development Goals (SDGs) and calls for improved digital infrastructure and simplified financial processes to reduce access disparities.

Chinoda & Kapingura (2024) explored the interplay between digital financial inclusion, institutional quality, governance, and economic growth within the Sub-Saharan Africa region from 2014 to 2020. Utilizing the generalized method of moments to account for endogeneity, the study finds that improved governance and institutional quality significantly enhance the positive effects of digital financial inclusion on economic growth. Additionally, the authors highlight the beneficial impacts of trade and population growth on economic growth, while inflation is shown to have a detrimental effect.

Xi & Wang (2023) explored the influence of digital financial inclusion on economic growth quality across various provinces in China. Utilizing advanced econometric models, the authors demonstrate that digital financial inclusion positively impacts the quality of economic growth, particularly in regions with higher levels of marketization and in the eastern parts of China. The study highlights the role of digital financial services in enhancing entrepreneurial activity and in promoting equitable economic development. The findings suggest that increased digital financial inclusion can lead to improvements not only in financial accessibility but also in broader economic quality by fostering innovation, environmental protection, and social welfare.

Despite the extensive research on DFI's impact on economic growth and human development, a gap remains in comprehensive, empirically driven studies that connect these effects within the context of South Asia, a region with unique digital and economic landscapes. This study aims to

bridge this gap by providing a detailed analysis of how DFI impacts economic growth in South Asia, using advanced econometric models to quantify these effects. By doing so, it extends the current understanding of DFI's role in economic dynamics, offering specific insights that are critical for policymakers and stakeholders in the region.

3. Data and Methodology

3.1 Data

The analysis utilizes data spanning from 2011 to 2022 for Bangladesh, Pakistan, and Nepal, sourced from the World Bank's World Development Indicators (WDI) and the International Monetary Fund's Financial Access Survey (IMF FAS). These datasets provide comprehensive economic and financial data essential for examining the impact of digital financial inclusion on economic growth in these countries. Due to occasional gaps in the annual data, mean imputation and trend analysis were employed to estimate missing values. This approach ensures continuity and robustness in the dataset.

3.2 Methodology

A Principal Component Analysis (PCA) was performed to create a Digital Financial Inclusion index using four key variables: Mobile subscriptions per 100 people, percentage of the population with internet access, number of registered mobile money agents per 100,000 adults, active mobile money accounts per 100 adults. The initial step involves standardizing the data through z-score normalization for each of the four key variables. The z-score is calculated using the formula:

$Z_i = (X_i - \mu)/\sigma$
where:
- X_i is the raw score,
- M is the mean of the variable,
- σ is the standard deviation of the variable.

This standardization process transforms the data to have a mean of zero and a standard deviation of one, which normalizes the scale of the variables, making them comparable and eliminating any bias due to scale differences. Following the normalization, the PCA is performed where the weights (eigenvectors) are derived for each variable, indicating their contribution to the principal component. The DFI Index is then calculated as a weighted sum of these standardized values:

DFI Index $= W_1 Z_1 + W_2 Z_2 + W_3 Z_3 + W_4 Z_4$
where:
- Z_1, Z_2, Z_3, and Z_4 are the z-scores of the four standardized variables,
- W_1, W_2, W_3, and W_4 are the weights assigned from the PCA.

This index effectively captures the overall level of digital financial inclusion by aggregating the diverse dimensions of digital finance accessibility and usage into a single, composite metric. This composite score is subsequently used in further econometric modeling.

In the econometric model under study, the dependent variable is the GDP per capita (2015 Constant US), which measures the overall economic growth of a nation per individual. Widely used in economic research, GDP per capita is a well-established indicator that effectively captures a country's economic performance and living standards. Numerous studies have employed GDP per capita to assess economic growth, reflecting its reliability and significance in economic analysis (Mashrur & Tabassum, 2023). The principal independent variable analyzed is the Digital Financial Inclusion (DFI) Index, designed to gauge digital financial accessibility and engagement within the population. The study analyzes the data using the Generalized Method of Moments (GMM) approach, specifically the Arellano and Bond (1991) estimator. This method is particularly suited for dynamic panel data models where endogeneity and autocorrelation may be present. The model also incorporates several control variables, including Foreign Direct Investment (FDI), Government Expenditure, Trade, and Inflation Rates. These control variables are included to account for other influential factors that could affect the economic growth rate. Given the potential endogeneity of GDP growth rates concerning the explanatory variables, the lagged value of GDP per capita (Lag 1) is used as an instrumental variable. This choice is based on the premise that past economic performance can influence current growth but is less likely to be directly affected by the changes within the same period.

4. Results and Discussion

4.1 Descriptive Statistics

Descriptive statistics of the variables summarized in Table 2, illustrate diverse economic and digital inclusion landscapes. GDP per capita varies significantly, averaging $1,262.73 ranging from $748.01 to $1,785.36, indicating economic disparity across the region. The number of registered mobile money agents averages 609.46 per 100,000 adults but shows extensive variability (standard deviation = 308.78), highlighting inconsistent financial service availability. Examining digital access, it is found that on average, only 20.51% of the population has internet access, with a maximum penetration rate of 49.56%. This underscores substantial digital connectivity challenges. Mobile penetration is notably higher, averaging 81.80 subscriptions per 100 people, which suggests a strong base for mobile-driven financial services despite the lower internet reach. The economic environment is characterized by an average inflation rate of 7.34%, with fluctuations noted as high as 19.87%, reflecting economic volatility. Government spending as a percentage of GDP also shows significant swings, averaging 5.09% but ranging from -11.96% to 21.42%.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
GDP	36	1262.732	303.164	748.015	1785.36
Number of registered mobile money agents per 100,000 adults	36	609.464	308.785	5.604	1226.72
Percentage of the population with internet access	36	20.515	12.103	4.502	49.567
Mobile subscriptions per 100 people	36	81.803	27.308	20.713	137.439
Active Mobile	36	134.939	117.119	0.072	454.226
Inflation	36	7.338	3.167	2.521	19.875
Trade	36	36.444	8.286	24.705	49.246
FDI	36	0.621	0.364	0.132	1.738
Govt Expenditure	36	5.091	6.212	-11.968	21.419

Source: Author's Analysis

4.2 Correlation Matrix

In Table 2, GDP is strongly positively correlated with Active Mobile Money accounts (r = 0.6463), indicating a significant influence of mobile financial activities on economic output. There is also a moderate positive correlation between GDP and Internet penetration (r = 0.2292), suggesting that Internet access contributes to economic growth. Conversely, a slight negative correlation exists between GDP and Inflation (r = -0.2537), implying that higher inflation may adversely impact economic growth. The positive correlation between GDP and Trade (r = 0.4734) highlights the beneficial effects of trade on economic performance. The strong correlation between Internet access and Mobile Subscriptions (r = 0.8592) shows their interconnected role in digital engagement.

Table 2. Correlation Matrix

	GDP	Regist~t	Internet	Mobile~n	Active~y	Inflat~n	Trade	FDI	Govt E~ure
GDP	1								
Registered~t	0.073	1							
Internet	0.229	0.711	1						
MobileSubs~n	0.165	0.408	0.859	1					
ActiveMobi~y	0.646	0.706	0.551	0.302	1				
Inflation	-0.253	-0.079	-0.124	-0.348	0.088	1			
Trade	0.473	0.010	0.067	0.226	-0.425	0.009	1		
FDI	0.060	0.490	0.461	0.146	0.191	-0.106	0.105	1	
Govt Expenditure	0.108	0.061	0.145	0.237	0.104	-0.124	0.025	0.272	1

Source: Author's Analysis

4.3 GMM Results

The results from Generalized Method of Moments (GMM) analysis, as shown in Table 3, the Digital Financial Inclusion (DFI) Index consistently shows a robust positive impact on GDP growth, with coefficients significantly high across models 2 and 3 (62.072 and 62.343 respectively), all significant at the 5% level. This underscores the substantial role that digital financial inclusion plays in enhancing economic productivity. These results highlight the critical role of digital financial inclusion in boosting economic productivity. The substantial coefficients suggest that enhancements in digital financial services and access can lead to significant improvements in economic outcomes. This finding aligns with current literature which posits that digital financial inclusion facilitates a range of economic activities by lowering transaction costs, increasing transaction speed, improving resource allocation, and broadening financial access to underserved populations. These mechanisms stimulate economic activities by enabling more people and businesses to engage in the formal economy and by fostering more inclusive financial environments. As digital platforms expand access to financial services for individuals and businesses alike, it increases economic participation and enhances overall economic efficiency and growth potential.

In all models, the lagged GDP (L.GDP) shows a positive and statistically significant influence on current GDP growth rates, with coefficients ranging from 0.441 to 0.491, indicating the persistence and continuity of economic performance. Among the control variables, Foreign

Direct Investment (FDI) displays a mixed influence; it is positive and significant in the first model (15.090) but turns negative and non-significant in the second model (-0.566), reflecting the variability in FDI's effects on economic growth. Inflation consistently shows a negative impact on GDP growth across the models, with coefficients such as -7.272 in Model 1 and -6.540 in Model 2, significant at 10% and 5% levels respectively, highlighting the detrimental effects of rising price levels on economic growth. Government expenditure (Govt) and Trade also show varied effects; Government expenditure does not have a significant impact in Model 1, but it is positive and significant in Model 3 (1.314), suggesting context-dependent impacts of fiscal policy. Trade has a positive and significant effect on GDP growth in Model 1 (3.956), but it is not significant in Model 2, indicating that trade openness can sometimes foster economic growth.

Table 3. GMM Results

	(1) Model 1	(2) Model 2	(3) Model 3
L.GDP	0.491^{***}	0.478^{**}	0.441^{*}
	(0.078)	(0.133)	(0.152)
DFI Index	48.323^{**}	62.072^{**}	62.343^{**}
	(12.141)	(17.425)	(12.992)
FDI	15.090^{*}	-0.566	
	(174.697)	(22.037)	
Inflation	-7.272^{*}	-6.540^{**}	-1.754^{*}
	(2.995)	(3.367)	(3.726)
Govt Ex~ure	-3.383		1.314^{**}
	(2.491)		(0.835)
Trade	3.956^{*}	3.543	
	(1.920)	(1.656)	
Observations	30	30	30

Standard errors in parentheses
$^{*}p < 0.10,$ $^{**}p < 0.05,$ $^{***}p < 0.01$
Source: Author's Analysis

5. Conclusion

This paper highlights the significant impact of digital financial inclusion on economic growth in South Asia, particularly across Bangladesh, Pakistan, and Nepal. The findings demonstrate a strong positive impact of Digital Financial Inclusion (DFI) Index on GDP growth, underscoring the potential of digital financial services to enhance economic productivity and participation. The analysis also reveals the influence of various economic factors such as government spending, trade, and foreign direct investment on the effectiveness of digital financial inclusion. Policymakers are encouraged to strengthen regulatory frameworks and ensure economic stability to optimize the benefits of digital financial services. Continued investment in digital technology and further research are essential to fully grasp the long-term impacts of digital financial

inclusion on the region's economic development, aiming to foster a more equitable and sustainable economic environment.

Declaration of Competing Interest

- No Conflict of interest.

Funding Availability

- This study got no funding.

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