

The Contribution of Digital Finance in Economic Growth with Moderating Role of Financial Development in BRICS Countries

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Abstract

This paper examines the impact of digital finance on the economic growth of BRICS countries (Brazil, Russia, India, China, and South Africa) from 2000 to 2023, emphasising the role of financial development as a moderator. Digital finance enhances financial inclusion, lowers transaction costs, and improves resource allocation, which is reflected in mobile subscriptions. The study employs a quantitative design using secondary panel data from the World Bank, utilising a log-linear regression model that incorporates various factors such as government expenditure, employment, trade openness, inflation rates, and foreign direct investment (FDI). Findings reveal a significant positive effect of digital finance on economic growth, with a stronger financial development framework amplifying this effect. The research suggests that enhancing the existing financial system is crucial for maximising the advantages of digital banking in poorer nations. It emphasises the importance of investing in digital infrastructure, financial literacy, and inclusive credit markets to leverage digital finance for sustainable growth in BRICS and other emerging markets.

Keywords: Digital Finance, Economic Growth, Financial Development, BRICS Countries, Panel Data Analysis, Financial Inclusion, Endogenous Growth Theory, Resource Allocation.

Introduction

The digitisation of the financial industry, or "digital finance," has gained importance in recent years. To address economic recessions in developing and emerging countries, promoting financial access has helped. In a broader sense, digital finance has served as a driving force behind financial accessibility and is commonly recognised as the means of improving financial inclusion going forward (Gomber, 2017). By providing more specialised financial services and solutions, digital banking has demonstrated significant promise in reaching underserved and underprivileged communities. The literature now in print claims that advancements in digital finance create new,

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affordable investment options that support financial inclusion and have a good welfare impact (Yang et al., 2023).

Many emerging nations have achieved rapid economic growth over the last three decades by depleting their resource stocks. It is clear that rapid industrialisation, population growth, urbanisation, and population expansion in Brazil, China, India, and Mexico have made air and water pollution a serious issue. Financial development could, in this case, moderate the impact of digital finance on economic growth, either increasing or reducing it. Digital banking alone can lead to economic growth, but its effects tend to be more evident in settings with more established financial institutions (Beck, 2007).

Digital banking reduces transaction costs, increases productivity, and fosters capital accumulation by making financial services more accessible, particularly to marginalised communities (Suri, 2016). However, the impact of digital currency on economic development varies, and a country's level of financial development can influence this effect. The size, accessibility, and effectiveness of financial markets and institutions define financial development, which can moderate the extent to which digital finance translates into economic outcomes (Sahay et al., 2020).

In countries with more advanced financial systems, digital banking might have a more beneficial effect due to better infrastructure and regulatory support (Pradhan et al., 2018). For example, China and India have advanced significantly in their adoption of digital finance due to supportive policies and rapid dissemination of technology, while other BRICS nations may lag behind due to institutional constraints or insufficient financial infrastructure (Manyika et al., 2016). The purpose of this study is to examine how digital finance contributes to economic growth in the BRICS countries and evaluate how financial development influences this relationship. In addition to contributing to the corpus of scholarly work, this kind of study provides policymakers with valuable insights into leveraging digital innovations to drive economic change.

Problem Statement

Over the past decade, digital finance has significantly influenced the global economy through services like peer-to-peer lending and mobile payments, particularly in the BRICS countries (Brazil, Russia, India, China, and South Africa). Despite their potential, the benefits of digital finance are unevenly distributed due to differences in infrastructure, regulatory frameworks, and financial literacy. While China and India excel in fintech and financial inclusion, South Africa and Russia face more challenges. This paper underscores the need to understand how financial development moderates the relationship between digital finance and economic growth in these countries. Current studies reveal that the effectiveness of digital banking is heavily influenced by a country's financial system and regulatory environment. The varying regulatory frameworks within the BRICS complicate the impact of digital finance on economic growth, necessitating policy adjustments to maximise its benefits. Addressing the existing knowledge gap is crucial for ensuring that digital financial innovations contribute to equitable development and support sustainable growth in the BRICS region.

Research Objectives

1. To analyse the impact of digital finance on economic growth.
2. To evaluate the moderating role of financial development in the relationship between digital finance and economic growth.

Research Questions

1. What is the impact of digital finance on economic growth?
2. How does financial development influence the relationship between digital finance and economic growth?

Research Hypotheses

1. Digital finance positively impacts economic growth.
2. Financial development moderates the relationship between digital finance and economic growth

Significance of the Study

This study explores how digital finance influences economic development within the BRICS countries: Brazil, Russia, India, China, and South Africa. It discusses the role of digital finance, including mobile banking, digital payment systems, and online lending, in changing the way financial services are delivered and improving access to financial tools. The research examines the link between digital finance and economic progress, showing that it can increase the availability of funds, reduce transaction costs, improve productivity, and expand access to financial services. The study also examines the levels of financial preparedness across BRICS nations and how these differences influence the ability of digital finance to support economic growth. It points out that digital finance can help reduce inequality and encourage greater economic participation. The research recommends that policymakers support innovation and digital inclusion while maintaining the stability and security of financial systems. It argues that combining digital finance with effective economic development strategies can lead to stronger growth and greater financial stability in developing economies.

Literature Review

Digital Finance

Digital finance is the fusion of financial services and digital technologies. The advancement of information technology, artificial intelligence, and big data analysis has substantially benefited digitalisation (Ozili, 2021). The growing use of digital technologies in the banking and finance industry's operations and product development is known as "digitalisation." Digital finance provides people and businesses with access to a wide range of sustainable financial services, such as online payments, credit, investments, remittances, and savings. These digital services are used by both individuals and businesses via bank digital channels such as point-of-sale terminals, ATMs, and mobile apps. New fintech services, such as digital ledger technology, peer-to-peer applications, and cryptocurrencies, are being provided in addition to the previously listed digital payments services (Kshetri, 2019).

"Digital finance," or the digitisation of the financial industry, has become increasingly important in recent years. It has contributed to advancing financial inclusion by addressing the problem of financial depressions in developing and emerging countries. Broadly speaking, digital finance has made financial inclusion easier and is widely seen as a strategy for advancing it in the future (Hangzhou & China, 2016). Compared to traditional forms, digital finance is more comprehensive and deep. Information asymmetry can be mitigated efficiently, and transaction costs for financial resources can be reduced with the rise of digital finance and other big data finance. Simultaneously, digital finance expands company space or enterprise growth, opens up new avenues for

autonomous enterprise innovation, widens enterprise financing channels, and reduces the financial barriers to such innovation (Li et al., 2021).

The combination of traditional financial services with digital and information technology is known as digital finance, or Internet finance. Thanks to big data and information technology, digital finance provides small and medium-sized organisations (SMEs) and consumers with sustainable financial services (Wang, 2018). Additionally, digital finance provides consistent technical support to expand the scope and accessibility of financial services. Peer-to-peer lending, digital payments, and other business models have significantly reduced the cost of identifying and assessing risks, thereby eliminating the need for financial institutions to act as middlemen. As a result, businesses can reduce financing costs and shorten the funding period (Zhang, 2020).

Financial Development

Financial Development, according to Levine (2005), is the process of enhancing the services that the financial system offers, including facilitating the exchange of goods and services, guiding capital toward lucrative investment opportunities, spreading risks, monitoring and managing the risks associated with these investments, and facilitating savings. To a certain extent, financial advancement can reduce information asymmetries, encourage risk-sharing, and ease financial constraints. Furthermore, financial growth makes the financial system more resilient to economic shocks, mitigates their negative effects, and lowers social inequality and macroeconomic instability.

The relevant literature has extensively examined the development of finance, a vital component in improving the national economy (Shen, 2006). Enhancing financial markets is crucial for economic growth because it boosts the system's efficiency, according to Levine (1997). The banking and financial industries have recently seen significant changes due to the rapid development of information and communication technologies. The global banking sector has been the biggest consumer of information and communication technology (ICT) goods and services since the middle of the 1990s. In its 2011 Financial Development Report, the World Economic Forum defined financial development as "the elements, regulations, and establishments that result in prosperous financial intermediation and markets, as well as extensive and widespread access to capital and financial services" (WEF, 2011).

A component of financial development, financial inclusion gives low-income households access to savings, insurance, and credit products, facilitating investments in human capital and easing consumption. According to research (Beck, 2007), financial development reduces income inequality by disproportionately benefiting the poor. According to King (1993), nations with more advanced financial systems typically see greater rates of productivity gains and capital accumulation. Financial advancement refers to the improvement in the volume, quality, and effectiveness of financial entities, markets, and tools within an economy.

Economic Growth

The rise in an economy's output of goods and services over a given time period is known as economic growth. Real gross domestic product (GDP) growth, which illustrates improvements in a nation's output and economic well-being, is typically used to gauge this. A number of factors, including improvements in capital resources, workforce size, technical advancements, and productivity gains, can drive economic expansion. Changes in the number of workers, impacted by immigration, demographic expansion, and differences in worker participation, are often associated with economic growth (Barro, 1997).

Economic growth remains one of the most fascinating and relevant areas of economics. It is pertinent because of the questions it answers. When Adam Smith developed many of the foundations of modern economics, there were likely few distinctions between the richest and poorest nations in the world (Ibrahim, 2018).

Together, the five emerging economies that comprise BRICS—Brazil, Russia, India, China, and South Africa—account for 17% of global trade, 30% of global GDP, and 43% of the world's population. Although the BRICS economies share many traits, they also diverge significantly. For example, the domestic service sector is the main driver of the Brazilian economy; energy and natural resource exports are the main drivers of the Russian economy; foreign investment and manufacturing exports are the main drivers of the Chinese economy; and natural resources are the main source of the South African economy (Das & Chatterjee, 2019).

Although previous studies have demonstrated that trade and foreign direct investment (FDI) positively affect economic development, the extent of this effect may differ across nations, depending on variables such as infrastructure, trade openness, human capital, capital investments, and macroeconomic stability. Research has examined the importance of trade and foreign direct investment (FDI) in economic development, as well as the role that economic development and capital formation play in promoting trade and FDI (Banday et al., 2021).

The BRICS nations are now the most closely watched group, accounting for about 20% of global GDP. Since each nation is at a distinct stage of economic development, countries can collaborate to significantly increase foreign reserves, expand financial markets, invest in their regions of dominance, and drive domestic growth. GDP is essentially a tool for evaluating a country's economic performance and contrasting it with that of other countries worldwide. Net exports, corporate investments, government expenditures, and consumer spending are the main determinants of a country's GDP. A country's GDP provides a comprehensive view of its economic status and can be used to determine whether it is expanding or contracting. The combined GDP of the BRICS countries is 22%. These nations account for 42% of the world's population and 32% of its arable land mass, respectively (Dua & Upadhyaya, 2019).

Hypothesis Development

Digital finance and economic growth

Digital finance helps SMEs, which are important engines of innovation and job creation, by making credit, microfinance, and peer-to-peer lending platforms more accessible. In Sub-Saharan Africa, Zins (2016) demonstrated that digital financial services facilitate SME growth and reduce credit constraints. On a larger scale, the expansion of digital finance is associated with higher GDP growth, driven by increased investment, consumption, and economic formalisation. IMF research by Sahay et al. (2015) demonstrated that increased financial inclusion, aided by digital technologies, can dramatically boost GDP growth, especially in low-income nations.

The delivery of precise and comprehensive financial solutions is the essential trait of digital finance, emerging from the integration of financial services with digital innovations like the Internet (mobile Internet and the Internet of Things), extensive data, distributed systems (cloud computing and blockchain), artificial intelligence, and secure information through biometrics and encryption (Ma Degong, 2020). In light of the needs of financial services for economic growth, digital finance is described here as a solution that emerges from the integration of conventional finance and technological advancements, enabling the tackling of challenges related to restricted access to traditional funding and subpar service quality and effectiveness (Teng, 2020).

The literature now in publication makes a direct or indirect connection between digital finance and economic growth, as well as with topics such as household consumption, gender equality, traditional financial markets, financing, and poverty alleviation. As the growth and development of digital finance requires established suppliers of banking business and financial services to adapt, new levels of user-centricity in the traditional financial market require diversified, economical, and intelligent financial products and services (Lorente, 2018).

Unlike the past three decades of high-speed expansion, China's economy has entered a "new normal" stage, transitioning from high-speed growth to high-quality growth. Reduced element and resource supply efficiency, reduced resource allocation efficiency, a lack of innovation potential, and growing resource and environmental restrictions, which manifest as economic structural deceleration, are among the issues limiting China's economic development in the new stage. Currently thriving and emerging as a new engine for future economic growth, digital finance is a combination of financial innovation and digital technology (Huang, 2018).

Digital Finance and Financial Development

The connection between digital finance and financial progression is reciprocal: Digital finance enhances financial progression by increasing accessibility, efficiency, and creativity in financial services. Financial progression fosters digital finance by supplying the essential institutional and infrastructural framework (regulatory systems, online connectivity, credit reporting agencies) needed for fintech to flourish.

Better risk management tools and more varied funding options are two ways that digital financial systems can improve the stability and resilience of financial organisations. Crowdfunding and peer-to-peer lending can be used in conjunction with traditional financial institutions to lower the danger of concentration. But to promote sustainable financial development, digital finance also poses risks (including cybersecurity and data privacy), which need to be managed (Arner, 2015). In addition, digital finance is becoming increasingly important in meeting our most urgent needs, as it supports social safety nets and economic assistance, which is why politicians and academics are paying closer attention to it. To put it briefly, digital finance has transformed financial development theory and organisational models of financial institutions, progressively becoming a useful tool for developing market nations to address financial exclusion (Jiang et al., 2022).

Additionally, Pradhan et al. (2021) used empirical data from India to examine the relationship between financial advancement, digital finance, and ICT adoption. They discovered that the expansion of ICT infrastructure, particularly mobile networks and internet access, contributed to the rapid rise of digital financial platforms, including electronic payments and mobile banking. Their results showed that digital finance helped India's overall financial development and significantly enhanced financial inclusion. For ordinary investors, the capital markets are now more accessible thanks to digital platforms. People may participate in the financial markets with little cash outlay thanks to robo-advisors, online trading platforms, and crowdfunding websites. These advancements democratize access to funds and investments, fostering greater financial development by expanding capital markets (Chen et al., 2019).

Control Variables

Foreign direct investment is an investment made by a corporation or individual in one country into businesses located in another. When an investor establishes overseas commercial operations or acquires foreign business assets, including obtaining ownership or a controlling position in a foreign company, this is known as overseas direct investment (OECD, 2019).

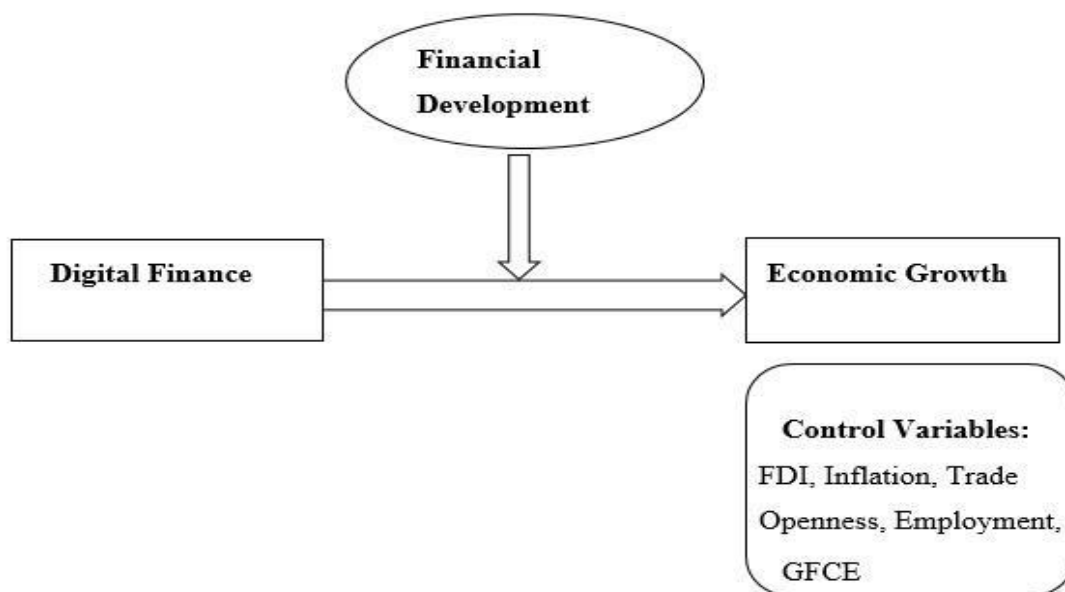
One of the most well-known concepts in economics is inflation. The rate of price increases over a given period of time is known as inflation. In general, inflation is a wide indicator, such as the general increase in prices or the cost of living in a country (Oner, 2010).

Trade openness was defined by Sachs (1995) as a composite measure based on communist trade regimes, black-market exchange rates, and tariff rates. They found that open economies typically grow faster than closed ones. The absence of restrictions or a free-trade approach is known as openness. Therefore, the term "trade openness" refers to the extent to which a home nation permits international trade. The secret to wealth is trade, which allows countries to flourish economically at breakneck speed. It is among the best solutions that economies can implement to eradicate social problems such as unemployment and poverty (Collier, 2002).

The BLS releases the ratio each month along with the unemployment rate and other data, and it is one of numerous metrics used to evaluate the strength of the labour market. It is mostly employed as a gauge of job holders and to monitor the rate of employment creation over time. In relation to the adult population ratio of 62.9% in November 2007, 62.9% of adults were employed before levelling off at about 58.5% in October 2009. points of 58.5% between October 2009 and March 2014. population ratio has gradually increased, reaching its April 2015 high of 59.3% (Donovan, 2015).

Government spending on products and services that directly meet the needs of community members, whether individually or collectively, is referred to as general final consumption expenditure (GFCE). Government final consumption expenditure refers to government spending on goods and services directly consumed to satisfy the needs of people or society at large, excluding capital investment (IMF, 2020).

Figure 1: Conceptual Framework



Theoretical Evidences

Endogenous Growth Theory

The endogenous growth theory holds that economic growth is mostly caused by internal, not external, sources. Knowledge, innovation, and human capital investments are regarded as important growth drivers. Increased returns to scale and steady, long-term economic growth are possible outcomes of these investments. The theory of endogenous growth posits that interventions, like grants for research and education, can lead to a lasting impact on the economy's growth rate (Romer, 1990).

Knowledge and innovations have the potential to diffuse throughout the economy and boost productivity in all areas. Investing in education and skills increases the potential for innovation and worker productivity. Knowledge-based investments have the potential to generate growing returns, in contrast to physical capital's declining returns. Government policies that promote innovation and capital accumulation, such as those related to education and R&D subsidies, can boost growth (Lucas, 1988).

Financial Intermediation Theory

Essentially, it is argued under the concept of financial intermediation that financial intermediaries, including banks, fintech firms, and microfinance institutions, can serve as an intermediary between the savers and the borrowers. These teams address the presence of information asymmetries in financial markets, control risk, and reduced transaction costs. The financial system is dependent on financial intermediaries to reduce the cost of information and transaction services (Freixas, 2008).

Digital finance is a term used to refer to the delivery of financial services (savings accounts, loans, insurance, payment, etc.) using digital platforms, mobile devices or the internet. Financial intermediation theory has many significant ways of advancing digital finance: To close the information gap between lenders and borrowers, digital platforms apply digital footprint, artificial intelligence, and data analytics to assess creditworthiness. As an example, credit scores are calculated by lending applications and mobile money applications including M-Pesa and Ant Financial based on transaction data. Digital tools enhance the capacity of the intermediaries to reduce adverse selection (Diamond, 1984).

Methodology

Sample

Panel data from the BRICS (Brazil, Russia, India, China, and South Africa) countries' annual observations from 2000 to 2023 are used in this study. The information came from reputable global database like: World Bank Development Indicators (WDI). These resources provide reliability and coherence across nations and eras.

Model Specification

The model analyzes the effect of digital finance on economic progress with financial development acting as a moderator and accounting for inflation, FDI, employment, GFCE, and trade openness. This log-linear panel regression adheres to similar methodologies utilized in empirical economic growth research (R. Levine, 2005a; Svirydzienka, 2016)

$$\ln(\text{GDPit}) = \beta_0 + \beta_1 \ln(\text{DFit}) + \beta_2 \ln(\text{FDit}) + \beta_3 (\ln(\text{DFit}) \times \ln(\text{FDit})) + \beta_4 \ln(\text{INFit}) + \beta_5 \ln(\text{FDIit}) + \beta_6 \ln(\text{EMPit}) + \beta_7 \ln(\text{GFCEit}) + \beta_8 \ln(\text{TOit}) + \varepsilon_{it}$$

Table 1: Variable description

Variable	Proxy	Definition	Source
Digital Finance (DF)	Mobile cellular subscriptions (per 100 people)	The number of public mobile phone service subscriptions per 100 individuals is known as mobile cellular subscriptions. utilized as a stand-in for financial inclusion and digital access.	World Bank (World Development Indicators, 2024)
Economic Growth (EG)	GDP (constant 2015 US\$)	Gross Domestic Product in constant 2015 US dollars reflects the value of all goods and services produced, adjusted for inflation.	World Bank (WDI, 2024)
Financial Development (FD)	Domestic credit to private sector (% of GDP)	This gauges the amount of money that financial institutions give to the private sector, revealing the depth and effectiveness of the financial system.	World Bank (WDI, 2024)
Foreign Direct Investment (FDI)	Net inflows (% of GDP)	net investment inflows to have a long-term stake in businesses that are active in an economy.	World Bank (WDI, 2024)
Inflation (INF)	Consumer Price Index (CPI, annual %)	Inflation levels are shown by the average yearly percentage change in consumer prices.	World Bank (WDI, 2024)
Employment (EMP)	Employment to population ratio (% ages 15+)	The percentage of a nation's working-age population that is employed, indicating the use of the labor market.	World Bank (WDI, 2024)
Government Final Consumption Expenditure (GFCE)	General government final consumption expenditure (% of GDP)	refers to the amount of money the government spends on products and services for investment or direct consumption.	World Bank (WDI, 2024)
Trade Openness (TO)	Sum of exports and imports (% of GDP)	Global integration is shown by trade openness, which is calculated as the total value of goods and services imported and exported as a proportion of GDP.	World Bank (WDI, 2024)

Econometrics Estimation

This study quantitatively examines the impact of an independent variable on a dependent variable using secondary data from 2000 to 2023 across BRICS countries. Employing descriptive and analytical frameworks, it applies statistical models and diagnostic tests to ensure reliable, accurate findings on variable relationships within these nations (Wooldridge, 2016).

Results and Discussion

This provides empirical evidence for data analysis methods such as correlation matrices, regression models, and descriptive statistics. It places a strong emphasis on providing quantitative evidence to support assertions regarding the impact of digital finance on financial development and economic advancement, requiring reliable policy recommendations supported by solid empirical research findings.

Table 2: Descriptive statistics

Variable	Mean	Mean	Min	Max
GDP(CONSTANT)	13.53204	.5907081	12.43247	14.24009
MCS	8.352672	.6084514	6.513218	9.257679
DCPS(BANK)	1.734496	.2376782	1.22591	2.289308
DCPS(GDP)	1.789311	.2293914	1.226285	2.289308
FDI	.3229181	.2436641	-.6195834	.701906
INF	.7190186	.3165322	-.6292338	1.331974
TO	1.636711	.1317734	1.34451	1.871668
EMP	1.7763	.0444634	1.676657	1.855949
GFCE	1.188894	.0895381	.9913356	1.317783

The table provides descriptive statistics for the variables of interest in the study. GDP has a mean of 13.53 and a relatively low standard deviation, while MCS has a mean of 8.35. The financial development metrics (DCPS Bank and DCPS GDP) have means of 1.73 and 1.78, FDI and inflation have relatively large standard deviations with their lowest values going into the negatives, trade openness is again fairly constant with a mean of 1.63 and employment is the least variable. GFCE has a mean of 1.18.

Table 3: Correlation Matrix

Variables	GDP(C ONST ANT)	MCS	DCPS(B ANK)	DCPS(GDP)	FDI	INF	TO	EMP	GFCE
GDP(CON STANT)	1.0000								
MCS	0.3811*** 0.0002	1.0000							
DCPS(BA NK)	0.1786* 0.0903	0.6647*** 0.0000	1.0000						
DCPS(GD P)	0.1786* 0.0903	0.5948*** 0.0000	0.8895*** 0.0000	1.0000					
FDI	-0.4576*** 0.0000	0.0756 0.4178	0.1158 0.2180	0.1027 0.2748	1.0000				
INF	-0.0910 0.3881	-0.3665*** 0.0001	-0.7143*** 0.0000	-0.6272*** 0.0000	0.0957 0.3071	1.0000			
TO	0.7152*** 0.0000	0.1042 0.2613	-0.0844 0.3698	0.1520 0.1050	-0.0807 0.3853	0.2392** 0.0097	1.0000		
EMP	-0.2070** 0.0431	-0.0276 0.7667	0.3834*** 0.0000	0.5990*** 0.0000	0.2634*** 0.0040	-0.3437*** 0.0002	0.1921** 0.0355	1.0000	
GFCE	-0.5994*** 0.0000	-0.1755* 0.0573	0.0651 0.4895	0.0504 0.5928	0.3210*** 0.0004	-0.0045 0.9621	-0.2900*** 0.0013	0.4579*** 0.0000	1.0000

The correlation matrix reveals that **GDP** holds a positive and statistically significant link with **MCS** and **trade openness (TO)**, whereas it exhibits a negative relationship with **FDI**, **employment (EMP)**, and **GFCE**. MCS demonstrates a robust positive connection with **DCPS (Bank)** and **DCPS (GDP)**. Inflation shows a significant negative association with financial development variables. The relationship between **DCPS (Bank)** and **DCPS (GDP)** is extremely strong, suggesting a potential multicollinearity concern in regression analysis.

Results of Digital Finance and Economic Growth Nexus

Firstly, using data from 2000 to 2023, we run the model to examine the direct relationship between digital finance and economic growth in the case of BRICS countries.

Table 4: Fixed Effect Model DF GDP

GDP(constant)	Coef.	Std. Err.	T	P>t
MCS	.2328595	.013421	17.35	0.000***
FDI	.1448203	.0301396	4.80	0.000***
INF	.0716182	.0297506	2.41	0.018**
TO	.8731988	.1193734	7.31	0.000***
EMP	3.161894	.4140421	7.64	0.000***
GFCE	1.07728	.3677102	2.93	0.004***
_cons	19.82675	1.06953	18.54	0.000***

Table 5: Random Effect Model for DF GDP

GDP(constant)	Coef.	Std. Err.	Z	P>z
MCS	.2200809	.0571752	3.85	0.000***
FDI	.7523874	.1346217	5.59	0.000***
INF	.1604539	.1373462	1.17	0.243
TO	2.700073	.2782694	9.70	0.000***
EMP	.8034628	1.148953	0.70	0.484
GFCE	1.187129	.4306342	2.76	0.006**
_cons	10.52803	1.850012	5.69	0.000***

Within the Fixed Effect model, each independent variables MCS, FDI, INF, TO, EMP, and GFCE holds statistical significance at typical levels, with EMP exhibiting the most robust positive influence (coefficient of 3.16). However, upon transitioning to the Random Effect model, both INF ($p = 0.243$) and EMP ($p = 0.484$) forfeit their statistical significance, while the coefficients for FDI, TO, and INF drastically increase compared to the estimates from the Fixed Effect model. The pronounced contrast between the two models, particularly the diminishing significance of INF and EMP in the Random Effect specification, implies that individual-specific effects are probably correlated with the independent variables.

Table 6: Hausman Test

Variable	Fixed	Random	Difference
MCS	.2328595	.2200809	.0127786
FDI	.1448203	.7523874	.6075671
INF	.0716182	.1604539	.2320721
TO	.8731988	2.700073	3.573272
EMP	3.161894	.8034628	2.358431
GFCE	1.07728	1.187129	.1098487

To determine whether the fixed effects model or the random effects model is more appropriate, the Hausman test was used. A robust variation using *suest* is advised in this case, as the results showed a negative chi-square value (-389.99), indicating a violation of the test's asymptotic assumptions and indicating that the standard Hausman test is invalid. Random effects are preferred over pooled OLS, as evidenced by the significant result obtained from the Breusch-Pagan Lagrange Multiplier test ($\text{chibar2} = 30.34$, $p = 0.0000$).

Impact of Financial Development as a Moderator in the Digital Finance–Economic Growth Nexus

Secondly, using the same panel data from 2000 to 2023, we run the model to examine the moderating role of financial development in the relationship between digital finance and economic growth across BRICS countries.

Table 7: Fixed Effect Model Financial Development as Moderator for DFGDP

GDP(constant)	Coef.	Std. Err.	T	P>t
MCS	.6263952	.0771373	8.12	0.000***
DCPS(bank)	4.320659	.4002588	10.79	0.000***
interaction	.5374455	.0484004	11.10	0.000***
FDI	.0023197	.0213333	0.11	0.914
INF	.0506067	.0214998	2.35	0.021**
TO	.3831107	.0849466	4.51	0.000***
EMP	.5142978	.3606648	1.43	0.158
GFCE	.545293	.2400295	2.27	0.026**
_cons	20.57005	.7155615	28.75	0.000***

Table 8: Random Effect Model Financial Development as Moderator for DFGDP

GDP(constant)	Coef.	Std. Err.	Z	P>z
MCS	.6433912	.3528919	1.82	0.068*
DCPS(bank)	5.177495	1.90809	2.71	0.007**
interaction	.5680562	.2117428	2.68	0.007**
FDI	.5774817	.1494096	3.87	0.000***
INF	.2732388	.1532589	1.78	0.075*
TO	2.740793	.2864417	9.57	0.000***
EMP	.9527821	1.493907	0.64	0.524
GFCE	1.136471	.4293623	2.65	0.008**
_cons	18.59466	4.070001	4.57	0.000***

In the moderator frameworks (Tables 7 and 8), the variable for financial development (DCPS bank) along with its interaction term presents a positive and strongly significant correlation in both Fixed and Random Effect models, indicating that financial development effectively moderates the association with DFGDP. MCS continues to be positive but diminishes in strength in the Random model ($p = 0.068$). The robust significance of the interaction term in both frameworks suggests that financial development enhances the impacts on DFGDP, though the discrepancies between Fixed and Random estimates once again indicate the Fixed Effect model for reliable selection.

Table 9: Hausman Test

Variable	fixed	Random	Difference
MCS	.6263952	.6433912	.016996
DCPS(bank)	4.320659	5.177495	.8568355
interaction	.5374455	.5680562	.0306107
FDI	.0023197	.5774817	.5798014
INF	.0506067	.2732388	.2226322
TO	.3831107	2.740793	3.123903
EMP	.5142978	.9527821	.4384843
GFCE	.545293	1.136471	.5911779

The Hausman test evaluates the suitability of fixed and random effects models. Since the model does not match the test's assumptions, the χ^2 result in this instance is negative (-71.16), which is invalid and suggests that the Hausman test is not reliable in this situation. Instead, the comment suggests use a generalist approach such as *suest*. Random effects are chosen over pooled OLS because the Breusch-Pagan Lagrangian Multiplier (LM) test yields $\text{chibar}^2(01) = 25.61$, $p = 0.000$, indicating that the variance of the random effects (u) is not zero.

Multicollinearity Results

The study assesses multicollinearity among independent variables in a multiple regression model using economic growth as the dependent variable.

Table 10: Variance Inflation Factor

Variables	VIF	1/VIF
DCPS(Bank)	8.49e+06	0.000000
DCPS(GDP)	8.49e+06	0.000000
MCS	6.24	0.160139
EMP	4.96	0.201670
INF	3.31	0.302033
TO	2.10	0.475349
GFCE	2.10	0.475418
FDI	1.39	0.717526
Mean VIF	2.12e+06	

The VIF results reveal extreme multicollinearity between DCPS(Bank) and DCPS(GDP), with values far exceeding the threshold of 10. This may distort regression estimates, suggesting the need to merge or remove these variables. Other variables show no significant multicollinearity.

Heteroscedasticity Results

Heteroscedasticity tests check if error variances in regression models remain constant across independent variable levels. A p-value below 0.05 indicates heteroscedasticity, violating this assumption and causing biased standard errors. Values above 0.05 confirm constant error variance and model reliability.

Table 11: Heteroscedasticity

Variable	Chi2(1)	Prob > chi2
GDP constant	0.02	0.8887

The χ^2 value of 0.02 and p-value of 0.8887 from the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity are significantly higher than 0.05. This indicates that the assumption of homoscedasticity is true and that there is no evidence of heteroscedasticity in the model, as we are unable to reject the null hypothesis of constant variance.

Discussion

This research examines the impact of digital finance on economic development in BRICS countries from 2000 to 2023, focusing on the mediating role of financial growth. Using panel data, it analyses GDP, credit, mobile subscriptions, and control variables. Findings reveal a strong positive link between digital finance and GDP, supporting endogenous growth theory by showing reduced

transaction costs, improved credit access, and enhanced financial inclusion in these nations.(Asiedu, 2002). The encouraging and significant interaction term (coefficient = 0.537, $p < 0.01$) confirms the moderating influence of financial development (domestic credit to the private sector), indicating that robust financial systems amplify the growth benefits of digital finance by efficiently allocating capital, in line with resource distribution theory. Among the control factors, trade openness and GFCE consistently show positive impacts on growth, while FDI exhibits a negative correlation, suggesting poor utilisation within BRICS economies (Chen, 2022).

Conclusion

A panel data survey of BRICS countries (Brazil, Russia, India, China, and South Africa) between 2000 and 2023 showed that digital financing greatly improved economic progress and that financial development played an important moderating role. However, there are differences in the advantages between countries: China and India have a greater impact due to their sophisticated fintech environments, while South Africa and Russia face institutional obstacles. In summary, digital finance holds the potential to revolutionise economic advancement when bolstered by sophisticated financial institutions, and BRICS policymakers should emphasise digital infrastructure, financial education, and strong regulatory frameworks to fully leverage these advantages. The theoretical importance of this study is that several key economic theories are implemented and elaborated in the framework of digital finance and economic growth of the BRICS countries. To explain the role of digital finance in enhancing the growth of human capital and innovation in long-term economic growth, the paper demonstrates using the Endogenous Creation Theory that digital finance, as illustrated by mobile cellular subscriptions, promotes the growth of both human capital and innovation. This gives some truth to the assertion made by(Romer, 1990), he national long-term growth is impossible without intellectual transfer and technical innovation. The paper also explains how digital platforms could enhance financial efficiency and inclusion by reducing transaction costs and information asymmetry, which has been proposed by the Financial Intermediation Theory as being workable (Diamond, 1984).

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