



ICT, FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN BRICS COUNTRIES

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Abstract

The development and transformation of advanced technologies are considered vital for maintaining competitive economic growth and to have treasure and capacity of more efficient energy in the region. This has attracted many researchers and policy makers to explore the impact of ICT and other digital technologies to check their contribution in the country's economic growth and sustainability. In lieu of these connections, the study aims to explore the impact of ICT and financial development on economic growth of BRICS countries. We analyzed the data of these countries from 2000 to 2018. The data was checked for the penal protocol procedures and hypothesis were tested using Quantile Regression. The outcomes of the study revealed that all dimensions of ICT i.e. ICT-Tel, ICT-Mob and ICT-Net have positive significant effect of the GDP of BRICS countries. The results also highlight the impact of financial development on economic growth and reported positive significant impact of financial development on the economic growth of this region. The results are expected to be very meaningful for the relevant regulatory bodies and specially the economic think tank of these countries.

Key Words: ICT, FD, GDP, Quantile Regression, BRICS

Introduction

The interplay between Information and Communication Technology (ICT), financial development, and economic growth is a dynamic and mutually influential relationship. ICT has revolutionized the financial sector, impacting its structure, operations, and accessibility. This, in turn, has significant implications for economic development and growth. ICT has transformed the way financial services are delivered, making them more efficient, convenient, and accessible. With the advent of online banking, mobile payment systems, and digital currencies, individuals and businesses can conduct financial transactions seamlessly, transcending geographical boundaries. ICT has facilitated the automation of processes, reduced transaction costs, and accelerated the speed of financial transactions, thereby improving overall financial efficiency. Furthermore, ICT plays a pivotal role in promoting financial inclusion, which is crucial for economic development. Through ICT-enabled platforms, individuals who were previously excluded from the formal financial system can now access a range of financial services, including savings accounts, loans, and insurance. This increased financial inclusion empowers individuals and businesses, enabling them to participate more actively in economic activities and access opportunities for growth.

Financial development, driven by ICT, also has a direct impact on economic growth. A well-developed financial sector facilitates efficient allocation of resources, mobilizes savings, and channels funds to productive investments. ICT enhances financial intermediation by providing platforms for crowdfunding, peer-to-peer lending, and digital banking, which stimulate investment and entrepreneurial activities. The availability of financial services and access to credit encourage entrepreneurship, innovation, and the expansion of small and medium-sized enterprises, contributing to overall economic growth. Moreover, ICT facilitates the dissemination and sharing of information, leading to better-informed decision-making and resource allocation. This enables businesses to adapt to market conditions, identify emerging opportunities, and make strategic investments. The widespread adoption of ICT also promotes knowledge sharing, collaboration, and innovation, fostering technological advancements and productivity gains, which are vital drivers of long-term economic growth. However, it is important to recognize that the relationship between ICT, financial development, and economic growth is not without challenges. While ICT has the potential to democratize access to financial services, it also exacerbates the digital divide, leaving marginalized populations behind. Moreover, the rapid pace of technological advancements poses regulatory and security challenges, requiring robust frameworks to ensure consumer protection, data privacy, and financial stability.

ICT has emerged as a transformative force in the financial sector, reshaping financial systems, expanding access to financial services, and driving economic growth. By harnessing the power of ICT, policymakers, financial institutions, and stakeholders can foster financial development, enhance financial inclusion, and unlock the full potential of technology for sustainable and inclusive economic growth. However, addressing the associated challenges is crucial to ensure that the benefits of ICT-driven financial development are widely shared and contribute to broader societal well-being.

Literature Review

ICT and Financial Development

ICT and financial development have been linked positively theoretically, but actual research has produced conflicting findings. Alshubiri et al., (2019) used system GMM to quantitative empirical study that there is the correlation between the variables of ICT and financial development in a panel data paradigm for the MENA nations in order to verify the conceptual perspective on the topic. Their findings demonstrated that ICT Infrastructure significantly and favorably impacts the growth of the financial industry market. They said that the nations in the MENA area could only attain a certain level of ICT development before experiencing financial progress. The relationship between ICT spread and stock market development and credit expansion was important but negligible to the finance system of developing and industrialized nations (Raheem et al., 2020).

To use a system GMM method, Cheng et al., (2021) checked the link among ICT, financial sector development, and productivity expansion in the African nations between 1988 and 2007. They discovered that ICT significantly and favorably impacts both economic development and access to financial services availability. Their empirical data also revealed that the banking sector was strengthened as a result of mobile phone use, which had an effect on economic development. For a panel of 168 Technology transfer enterprises from Japan, the US, and Europe, Amri (2018) examined the link and impact of organizations' ICT strategy on their financial performance results. They discovered that the use of ICT considerably improved business performance. Additionally, it was discovered that value expropriation issues of collaborative engineering processes may counter balance their valuation perspective.

Das et al., (2018) demonstrated a favorable and substantial relationship between ICT proliferation and financial innovations using logistical modeling techniques. Their findings further revealed that the adoption, selection and implementation of ICT-enhanced effectiveness, usefulness, efficiency, innovations, and expansion in firms played a crucial role, particularly in SMEs. Which in turn, made organizational and the supply chain effective. For the Next-11 nations, Ramzan et al., (2022) looked into the relationship between ICT, money, and growth. According to their empirical study, ICT encourages financial development, which then in turn promotes economic expansion.

ICT and Economic Growth

The researches that are now available on the association between ICT and economic development dates back a few decades. Although there are conflicting actual findings, the theoretical link between ICT and economic growth or productive expansion is said to be beneficial. ICT innovation and adoption has a favorable and considerable impact on economic growth, according to several research. For instance, Mendonca et al., (2008) used cross-sectional datasets from the Brazilian economy to examine the connection among ICT and economic productivity. They discovered that employee use of ICT greatly boosts output. A country's labor efficiency and total economic expansion are positively impacted by ICT development elements such as Infrastructural facilities, ICT uses, ICT preparedness, and ICT products, trade and exports (Niebel, T., 2018).

Majeed & Ayub (2018) discovered long-run co integration test and cause and effect trying to run from ICT to GDP expansion as well as non-ICT to income progress by examining the protracted long causal association between ICT and economic growth in countries using the particular sector total revenue production factor approach with the incorporation of ICT and non-ICT equity and other vital components. ICT is essential to the growth of every economic sector, but particularly to the economic liberalization. Over instance, Bilan et al., (2019).used the modified generalized moment method (GMM) technique to examine the association between ICT and economic development using a panel of 159 nations for the years 2000–2009. Their findings demonstrated that ICT considerably and favorably impacts economic growth in elevated nations. ICT has a little effect on the economy in low and middle nations, nevertheless. Therefore, these nations should develop and put into practice innovation policies in order to boost or promote economic growth.

Jehangir et al., (2011) suggested that it is well-established that the uptake of technological advances, the exponential growth of online consumers, and digital spending have a beneficial effect on e-commerce business all over the world, which in turn promotes economic growth. He used GMM regression to examine the association between ICT usage and economic growth in the context of African nations. They discovered that the use of ICT boosts economic productivity expansion and stimulates economic activity. Kim (2015) examined the causal link between ICT wealth and business development for the US economy using data on ICT investment. The empirical findings show a direct and positive causal relationship between ICT investment and economic development. Internet use was used as a stand-in for ICT by

Appiah et al., (2021) as they looked into the connection between ICT and growth of the Economy. They used the limits testing method and discovered that ICT and economic growth expansion are long-term co integrated. Additionally, their empirical study analysis shows that using the internet electronic devices increases economic activity, which contributes to economic growth.

Methodology

Data and Description of Variables

The data were collected from BRICS countries from 2000 to 2018, using the data base of WDI. Before proceeding with the analysis the data were converted into log form. We used numerous dimensions of ICT i.e. ICT-Tel which is measured as fixed telephone lines per 100 inhabitants; ICT-Mob measured as the mobile phone users per 100 inhabitants and ICT-Net which represent the internet users out of 100. These variables to capture the ICT has been weighted and used by Kurniawati (2020). The economic growth is measured in term of GDP per capita (US constant 2010). In the body of literature many studies measured similarly (Kurniawati 2020; Ullah et al., 2021). The Financial development is termed as the amount of domestic credit to the private sector to GDP (Zeshan et al., 2021).

Data Estimation Techniques

The study use numerous techniques for the data analysis as a procedure and protocol of the data nature.

Panel Unit Roots Test

First we use tests identify unit roots in panel data for, this purpose we prefer using few well known techniques. We use first general panel unit root test as we assume cross sectional technique independence in the data, in this regards the test of Levine, Lina & Chu (LLC) formal cited as Devine et al (2002) that is also called a homogenous panel unit root estimator or test and ADF test, cited as Maddala & Wu (1999), that is called a panel heterogeneous unit root test. While, accounting for and knowing about the cross sectional dependence, the study prefers to use Pesaran (2007) for this purpose. The CIPS is used for this as second generation unit root techniques.

Cross Sectional Dependence Test

While for the management of cross sectional dependence the research in hand uses CD test in the spirit of Pesaran (2004). The CD test is use in four dimension i.e., lang-range multiplier test by Breusch & Pagan (1980), the Scaled CDM test by Pesaran (2004), general CD test by Pesaran (2004) and bias adjusted LM test by Breusch & Pagan (1980).

Panel Cointegration test

We also assessed the co-integration among variables in this regards, we use Pedroni (1999), for which it is essential that integration order of the variables should be 1(1). This test also accounts for country size as well as heterogeneity.

Penal Quantile Regression for Hypothesis Testing

To analyze the data, this study is based on the novel Quantile regression method that has been developed by Powell (2016). This methodology is considered very useful in case when the independent variables exhibits different (varying) effect at different points based in the conditional distribution of the dependent variable and this technique purely estimates the dynamic of independent variable in each point based on the conditional distribution. This method is superior than the traditional methods of regression as the quantile fraction dose not postulate any movement function and this provides better results if there exist outlier in the data (Zhu et al., 2016). These techniques is also advantageous if the data do not meet the assumption of liner regression (Sharwood and Wang, 2016). Hence, we use the panel quantile techniques with fixed effect as follows.

$$Y_{it} = \alpha_i + \beta(q)X_{it} + \mu_{it}$$

Data Analysis and Results

Table 1 reports stationary level of the variables. The results show that all variables exhibit stationary level at first difference, the test reveals the stationarity of variable at level. Hence all are stationary at 1(1) level.

Table 1: Unit Root test

Variable	LLC		ADF		CIPS	
GDP	3.921	-9.345***	8.312	112.920**	1.35	2.312***
ICT-Mob	2.622	-8.621***	9.612	132.361***	1.41	2.502***
ICT-Net	3.091	10.316***	7.287	162.312***	1.62	2.621***
ICT-Tel	2.910	8.761***	11.370	142.314***	1.83	3.621***
FD	1.362	12.361***	13.617	102.312***	1.92	2.872***

The results of table 2 shows the cross sectional in the data, which reveals by all tests that the data is not free from cross sectional dependence and serial correlation there, due to which simple OLS is not a choice to test hypothesis.

Table 2: Cross-sectional Dependence Test

Tests	Decision Value	Prob
Breusch-Pagan LM (Lagrang Multiplier)	36.675	0.000***
Breusch-Pagan LM(Bias Adjusted)	4.256	0.042**
Pesaran Scaled LM	21.271	0.000***
Pesaran General	24.262	0.000***

, * show significance at 5% and 1%.

Table 3: Cointegration test (Pedroni, 1999)

Common AR coefficients (within-dimension)				
	Statistics	Prob	Weighted statistics	Prob
P.V-statistic	-2.727	0.978	-2.136	0.672
P.rho-statistic	1.781	0.727	1.627	0.701
P.PP-statistic	-6.231	0.000***	-6.731	0.000***
P.ADF-statistic	-7.264	0.000***	-7.13	0.000***
Individual A.R coefficient				
G- rho-statistic	2.311	0.912		
G- PP-statistic	-7.221	0.000***		
G- ADF-statistic	-7.891	0.000***		

*** significant at 1 percent level

Table 2 reports the results of Pedroni co-integration test, which demonstrates that four statistics are significant, in the first case within dimension panel PP statistics and panel ADF stat are significant, similarly between dimension outcomes group PP stat and group ADF stat are significant which validate the co-integration among variables.

Table 4: Quantile Regression Results

Variables	q0.0	q0.25	q0. 50	q0.75	q0. 90
ICT-Mob	0.256**	0.236**	0.286**	0.361***	0.411***
ICT-Net	-0.261**	0.213**	0.221**	0.272**	0.121*
ICT-Tel	0.312***	0.341***	0.228**	0.425***	0.626***
FD	0.126*	0.261**	0.211**	0.136*	0.141*

*, **,*** significant at 10%, 5% and 1% respectively

Table 4 depict the QR results of the selected quantiles from 0.10, 0.23, 0.50, 0.75 and 0.90. These quantiles depict the comprehensive analysis of all variables i.e., ICT-Mob, ICT-Net, ICT-Tel and FD. The reported results of the table show that ICT-mob is statistically significant in all quantile, which signifies the positive effect of ICT-Mob on the GDP of the country.

Secondly, ICT-Net and ICT-Tel also show positive and statistically significant coefficient in all quantiles which means that more use of these dimensions of ICT will enhance GDP of BRICS nations. The financial development also shows significant coefficient in all reported quantiles, which mean that financial development also enhances GDP of BRICS countries.

Conclusion and Implications

The development of the country is reliant on the tremendous economic growth. The economic growth is based on the production and manufacturing of the country that help in promoting employment opportunities and surplus trade account and current account. The efficient energy consumption and environmental sustainability are vital for each country that purely help the sustainable economic growth of the country. To get these economic and environmental milestones numerous countries modernizing their technological arsenals to achieve these targets. Therefore the transformation of traditional technology to advanced technology and ICT equipment are focused to enhance the capacity of efficient energy and maximize the revenue of the country which in turn helps both economic and environmental sustainability. This study explored the nexus of ICT, financial development and economic growth of the BRICS

countries using the data from 2000 to 2018. The results concluded the importance of ICT to enhance the economic growth. The reported results inferred that all dimensions of ICT i.e. ICT-Mob, ICT-Net and ICT-Tel have significant contribution in the economic development of BRICS countries. The results show that these countries are more driven towards advanced technological structure which directly contributing in their economic uplifting. The results also concluded that financial development is very helpful and play a key role in the economic millstones of these countries.

The results are very handy for the relevant policy regulatory bodies. The government in these countries should show more development in term ICTs and financial development to get a path towards sustainability. More research and innovation should be launched to make the technological structure more advanced and robust. Government should encourage private loans to ensure advance in term technology in the private enterprise portfolio. Future studies should compare regions for the same variables and intellectual capital can also be used as a moderator to provide a robust picture in this area.

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