The Impact of Mobile Telecommunications on Economic Growth in Tanzania.

Fredrick A. Mapunda[1] and Mary Kulwijila[1*]

Abstract: *The advancements in the mobile telecommunication industry transform communications-aligned devices into service delivery mechanisms. In Tanzania, telecommunication developments led to an abrupt increase in the number of subscribers and telecommunications expenditures. Despite the increase in the number of subscribers and expenditures in mobile telecommunications services, there is limited information on their contributions to economic growth in Tanzania. This study examined the impact played by mobile telecommunications services on the economic growth of Tanzania. The work centred on appraising the effects of mobile voice call, text message, internet and mobile money services on the growth of GDP per capita of Tanzania. Time series data from 2014 to 2023 was employed. The endogenous growth framework through the macro production model examined the influence of variables. Micro telecommunications investment demand models are jointly estimated to control the reverse impact of economic growth. The results revealed that mobile voice calls, internet, and mobile money services contributed positively to the GDP per capita of Tanzania. To realise countrywide development, Tanzania should strengthen penetration of mobile voice calls, internet and mobile money services in rural areas. Thereafter, Tanzania should enhance implementations of the ICT policy to transform the country into ICT ICT-driven middle-income economy through telecommunications. Moreover, Tanzania should strategically improve mobile money services platforms as an effective roadmap to the cashless economy.*

Keywords: Economic Growth, Telecommunications, Endogenous Growth.

JEL classification: C35, D63, I41

1.0 Introduction

The role of technological advancements in economic growth has gained significant attention among researchers in recent decades (Waverman et al., 2005). This focus is largely attributed to the rapid developments in information and communication technologies (ICTs) worldwide, which have opened up various economic opportunities across both productive and non-productive sectors (Maiorano & Stern, 2007). In many

[1] *Department of Economics, The University of Dodoma.*
[*] *Correspondence E-mail: kulwijila@ymail.com*

developing countries, the ICT sector, particularly mobile telecommunications, has become a key driver of economic growth (Sridhar and Sridhar, 2007).
Mobile telecommunications have fundamentally transformed communication patterns and economic interactions by enhancing productivity and improving coordination among market agents (Jensen, 2007). These advancements have shifted mobile devices from mere communication tools to essential service delivery mechanisms (Jacobsen, 2003). Moreover, mobile telecommunications have broadened market access and increased efficiency through instant information sharing, fostering active participation in economic activities, enhancing transparency, and strengthening public leadership (Röller & Waverman, 2001). Additionally, mobile telecommunications have created employment opportunities in various sectors, including mobile money services and telecommunications-related trade (Klonner and Nolen, 2010).

In Tanzania, investments in ICT infrastructure have expanded significantly, supported by both private sector initiatives and government programs, such as the Universal Communication Access Fund (UCSAF), which aims to enhance telecommunications access in underserved areas (UCSAF, 2020). The establishment of the National Information and Communication Technology Broadband Backbone (NICTBB) has also played a crucial role in reducing interconnectivity costs and improving telecommunications services across the country (TCRA, 2020). Currently, telecommunications services in the country have extensive uses apart from the commonly notable services of voice calls and short messages. The evolution of mobile internet services and mobile money services has accelerated user engagement in telecommunications services in the country as well (GSMA, 2020).

Furthermore, Tanzania's customer subscriptions to mobile telecommunication services have highlighted a tremendous upturn (TCRA, 2024). This can be signified by rapid shifts in the number of subscribers per year on both voice calls, text messages, internet and mobile money services (GSMA, 2021). On average from 2014 to 2023, the percentage increase in the number of subscribers for both voice calls, internet and mobile money services is 106%, 217% and 269% respectively (TCRA, 2024). Among the factors that pioneer customer subscriptions into mobile telecommunications services are the evolution of mobile-based network services, the spin-out of smartphones and the development of internet platforms in the country (TCRA, 2024). Despite the increase in the number of subscribers and the expansion of mobile telecommunication services that could be utilised, there remains a significant gap in understanding the actual contributions of these services to Tanzania's economic growth.

Many scholars have studied the impact of mobile telecommunications on economic growth across the globe and Tanzania in particular (e.g., Wickramasinghe et al. 2023; Barroso et al. 2020; Lee et al. 2012; Enowbi 2008; Nadiri and Nandi 2003; Msoffe and

 https://doi.org/10.58548/2025jaep31.2350

Lwoga, 2019; Mpogole et al. 2008; and Scott et al. 2005). However, most of these studies employed aggregated mobile telecommunications data to see the impact on economic growth. This study aims to fill this gap by investigating the distinct impact of mobile telecommunications services in promoting economic growth in Tanzania to smooth the aggregation bias. This study seeks to provide valuable insights that can inform policymakers and stakeholders on how to effectively leverage this sector for enhanced economic growth.

2.0 Literature Review

2.1 Theoretical Review

The theoretical review scrutinises key theories that explain the causal linkage between research variables (Kothari, 2014). The theories provide frameworks through which the causality of independent and dependent variables is explained. There are many theories that explain the causal associations of mobile telecommunication services and economic growth. The endogenous growth theory that explains the linkage of endogenous forces and economic growth is employed in the study, for it provides a better platform to test the variables.

The endogenous growth theory relies on internal factors as the predominant foundations of economic growth (Albiman & Nn, 2016). The theory stresses endogenous forces rather than external forces as the causes of economic growth. It explores the enhancement of human capital through technological development and productivity efficiencies as a means for economic growth. According to the theory, the key factors for economic growth are investment in innovation, knowledge and human capital. It explains that the long-run growth rate of the economy depends on policy measures.

In endogenous growth theory, technological investments and human capital development through better education and quality health services are key determinants for economic growth as they provide a room for knowledge and skills to be acquired and utilised in production (Etale & Etale, 2016). The theory stresses on factors of production being accumulated as the driving forces for economic growth. Therefore, in the long run impact of technological and human capital development will stand as an intervention in boosting economic growth.

The mobile telecommunication industry is faced with high technological competition that consequently leads suppliers and operators to deliver unique services and products to the markets in accelerate their competitiveness (Romer & Lucas, 2018). In the reinforcement of their market competitiveness, market players invest in service innovations and human capital development, therefore capturing key factors for economic growth as they were postulated in the endogenous growth theory.

2.2 Empirical Review

Scholars have examined the effect of telecommunication services on economic growth. Kefela (2011) in the study of telecommunication impact on economic growth found that the services revealed a substantial impact on the economic growth of Sub-Saharan Africa conveyed through enhanced work efficiencies, productivity gains and telecommunication investments dividend share. The effects appeared to be larger in countries with low internet infrastructures than in those with upgraded internet infrastructures. The study revealed that apart from calling cost, voice call services were a significant item in contributing to economic growth, especially in nations with low literacy rates, which are also faced with infrastructural challenges. Deployment of panel data across Sub-Saharan African countries hindered country-specific focus on the study.

Chavula (2012) assessed the impact of telecommunications penetration on the per capita income growth of forty-nine African countries. The study explored those investments in mobile telecommunications that have a significant impact on economic growth while enhancing human capital in both upper-middle, upper-low and low-income countries in Africa. The study portrayed domestic investments, institutional quality and human capital development as significant effects of telecommunication services on people's living standards.

Farhadi et al. (2012) in the study of information and communication technology impact on productivity found that information and communication uses have a positive impact on economic growth. The study identifies enriched information availability and capital flows among key factors for growth from information and communication technology. The impact was greater in higher-income countries than in other countries.

Sridhar and Sridhar (2007) found that mobile telecommunication services, especially information-intensive ones such as internet services, have a significant influence on economic growth through efficient search. The study of Sridhar and Sridhar (2007) indicated that mobile telecommunication penetrations have a large effect on national output, as it reduces production costs while generating revenue for reinvestment in both developed and developing countries.

Barroso et al. (2020) studied telecommunication infrastructures and their consequential impact on the economic development of developing nations. The results pointed out that unreliable telecommunication infrastructures are the major bottleneck to any developing country in the current century.

Wickramasinghe (2023) examined telecommunication infrastructures effects in national development. The study determined the telecommunication industry to be a link to

 https://doi.org/10.58548/2025jaep31.2350

poverty eradication initiatives in developing countries. The impact of telecommunication facilities is also reflected in developing countries mileage to attain sustainable development goals. The digitisation of public services stands among major areas where telecommunications has a significant impact.

Lee, Levendis and Gutierrez (2012) in their study determined the impact of mobile telecommunications on economic growth, apart from comprising unique services like the internet, which could not be offered by previous landline phones. They found the growing importance of mobile telecommunication facilities in Sub-Saharan countries due to the low cost entailed by these facilities.
Levine (2005) found that financial systems have a significant effect on economic growth. The mobile money systems simplify the transfer of value between mobile phone users through handset procedures. The impact of financial systems on economic growth is due to the easing of financing constraints facing firms, especially in remote productivity areas. Mobile money facilities enable easy transfer of value between mobile phone subscribers through a menu and unique identification numbers that can be accessed on mobile phones.

The mobile money facilities' consequences in poverty alleviation in developing nations were reviewed by Mpofu (2023). The study examined the rural community effects of mobile money facilities. Results depicted a positive association between mobile money services coverage and poverty alleviation initiatives in the community, especially in developing countries.

Most of the reviewed studies applied combined telecommunications data in assessing its impact on economic growth, which revealed the consequences of consumers' choices in mobile telecommunication services. This study appraises the specific role played by mobile telecommunication services in the economic growth of Tanzania to smooth the aggregation bias.

2.3 Conceptual Framework

The study centred on the endogenous growth approach, for it provides a better platform to appraise the economic impact of mobile telecommunications services through the macro production framework (Gruber et al., 2011). The conceptualisation context through the macro production framework is instituted from endogenous theory to realise the study objective. The macro production framework expounds GDP as a function of capital stock (Net of telecommunication), human capital, telecommunication stock and time trend. The telecommunication stock extended to accommodate the specific mobile telecommunication services. To tackle the reverse causality of economic growth into mobile telecommunication services, the micro telecommunications investment demand

equations were jointly estimated with the macro production function (Datta & Agrwal, 2004). The micro telecommunication investment demand function describes telecommunication services as a function of previous GDP per capita and previous telecommunications services.

In responding to the specific objectives of the study, the macro production framework in Gruber et al. (2011) was extended to include voice call stock, text message stock, internet stock and mobile money stock as telecommunication stock measures. The sub-sectoral portion of telecommunication services in the aggregate economy is endogenised through a micro telecommunication investment demand function specified and jointly estimated with the macro production function.

Voice call services facilitate instant exchange of information that excites market efficiencies, improves work, accelerates consumption of airtime, transforms the way businesses and consumers operate, which in turn boosts productivity and impacts GDP per capita (Roller & Waverman, 2001). In this study, voice-call services were measured through voice call density or voice call penetration rate, which denotes the number of mobile voice call subscribers per hundred inhabitants in Tanzania.

Text message services reduce information search time and costs through record-based information sharing, hasten spending on short message services and transform the way consumers and producers interact, which nourishes market efficiencies and strengthens productivity gains (Jorstad et al., 2005). Throughout the study, text message services are reflected by text message density or text message penetration rate, which means the number of mobile text message subscribers per hundred inhabitants in Tanzania.

Internet services allow massive real-time exchange of information that strengthens agents' coordination in the market, renovates information accessibility among market actors and quickens internet bundles consumption, which in turn boosts productivity and GDP per capita (Lee et al., 2012). In this study, internet service is represented by mobile internet density or mobile internet penetration rate captured through the number of mobile internet subscribers per hundred inhabitants in Tanzania.

Mobile money services ease the exchange of value among producers and consumers; they abridge financial constraints through savings mobilisation from customer deposits. This, in turn, accelerates productivity and stimulates GDP per capita (Masamila, 2014). All over the study, mobile money services weighed from mobile money density or mobile money penetration rate, which means the number of mobile money subscribers per hundred inhabitants in Tanzania.

 https://doi.org/10.58548/2025jaep31.2350

The variable public expenditure in ICT skills introduced as a proxy for literacy level of the country, is a complementary package for mobile telecommunication services penetration impacts on the country (Andrew & Petkov, 2003). The penetration impact of mobile telecommunications services into the country relies on many factors other than the telecommunication infrastructure itself. The literacy level of the prospective community is among the key factors to be observed for achieving sustainable mobile telecommunications impacts on the economy (Waverman et al., 2005).

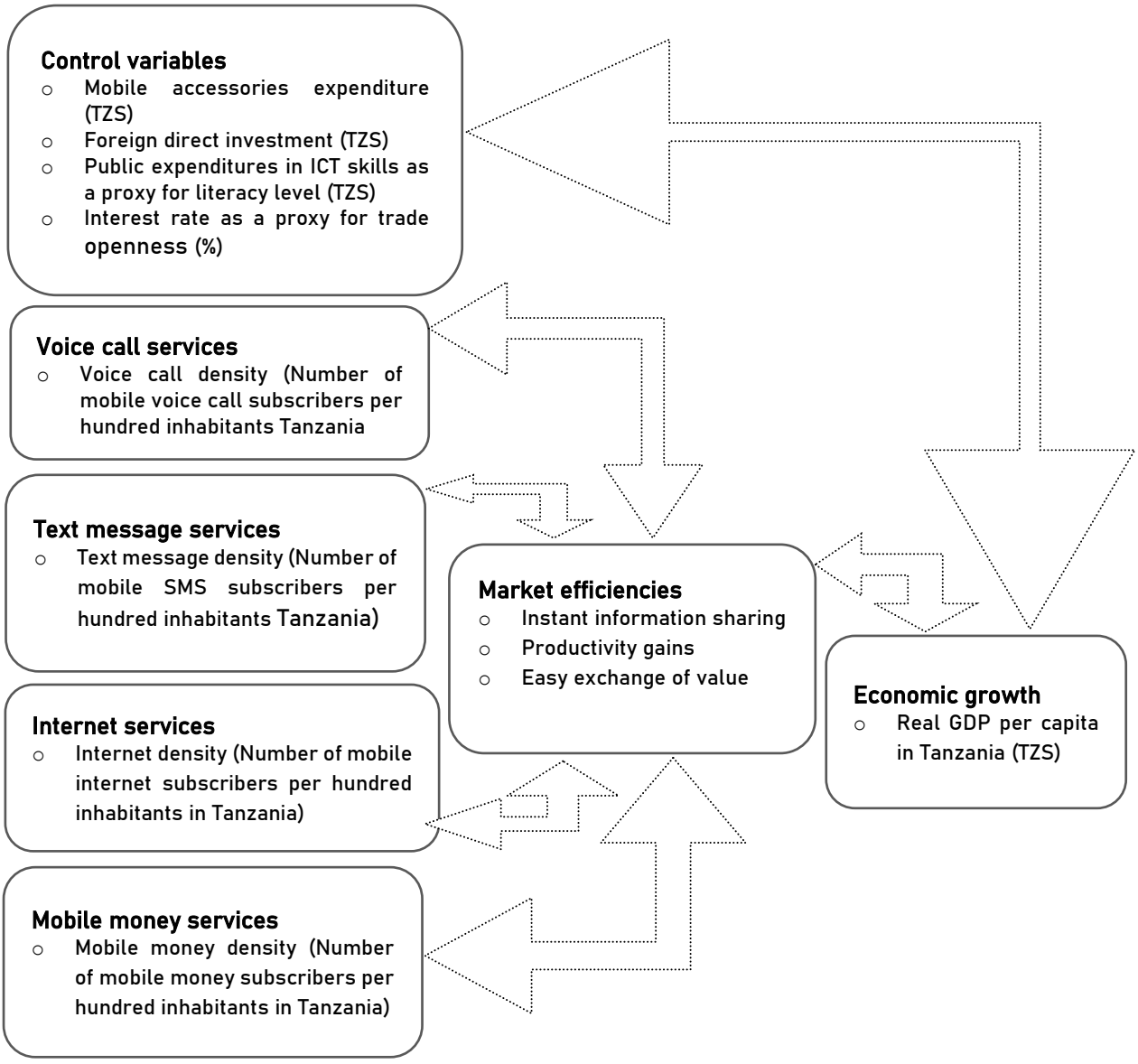

Figure 2. 1: Conceptual Framework

The interest rate was used as a proxy for the trade openness index in Tanzania to address the data challenge. Interest rate contains both the current market information and the future predictions about the market; therefore, it reflects trade openness (BoT,

2020). Trade openness provides accessibility to potential market information to consumers and suppliers through mobile telecommunications facilities, which in turn has its impact on the economy. The average interest rate on the market reflects existing facts and forthcoming expectations around the market; therefore, it will be taken as a proxy for trade openness.

The control variable, mobile accessories expenditure share, is introduced to capture abrupt changes in mobile accessories spending imposed by mobile telecommunication penetrations (Mensah, 2021). The penetration of mobile telecommunication widens the share of community spending on mobile phone accessories. Though most of the mobile phone accessories are imported, their expenditure patterns have risen significantly in recent years (NBS, 2021). Nowadays, mobile accessories consumption and technical support expenses are part of households' expenditure share in Tanzania.

Market efficiencies centred on streamlining enhanced competitions imposed by mobile telecommunications to the market through instant exchange of market information, productivity gains and easy exchange of value (Gruber, 2011). The availability of instant information, productivity gains and easy exchange of values stimulates competition in the market (Lee et al., 2012). The high competition in the market assures market efficiencies and accelerates economic growth. Therefore, the conceptual framework employed in the study to fulfil research objectives is summarised in Figure 2.1.

3.0 Methodology

The study employed a time series research design, where both quantitative and descriptive approaches were utilised. The time series research was opted for because it accommodates all targeted variables, while allowing the researcher to gather information on diverse intervals of previous time and the current environment for matters to be evaluated (Kothari, 2014). This methodology is better off in terms of cost, time and flexibility in data collection.

3.1 Data

Time series data used in the study were gathered from three reliable sources in the United Republic of Tanzania. The data for mobile internet subscribers and mobile money subscribers originated from quarterly communication statistics reports issued by the Tanzania Communication Regulatory Authority. The reports summarise the number of active mobile phone subscribers in a given quarter (TCRA, 2023). Data for GDP per capita was extracted from the figures booklet published by the National Bureau of Statistics. The booklet précises country quarterly GDP, population and other specified statistics (NBS, 2021). Figures for public expenditure in education and interest rates were drawn from the Quarterly Economic Bulletin issued by the Bank of Tanzania. The whole study covered forty consecutive quarters from January 2014 to December 2023. The selection

 https://doi.org/10.58548/2025jaep31.2350

of the data period was based on the availability of data for all the variables of interest, for which the 2014 – 2023 period met the criteria.

3.2 Models

The study centred on Roller and Waverman (2001) modelling approach for the telephone network. The idea addressed the endogenous growth framework as it was postulated by Datta and Agrwal (2004), Waverman et al. (2005) and Gruber et al. (2011). The framework offers a better platform to derive the macro production model in the telecommunication industry. The macro production model was modified to accommodate the mobile telecommunication services in Tanzania. To control for the reverse causality, the micro telecommunication investment demand equations were jointly estimated with the macro production function.

3.2.1 Macro Productions Model

The economic growth function, as it was postulated by Gruber et al. (2011), provides a speculative basis for an analytical macro production model to measure one way causative of mobile telecommunications on economic growth. The model placed output (Y) as the function of capital stock (K), net of Telecommunication stock, Human capital stock (HK), Telecommunication stock (Tel) and time trend (t). The functional form of this equation is written as follows;

$$Y_t = f(K_t, HK_t, Tel_t, t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (i)$$

Where Y is aggregate output at time t measured as gross domestic product, K is capital net of telecommunication stock, HK is human capital stock in the mobile telecommunication industry, Tel is Telecommunication stock and t is time trend.

Since the focus of the study is on mobile telecommunications, the stock of telecommunication (Tel) represents mobile telecommunication services only. But also, the mobile telecommunication services in Tanzania comprise voice call services, text message services, internet services and mobile money services. Subsequently, the telecommunication stock in equation (i) is extended to accommodate voice call, text message, internet and mobile money services as follows.

$$Y_t = f(K_t, HK_t, Voice_t, Text_t, Internet_t, Mmoney_t, t) \dots\dots\dots\dots\dots\dots\dots\dots (ii)$$

Where Y is aggregate output at time t, K is capital net of telecommunication stock, HK is human capital stock in telecommunication industry, $Voice$ is the mobile voice call stock, $Text$ is the mobile text message stock, $Internet$ is the mobile internet stock and $Mmoney$ is mobile money stock at time t, and t is time trend.

By dividing all variables of equation (ii) above by population (Pop), the resulting growth framework complements the idea of Roller and Waverman (2001), Datta and Agrwal (2004), Waverman et al. (2005), Sridhar et al. (2007) and Gruber et al. (2011). After division, the aggregate output per population reflect the gross domestic product per capita, capital stock net of telecommunication per population is a reflect of public expenditure in ICT skills to capture literacy level, human capital stock in telecommunication industry per population is a reflect of sectorial openness, mobile voice call stock per population denotes voice call services penetrations which is mobile voice call density, mobile text message stock per population indicates mobile text message density, mobile internet stock per population signify mobile internet density and mobile money stock per population symbolizes mobile money density. Therefore, by rearranging the functional form of the equation is rearranged as follows;

$$GDPpc_t = f(Vcall_t, Tmes_t, Inter_t, Mmon_t, PE_t, R_t) \dots\dots\dots\dots\dots (iii)$$

Where $GDPpc$ is gross domestic product per capita at time t, $Vcall$ is mobile voice call density at time t, $Tmes$ is mobile text message density at time t, $Inter$ is mobile internet density at time t, $Mmon$ is mobile money density at time t, PE is public expenditure in ICT skills at time t as a proxy for literacy level, R is interest rate as a proxy for trade openness.

By controlling other factors and applying natural logarithms to both sides, the econometric model estimated is written as follows;

$$lnGDPpc_t = \beta_0 + \beta_1 lnVcall_t + \beta_2 lnTmes_t + \beta_3 lnInter_t + \beta_4 lnMmon_t + \beta_5 lnPE_t - \beta_6 lnR_t + \theta_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (iv)$$

Where;

$lnGDPpc$ = GDP per capita (TZS)

$lnVcal$ = Voice call density (Mobile voice call subscribers per hundred inhabitants)

$lnTmes$ = Text message density (Mobile text message subscribers per hundred inhabitants)

$lnInter$ = Internet density (Mobile internet subscribers per hundred inhabitants)

$lnMmon$ = Mobile money density (Mobile money subscribers per hundred inhabitants)

$lnPE$ = Public expenditure in ICT skills as a proxy for literacy level (TZS)

lnR = Interest rate as a proxy for trade openness (%)

θ_t = Constant term, β_0=Intercept, β_1– β_6=Coefficients, t = Time

 https://doi.org/10.58548/2025jaep31.2350

3.2.2 Micro Telecommunication Investment Model

The micro telecommunication investment demand model was developed to endogenise the mobile telecommunication industry into the aggregate economy. The model was developed from Roeller and Waverman (2001) telecommunication demand equation. The model assures reverse causality management while exploring the economic growth impact on mobile telecommunications services. The micro telecommunication investment demand equation states telecommunications as a function of per capita income and telecommunication prices per user. The functional form of the equation is written as follows;

$$Tel_t = f(GDP/Pop_t, TP_t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (v)$$

Where Tel is mobile telecommunication penetration, GDP/Pop is gross domestic product per population, and TP is telecommunication prices per user.

To account for reverse causality, the GDP per capita above is the previous GDP per capita, while the telecommunication prices in equation (v) above reflect previous mobile telecommunications services. Therefore, by rearranging the telecommunication demand function in equation (v) while introducing a natural logarithm on both sides, the jointly econometric model is written as follows;

$$lnTel_t = \lambda_0 + \lambda_1 lnTel_{t-1} + \lambda_2 lnGDPpc_{t-1} + \varepsilon^1 \dots\dots\dots\dots\dots\dots\dots\dots (vi)$$

$$lnGDPpc_t = a_0 + a_1 lnGDPpc_{t-1} + a_2 lnTel_{t-1} + \varepsilon^2 \dots\dots\dots\dots\dots\dots (vii)$$

Where;

$lnTel_t$ = Mobile voice call, text message, internet and mobile money density (%)

$lnTel_{t-1}$ = Previous mobile voice call, text message, internet and mobile money density (%)

$lnGDPpc_t$ = GDP per capita (TZS)

$lnGDPpc_{t-1}$ = Previous GDP per capita (TZS)

λ_0 and α_0 = Intercepts, λ_1, λ_2 and α_1, α_2 = Coefficients

3.3 Description of Variables

The wholly studied variables were expected to have clear statistical associations with economic growth. Table 1 summarises the studied variables.

Table 3.1: Description of Variables

Variable Name	Description	Code	Captured Item
Gross Domestic Product per capita	Amount of goods and services produced in the country per population (TZS)	GDPpc	Economic growth
Voice call density	Percentage of mobile voice call subscribers in Tanzania (%)	Vcall	Voice call services
Text message density	Percentage of mobile text message subscribers in Tanzania (%).	Tmes	Text message services
Internet density	Percentage of mobile internet subscribers in Tanzania (%).	Inter	Internet services
Mobile money density	Percentage of mobile money subscribers in Tanzania (%).	Mmon	Mobile money services
Public expenditures on ICT skills	Amounts of public spending on ICT skills (TZS)	PE	Literacy level
Interest rate	Average percentage of market interest rate (%)	R	Trade openness

3.4 Testing of Regression Models

The Augmented Dickey-Fuller (ADF) test determined the stationarity of variables estimated in the study. The test evaluates the properties of variables being studied to avoid spurious results in the research work. The Johansen test for co-integration was employed to determine the presence of a co-integrating variable (Gujarat, 2004). To determine the extent of short-run measures and the long-run impacts of mobile telecommunications services on the economy, the Johansen test of maximum likelihood was employed (Johansen and Nielsen, 2012). The Granger causality test on mobile telecommunication services and economic growth was examined to ensure causation of variables. The Breusch-Godfrey LM test and Jarque-Bera test for autocorrelation were implemented in diagnostic tests of the macro production model (Huitema and Laraway, 2006).

4.0 Findings and Discussion

4.1 Unit root results

Results of stationarity tests in GDP per capita, voice call density, text message density, internet density, mobile money density, public expenditure in ICT skills as a proxy for literacy level and interest rate as a proxy for trade openness demonstrated non-stationarity in all variables; therefore, they were differenced accordingly. Table 4.1 highlights unit root test results.

Table 4.1: Unit root test results

	Augmented Dickey-Fuller results				
	Before differencing		After differencing		Order of integration
Variable	Test statistics	Critical value	Test statistics	Critical value	
lnGDPpc	-1.667	-2.961	-10.308	-2.964	I(1)
lnVcall	-0.676	-2.961	-6.548	-2.964	I (1)
lnTmes	-0.792	-2.961	-5.677	-2.964	I (1)
lnInter	-4.130	-2.961	-4.018	-2.964	I (1)
lnMmon	0.316	-2.961	-7.054	-2.964	I (1)
lnPE	-2.628	-2.961	-6.114	-2.964	I (1)
lnR	-1.271	-2.961	-6.485	-2.964	I (1)

Source: STATA calculation

4.2 Co-integration Test Results

Test for co-integration in GDP per capita, internet density, mobile money density, public expenditure in education and interest rate through the Johansen test for co-integration, confirms the existence of co-integration on at least four equations. Therefore, there is a long-term association between GDP per capita, internet density, mobile money density, public expenditure in education and interest rate. Table 3 highlights co-integration test results.

Table 4.2: Co-integration Test Results

Johansen tests for cointegration					
Trend: constant				Number of obs =	38
Sample: 3 - 40				Lags =	2
maximum rank	parms	LL	eigenvalue	Trace statistic	5% Critical value
0	56	485.3502	.	176.5906	124.24
1	69	515.43183	0.79469	116.4273	94.15
2	80	535.3643	0.64974	76.5624	68.52
3	89	549.72427	0.53036	47.8424	47.21
4	96	560.53124	0.43379	26.2285*	29.68
5	101	568.24867	0.33381	10.7936	15.41
6	104	573.53529	0.24289	0.2204	3.76
7	105	573.64549	0.00578		

Source: STATA calculation

4.3 Regression Results

The Results of Regression Analysis for Macro Production Model Which Relates GDP Per Capita, Voce Call Density, Text Message Density, Internet Density, Mobile Money Density, Public Expenditure in Skills Development as a proxy for Literacy Level and Interest Rate as a proxy for Trade Openness indicates positive significant relationship between GDP Per Capita, Voce Call Density, Internet Density and Mobile Money Density. The Text Message Density Depicts a negative association with GDP Per Capita. On Average, a 1% increase in Voice Call Density, Internet Density, and Mobile Money Density causes the GDP Per Capita to increase by 2.28%, 0.55% and 0.43% respectively. The goodness of fit of the regression line is 93.64% while the P-values for Voice Call Density, Internet Density and Mobile Money Density are 0.007, 0.000 and 0.001, respectively, which are statistically significant at 5% confidence level. The constant term demonstrates a positive Intercept. Table 4.3 Summarise the Results.

Table 4.3: Regression Results

lnGDPpc	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
lnVcall	2.276765	.7842587	2.90	0.007	.681179	3.872352
lnTmes	-2.928927	.8152291	-3.59	0.001	-4.587523	-1.270331
lnInter	.5497122	.0972701	5.65	0.000	.3518147	.7476097
lnMmon	.4275635	.1214579	3.52	0.001	.1804557	.6746714
lngPE	-.0009462	.0404935	-0.02	0.981	-.0833309	.0814385
lnR	.1606239	.098774	1.63	0.113	-.0403332	.3615811
cons	13.68768	1.026121	13.34	0.000	11.60002	15.77534
R-squared	0.9364					

Source: STATA calculation

4.3.1 The Effect of Voice Call Services on GDP per capita of Tanzania

The study examined the affiliation of voice call services and GDP per capita in Tanzania. Statistical results highlighted a strong relationship between voice call services and the GDP per capita of Tanzania. From the regression results as depicted in Table 4.5 effect of voice call services on GDP per capita of Tanzania appears to be higher than all fitted variables. The results complement the idea of Sridhar and Sridhar (2007), who commended that, for telecommunications services to have an impact on economic growth, they must be information-intensive ones. The premier feature of voice call services is instant response among communicating parties that assures clear information on discussion matters. Voice call services are easily accessible through handset procedures fitted into both smartphones and non-smart mobile phones. The simplified accessibility in voice services accelerates information sharing among market participants, which in turn streamlines market efficiencies and boosts productivity.

 https://doi.org/10.58548/2025jaep31.2350

The outcome of the association of voice call services and GDP per capita of Tanzania also complements the viewpoints of Waverman et al. (2005) who spinout on time serving for searching market information and the productivity gains among direct influences arising from mobile telecommunications reforms. Voice call services have become highly consumable services among mobile telecommunications services in Tanzania, especially in remote areas where the literacy level is low, but they are major agricultural producers. Therefore, the voice call service is linked to economic growth through the shortest time of acquiring market information held effectively.

Furthermore, the results are surpassed by Kefela (2011), who found that mobile voice call services are an important determinant of the rate of economic growth in sub-Saharan Africa. Apart from being cost-effective, voice call services were a significant influencer of economic growth, especially in nations with low literacy rates, while faced with infrastructural challenges. This notion complements the study results, which centred on strengthened market efficiencies hastened by instant information sharing as a key to economic growth. In Tanzania, network infrastructure developments have been envisaged countrywide over recent decades through a joint investment project of the private sector and public corporations. Therefore, massive telecommunication development projects, especially the construction of communication poles in remote areas, pin up the generalised effect of voice call services on GDP per capita.

In relation to that, average market-based rates for utilising voice call services in Tanzania over recent decades have been decreasing for all service providers, especially through cross-network bundled mobile voice call services (GSMA, 2021). The cheapest cost factor expedites the mobile telecommunication service consumption and assures massive information sharing through voice call services. The study results polish up the theoretical recommendations on the direct association of telecommunications services and economic growth.

The advancement in telecommunication technologies offers more alternative channels to utilise voice call services by mobile telecommunication customers, especially the internet ones. The rollout of internet-based voice calls significantly reduces the information search period in both national and international markets through boundless voice calling services that, in turn, speed up economic growth.

Moreover, the telecommunication market in Tanzania has undergone major infrastructural reforms after the establishment of the National Information and Communication Technology Backbone cable. The fibre optic cable reduces voice call costs for both domestic voice calls and international voice calls among mobile telecommunication users. Easy access to international markets information stimulates

the productivity gains, which in the long run magnify mobile telecommunication impacts on the economy.

4.3.2 Text Message Services' Effects on GDP per capita of Tanzania

The study scrutinised the association between text message services and GDP per capita in Tanzania. Regression results point out the reverse influence of text message services on GDP per capita. On average, 1% increase in text message density causes the GDP per capita to decrease by 2.93%. The result complements the notion that most of the text message subscriptions in the country are for social coordination, not productivity enhancements. The effect of text message services on GDP per capita in Tanzania was statistically significantly negative.

4.3.3 The Influence of Internet Services on GDP per capita of Tanzania

The influence of mobile internet services on the GDP per capita of Tanzania was evaluated in the study. Regression results on mobile internet services and GDP per capita expose a significant positive relationship between mobile internet services and GDP per capita. From regression results, the influence of mobile internet services on GDP per capita stands to be very strong.

The results highlighted that massive real-time exchange of information through internet-based mobile telecommunication modalities strengthens agents' coordination in the market, which in turn stimulates productivity and accelerates GDP per capita. The innovation of mobile internet services allows consumers and suppliers to receive and send information instantly to a huge population. The results are in line with Hoffman (2018), who stressed the positive impact of submarine internet cables on the economic growth of developing nations.

The results support the idea of Bertschek (2015), who determined the presence of a significant impact of mobile telecommunications development on economic growth, since they comprise unique services such as mobile internet services, which could not be offered by previous landline phones. The mobile internet services transform the way consumers and producers interact in the market, which improves market efficiencies and speeds up economic growth in Tanzania.

The outcomes ratify the economic gain from smartphone accessibility in the country. The evolution of smartphones in mobile telecommunications markets of Tanzania accelerated internet service consumption amongst telecom customers due to their portability and affordability of the mobile-based internet services (Roessler, 2021). The smartphone applications enhance supply chain management in the markets through handset procedures that further market efficiencies and hasten productivity in the country.

 https://doi.org/10.58548/2025jaep31.2350

These results complement the macro benefit of internet platforms' affordability in developing nations as narrated by Andrianaivo and Kpodar (2011). The evolution of social media platforms in Tanzania stimulated internet-based information sharing. The impacts are highly exposed, especially to youth who are the key players of the platforms and are essential for productivity improvements and market participation enhancements that would assure sustainable economic growth.

This analytical result concurs with ITU (2018), where they determined that mobile digitisation has a significant effect on the economic development of less developed countries than in developing countries. The impact of mobile digitisation services is now experienced by almost all individuals in Tanzania, especially for government services, which have been highly transformed into electronic channels. The establishment of mobile-based health services, education services and commercial services in the country is among the few digital transformations experienced, which have direct effects on economic growth (NBS, 2021).

Furthermore, the results are in line with Aker and Mbiti (2010), who determined new possibilities brought by mobile telecommunication in markets and services, across urban and rural, but also rich and poor divides. The mobile internet facilities showcase state-of-the-art modernised infrastructures in most rural areas of Tanzania, which in turn quicken information accessibility economically and socially. The instant availability of market information has found the growing importance of mobile telecommunication services in economic growth.

Moreover, the study results complement the notion of Amaghionyeodiwe and Annansingh (2017), who found that mobile telecommunications have a significant influence on the economic growth of developing countries. Their study entails wider information flows and limitless market boundaries as key beneficial factors explored by mobile telecommunication services. The widened information flows enhance market competition, which serves as an engine for market efficiencies, which assure improved productivity and sustainable economic growth in the country.

The high innovation on digital products and the advancement in mobile internet services technologies in Tanzania, streamlined market competitions, shortened supply chain and increased online-based employment share through digital platforms. Furthermore, the progresses widen market opportunities through limitless advertisement, which in turn stimulates economic growth in the country.

4.3.4 Mobile Money Services Contribution to GDP per capita of Tanzania

The contribution of mobile money services to the GDP per capita of Tanzania was scrutinised by this study through regression analysis. Regression results show a positive and significant relationship between mobile money services and GDP per capita in Tanzania. From the findings, the effect of mobile money services on GDP per capita is magnified by the easy exchange of value among producers and consumers, abridged financial constraints through savings mobilisation from customer deposits, which in turn accelerate productivity and stimulate economic growth.

The study results, coupled with Nan (2019), which focuses on savings mobilisation through handset procedures, are among the beneficial impacts of mobile money services on productivity. Resource mobilisation in mobile money services in Tanzania is enhanced by customer deposits through mobile money agents located countrywide. The funds deposited by mobile money customers in their electronic accounts are always handled physically by the contracted bank, which uses the funds to issue loans to qualified lenders who spend the money and bear interest. The issued loans hasten spending in the country while stimulating investment and consumption share. Investments and public spending both have a direct impact on the GDP per capita of Tanzania.

Thereafter, the explored significant positive relationship between mobile money services and GDP per capita nourishes the suggestion of Ahmad (2020), who highlighted the economic impact of mobile money services in developing countries. In Tanzania, mobile money services have become a key strategic business of almost all mobile telecommunications companies in recent years. The business hugely expands in terms of the number of transactions operated through mobile phones, but also the amount of funds transacted through mobile money accounts. The increase in the number of transactions and the rise in the transacted figures both highlight enhanced exchange of values, which accelerate productivity and affect economic growth.

Furthermore, the findings signify the direct impact of employment opportunities generated by mobile money services on the country's economy, as was commended by Asamoah (2019). Mobile money services in Tanzania are structured with mobile money agents who play a key role in accepting deposits, facilitating transfers and allowing withdrawals from customers. The number of mobile agents in Tanzania abruptly increased during the study period, which indicates a large number of employment opportunities offered to the country's economy from mobile money services. These employment opportunities have a direct impact on the economic growth of the nation.

Nowadays, mobile money companies in Tanzania offer short-term advances to mobile money customers with respect to their consumption capacity. Short-term advances to

 https://doi.org/10.58548/2025jaep31.2350

customers based on mobile money transaction flows resolve instant cash needs and simplify credit rating arrangements among mobile telecommunications customers. The short-term advances through mobile money accounts have simpler terms, which enhance financial inclusion and stimulate productivity in the country, which in turn accelerates economic growth.

The explored results complement the theoretical topics, which express the evolution of mobile money services as transformations from payment-based services to financial constraint solutions in developing countries (Economides, 2017). In Tanzania, mobile money operators promote minor savings and credit society formalisations through the establishment of free-of-charge mobile money group accounts. The formalisation of savings and credit societies strengthens investment habits in the country, therefore reducing financial constraints and boosting economic growth.

The results are supported by Levine (2005), who stipulates that mobile money services have a significant effect on productivity through abridging the transfer of value between consumers and producers. Mobile money facilities enable easy transfer of value among users through menus and unique identification numbers that can be accessed on mobile phones. Results are in line with Mishra and Bvuma (2022), who insisted that financial systems have a significant effect on economic growth. According to their study, the impact of financial systems on economic growth is due to the easing of financing constraints facing firms. Easing financial constraints accelerates productivity in both manufacturing and service sectors, therefore boosting the economic growth of the given nation.

The development in mobile money technologies transformed manual-based mobile money services to digital mobile money applications, therefore simplifying the exchange of value and market agents' coordination, which stimulates the effects into productivity gains. The transformations offer more service channels that could be utilised in mobile money services, especially online banking and insurance services, which complement mobile money services' contributions to economic growth in Tanzania. Moreover, the widened mobile money agents' coverage expands savings mobilisation from customer deposits, therefore assures capital accessibility for financing investment projects which directly affect the economic growth in Tanzania.

4.4 Vector Error Correction Model

The Vector error correction model results through the Johansen test advocate that the long-term impact on the economic growth of Tanzania is promoted by mobile money services. The coefficient of ce1 for mobile money services is positive, while the p-value is statistically significant. Since the coefficients are positive and the p-values are

statistically significant at 5% confidence interval, the vector error correction model points out the long-run effect of mobile money services on economic growth. Furthermore, the vector error correction model test highlights positive ce1 coefficients for mobile voice services, mobile text message services and public expenditure in skills development as a proxy for literacy level. Though their probability are larger than the confidence interval level, therefore they are statistically not significant. Table 4.6 summarises the results.

Table 4.4: Vector error correction model results

lnGDP Variable	1	2	3
lnVcall	.1719886 (0.839)	.3154211 (0.733)	-.1116037 (0.924)
lnTmes	.1046546 (0.929)	-1.028334 (0.240)	.4414487 (0.696)
lnInter	-.1033688 (0.744)	-.0661186 (0.837)	-.3525994 (0.405)
lnMmon	.4897867 (0.011)**	.5538513 (0.004)***	-.2502242 (0.150)
lnPE	.074592 (0.068)*	-.0410506 (0.235)	.0674025 (0.078)*
lnR	-.0004393 (0.998)	.1014082 (0.566)	.483858 (0.001)***
_ce1	.2016674 (0.001)***		
_cons	.06207 (0.000)***		

Source: STATA calculation

4.4 Causality Test Results

4.4.1 Granger Causality Results in the Macro Production Model

The Granger causality test results in the macro production model assessed the causativeness of GDP per capita, voice call density, text message density, internet density, mobile money density, public expenditure in ICT skills as a proxy for literacy level and interest rate as a proxy for trade openness. The results highlighted the existence of very strong one-way causality from mobile internet services to GDP per capita. But also, the results signify very strong one-way causality from mobile money services to GDP per capita. Therefore, the results exposed mobile internet services and mobile money services as causative of GDP per capita. Then, the direction is from mobile internet services and mobile money services to GDP per capita.

The results depicted very weak on way causality from voice call services to GDP per capita. There is also one-way, very weak causality from text message services to GDP

per capita. Therefore, the causality of mobile voice call services and mobile text message services on GDP per capita is weak. Table 4.5 summarises the results of the Granger causality test.

Table 4.5: Granger Causality Results in the Macro Production Model

Null Hypothesis	Chi2	Prob > Chi2
lnGDPpc#lnVcall	.45191	0.798
lnVcall#lnGDPpc	7.8099	0.020
lnGDPpc#lnTmes	.93876	0.625
lnTmes#lnGDPpc	13.871	0.001
lnGDPpc#lnInter	9.2768	0.010
lnInter#lnGDPpc	.15858	0.924
lnGDPpc#lnMmon	6.4376	0.040
lnMmon#lnGDPpc	.84259	0.656
lnGDPpc#lnPE	.19045	0.909
lnPE#lnGDPpc	1.6407	0.440
lnGDPpc#lnR	4.2604	0.119
lnR#lnGDPpc	4.9765	0.083

Source: STATA calculation

4.4.2 Granger Causality Results in Micro Telecommunications Investment Model

The micro telecommunications investment demand models were jointly estimated to assess the reverse impact of GDP per capita on voice call density, text message density, internet density and mobile money density. The results point out strong one-way causality from the logarithm of previous GDP per capita to mobile internet density. But also, there is weak one-way causality from GDP per capita to voice call density, text message density and mobile money density. Table 4.6 summarises the results.

Table 4.6: Causality Results in Micro Telecommunications Investment Model

Null Hypothesis	Chi2	Prob > Chi2
Vcall#GDPpc(-1)	2.4395	0.295
Tmes#GDPpc(-1)	2.5859	0.274
Inter#GDPpc(-1)	9.7185	0.008
Mmon#GDPpc(-1)	0.64142	0.726

Source: STATA calculation

Where GDPpc(-1) is lagged GDP per capita of Tanzania, Vcall(-1) is lagged voice call density, Tmes(-1) is lagged text message density, Inter(-1) is lagged mobile internet density in Tanzania and Mmon(-1) is lagged mobile money density in Tanzania.

4.4.3 Diagnostic Test Results

The diagnostic assessment through Breusch-Godfrey LM test and Jarque-Bera test in macro productions model of GDP per capita, voce call density, text message density, internet density, mobile money density, public expenditure in skills development and interest rate indicated there is no serial correlation of error term and other variables, because p-value are higher than 0.05 confidence level. The results assured that the estimation of GDP per capita through the macro production model was not misstated. It proves the stabilisation of different shocks on the study results. Therefore, the null hypothesis that there is no serial correlation is accepted.

5.0 Conclusion and Recommendations

The regression results show that both mobile internet services and mobile money services have a positive and significant impact on GDP per capita in Tanzania. The impact of mobile internet services on GDP per capita is higher than mobile money services. Therefore, to stimulate economic growth in the country, the government should first direct huge efforts to optimise the penetration of mobile internet services and then mobile money services. The following policy improvements to enhance mobile telecommunications services for the economic growth of Tanzania are recommended.

Firstly, Tanzania should dedicate more initiatives to promote mobile voice call services, mobile internet services and mobile money services investments in rural areas to achieve the national development goals. The Vision 2025, currently implemented by Tanzania, insists on an economy that can easily adapt to changes in technological conditions. In achieving a competitive economy capable of producing sustainable growth and shared benefits as per Vision 2025, mobile telecommunication services should stand as a central investment agenda.

Secondly, Tanzania should focus on streamlining mobile money service adaptations countrywide, since its contribution to economic growth is strong, while it assures a better platform in transforming the nation into a cashless economy. The mobile money services penetration per population in Tanzania provides a clear roadmap to a cashless economy in the country.

Finally, Tanzania has to devote more resources to execute the ICT policy that targets to accelerate socio-economic development, with the potential to transform the country into an ICT-driven middle-income economy and society. The policy explored mobile voice call services, internet services and mobile money services, and uncovered a huge share of

 https://doi.org/10.58548/2025jaep31.2350

formal and informal employment opportunities for the citizens. Therefore, effective implementation of the ICT policy accelerates directly telecommunications penetrations, which in turn boost income per capita and enhance economic growth.

5.1 Acknowledgement

The appreciation goes to the Tanzania Communication Regulatory Authority, the Bank of Tanzania and the Tanzania Bureau of Statistics for the timely accessibility of data. Their sequential publishing and detailed explanations simplified the research work and assured fulfilment of targeted objectives. Furthermore, digital issuance of data provided a smooth mechanism for responding stipulated hypothesis in the literal work.

References

Acemoglu, Daron (2009). "Endogenous Technological Change". Introduction to Modern Economic Growth. Princeton University Press.

Ahmad, A. H., Green, C., & Jiang, F. (2020). Mobile money, financial inclusion and development: A review with reference to African experience. *Journal of Economic Surveys*, *34*(4), 753-792.

Akcigit, Ufuk; Ates, Sina T. (2021). *"Ten Facts on Declining Business Dynamism and Lessons from Endogenous Growth Theory". American Economic Journal.*

Aker, J.C., and Mbiti, I.M. (2010). "Mobile Phones and Economic Development in Africa." *Journal of Economic Perspectives.*

Ali Z, Bhaskar SB. (2016*). Basic statistical tools in research and data analysis. Indian J Anaesth.*

Andrew T.N. and Petkov D., (2003). The need for a systems thinking approach to the planning of rural telecommunications infrastructure. *Telecommunications Policy*, *Volume 27*, *Issues 1–2, Pages 75-93.*

Ani, W., Ugwunta, D., Eneje, B. and Okwo, M. (2014). "How Telecommunication Development Aids Economic Growth: Evidence from ITU ICT Development Index (IDI) Top five countries for African Region". *International Journal of Business, Economics and Management.*

Astivia, O.L.O., & Zumbo B.D. (2019). "Heteroskedasticity in Multiple Regression Analysis: What it is, How to Detect it and How to Solve it with Applications in R and SPSS," *Practical Assessment, Research, and Evaluation: Vol. 24*

Barro, R. J.; Sala-i-Martin, Xavier (2004). *Economic Growth (2nd ed.). New York: McGraw-Hill.*

Barro, Robert J.; Sala-i-Martin, Xavier (2004). "One-Sector Models of Endogenous Growth". Economic Growth (Second ed.). New York: McGraw-Hill.

Beckerman, W. (1962). "Projecting Europe's Growth". *The Economic Journal.*

Bertschek, I., Briglauer, W., Hüschelrath, K., Kauf, B. & Niebel, T. (2015). The Economic Impacts of Broadband Internet: A Survey. *Review of Network Economics*, *14*(4), 201-227.

BoT (2022). Economic Bulletin for the Quarter Ending June 2022: Vol. LIV No.2. *Bank of Tanzania*.

Burt, Oscar R. (1987). The Fallacy of Differencing to Reduce Multicollinearity. American Journal of Agricultural Economics. *Oxford University Press*

Carroll, C. (2011). "The Rebelo AK Growth Model", the steady-state growth rate in a Rebelo economy is directly proportional to the saving rate.

Chavula, H.K, (2012). "Telecommunications development and economic growth in Africa". *Information Technology for Development.*

Chongela, J. (2015). Contribution of the agriculture sector to the Tanzanian economy. *American Journal of Research Communication*, 3(7), 57-70.

Datta, A. and Agarwal, S. (2004). "Telecommunications and economic growth: A panel data approach," Applied Economics. *Taylor & Francis Journals*.

East African Community (2021). 6th Development Strategy 2021/2026. EAC Headquarters, Arusha, Tanzania.

Economides, Nicholas & Jeziorski, Przemyslaw. (2017). Mobile Money in Tanzania. *Marketing Science*. 36. 815-837.

Ellway, B. (2014), "The voice-to-technology (V2T) encounter and the call centre servicescape: Navigation, spatiality and movement", *Journal of Service Management*, Vol. 25 No. 3, pp. 349-368.

Enowbi, M. 2008. "The Role of Telecommunication Infrastructure in the Regional Economic Growth of Africa". *The Journal of Developing Areas.*

Eveland, J.D. (1986). "Diffusion, Technology Transfer, and Implementation: Thinking and Talking About Change". Science Communication.

Farhadi, M., Fooladi, M., and Ismail, R. (2012). "Information and Communication Technology Use and Economic Growth". *PLoS ONE.*

Farmer, Roger E. A. (1999). "Endogenous Growth Theory". Macroeconomics (Second ed.). Cincinnati: South-Western.

GSMA (2020). "The mobile economy 2020". *GSMA Publishing.*

GSMA (2020). State of the Industry Report on Mobile Money. GSM Association Head Office, London.

Haftu, Girmay Giday, 2019. "Information communications technology and economic growth in Sub-Saharan Africa: A panel data approach," *Telecommunications Policy, Elsevier*, vol. 43(1), pages 88-99.

Hoffman, A. (2018). Africa Telecommunications Infrastructure in 2018: Overview and Policy Recommendations. SSRN: https://ssrn.com

Howitt, Peter (April 2007). Growth and development: C. D. Howe Institute Commentary.

Huebner M, Vach W, le Cessie S. (2016). A systematic approach to initial data analysis is good research practice. J Thorac Cardiovasc Surg

 https://doi.org/10.58548/2025jaep31.2350

Huitema, B., & Laraway, S. (2006). Autocorrelation. Encyclopedia of measurement and statistics.

Huitema, Bradley, Laraway, Sean (2009) "Encyclopedia of Measurement and Statistics Edition: Autocorrelation." *SAGE Publications.*

ITU (2010). "Handbook for the collection of administrative data on telecommunications/ ICT". *ITU Publication Production Service (PUBL)*.

ITU (2019). "Collection of the basic texts of the International Telecommunication Union adopted by the Plenipotentiary Conference". *ITU Publishing*.

Jensen, R. (2007). The Digital Provider: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector. The Quarterly Journal of Economics

Johansen, S. and Nielsen, M.Ø., (2012). Likelihood inference for a fractionally cointegrated vector autoregressive model. *Econometrica*, *80*(6), 2667-2732.

Jørstad, I., Dustdar, S., & van Thanh, D. (2005). Evolution of Mobile Services: An analysis of current architectures with a prospect to the future. In *Ubiquitous Mobile Information and Collaboration Systems: Second CAiSE Workshop, UMICS 2004, Riga, Latvia, June 7-8, 2004, Revised Selected Papers 2* (pp. 125-137). Springer Berlin Heidelberg.

Kaur P, Stoltzfus J, Yellapu V. (2018). Descriptive statistics. Int J Acad Med

Kefela, G.T., (2011). "The impact of mobile phones and economic growth in developing countries". *African Journal of Business Management.*

Klonner, S., & Nolen, P.J. (2010). Cell Phones and Rural Labour Markets: Evidence from South Africa. Proceedings of the German Development Economics Conference, Hannover.

Kothari, C.R. 2014. "Research Methodology: Methods and Techniques". *New Age International Publisher.*

Kozak M., Wnuk A., Tartanus M., Hartley J. (2012). Key variables come first! How best to design a correlation table when there is one key variable. *Journal of Information Science*

Kpodar, K. & Andrianaivo, M. (2011). ICT, Financial Inclusion, and Growth: Evidence from African Countries. IMF Working Papers.

Kpodar, K. and Andrianaivo, M. (2011) ICT, Financial Inclusion, and Growth Evidence from African Countries. IMF Working Paper No. 11/73.

Krugman, Paul (2013). "The New Growth Fizzle". New York Times

Lavrakas, P. J. (2008). Encyclopedia of survey research methods (Vols. 1-0). Thousand Oaks, CA: Sage Publications, Inc.

Lee, S., Gutiérrez, L., and Levendis J., (2012). "Telecommunications and economic growth: an empirical analysis of sub-Saharan Africa". *Routledge publisher.*

Liew, Venus. (2004). Which Lag Selection Criteria Should We Employ?. Economics Bulletin. 3. 1-9. Research gate

Loayza & Odawara, 2010. "Infrastructure and Economic Growth in Egypt". *The World Bank, Policy Research Working Paper Series.*

Lucas, R. E. (1988). "On the mechanics of Economic Development". Journal of Monetary Economics.

Maiorano, F., & Stern, J.P. (2007). Institutions and Infrastructure Investment in Low and Middle-Income Countries: The Case of Mobile Communications. Utilities Policy. 15.

Maiorano, Federica & Stern, Jon, 2007. "Institutions and telecommunications infrastructure in low and middle-income countries: The case of mobile telephony," Utilities Policy, Elsevier, vol. 15.

Masamila, B. (2014). State of Mobile Banking in Tanzania and Security Issues. International Journal of Network Security & Its Applications.

Mishra, R., & Bvuma, S. (2022). Conceptualising the Relationship between Mobile Money Banking and Financial Inclusion to Support Sustained Economic Growth. *African Journal of Public Affairs*, *13*(1), 54-78.

Mpogole, H., Usanga, H., and Tedre, M. 2008. "Mobile phones and poverty alleviation: A survey study in rural Tanzania". *Proceedings of the 1st International Conference on M4D Mobile Communication Technology for Development.*

Msoffe, G. and Lwoga, E. 2019. "Contribution of mobile phones in expanding human capabilities in selected rural districts of Tanzania". *Global Knowledge, Memory, and Communication.*

Nadiri & Nandi, 2003. "Telecommunication infrastructure and economic growth". *Traditional Telecommunications Networks.*

Nan, W. V. (2019). Mobile money and socioeconomic development: A cross-country investigation in Sub-Saharan Africa. *Journal of International Technology and Information Management*, *27*(4), 36-65.

NAOT (2020). "Performance Audit Report on the management of revenue collection from Telecommunication service providers: Tanzania Communication Regulatory Authority, The Tanzania Revenue Authority, and The Ministry of Works, Transportation and Communications". *National Audit Office*.

NBS (2020). "National Accounts of Tanzania Mainland 2013-2019: Second Edition in the Revised GDP series base year 2015". *National Bureau of Statistics*.

Odhiambo, N. M. (2010). Interest rate reforms, financial deepening and economic growth in Tanzania: a dynamic linkage. *Journal of Economic Policy Reform*, *13*(2), 201–212.

OECD (2020). "A Roadmap toward a Common Framework for Measuring the Digital Economy: Report for the G20 Digital Economy Task Force". *OECD Publishing.*

Ogunrinola, I. and Osabuohien, E. (2010). "Globalisation and Employment Generation in Nigeria's Manufacturing Sector (1990-2006)". *European Journal of Social Sciences.*

Ortigueira, Salvador; Santos, Manuel S. (1997). "On the Speed of Convergence in Endogenous Growth Models". American Economic Review.

 https://doi.org/10.58548/2025jaep31.2350

Oyeniran & Alliyu, 2016. "Information and telecommunication infrastructure and economic growth: An experience from Nigeria". *Serbian Journal of Management.*

Parente, Stephen (2001). "The Failure of Endogenous Growth". Knowledge, Technology & Policy.

Pratt, L., Wiseman, R.L., Cody, M.J., and Wendt, P.F. (1999). "Interrogative strategies and information exchange in computer-mediated communication". *Communication Quarterly.*

Rebelo, Sergio (1991). "Long-Run Policy Analysis and Long-Run Growth". Journal of Political Economy.

Robert F. Engle and C. W. J. Granger (1987).Co-Integration and Error Correction: Representation, Estimation, and Testing. Econometrica Vol. 55, No. 2. *The Econometric Society*

Roessler, P., Carroll, P., Myamba, F., Jahari, C., Kilama, B., & Nielson, D. (2021). The economic impact of mobile phone ownership: Results from a randomised controlled trial in Tanzania.

Romer, D. 2019. "Advanced Macroeconomics, Fifth Edition". *McGraw-Hill.*

Romer, David (2011). "Endogenous Growth". Advanced Macroeconomics (Fourth ed.). New York: McGraw-Hill.

Romer, P. M. *(1994).* "The Origins of Endogenous Growth". *The Journal of Economic Perspectives.*

Sachs, Jeffrey D.; Warner, Andrew M. (1997). "Fundamental Sources of Long-Run Growth". American Economic Review.

Shrestha, Noora. (2020). Detecting Multicollinearity in Regression Analysis. American *Journal of Applied Mathematics and Statistics.*

Shukla, Satishprakash. (2018). Variables, Hypotheses and Stages of Research. Researchgate

Spriestersbach A, Röhrig B, du Prel JB, Gerhold-Ay A, Blettner M. (2009). Descriptive statistics: The specification of statistical measures and their presentation in tables and graphs. Part 7 of a series on evaluation of scientific publications. Dtsch Arztebl Int

Sridhar, K. and Sridhar, V. (2007). "Telecommunications infrastructure and economic growth: Evidence from developing countries". Applied Econometrics and International Development.

Tanzania Communications Regulatory Authority Act, CAP 172, R.E 2017. *Government printer.*

TCRA (2019). Quarterly magazine of the Tanzania Communications Regulatory Authority, Fourth Quarter. The Regulator magazine.

TCRA (2020). "Tanzania Gears Up for Digital Transformation". *The Regulator.*

TCRA (2020). Quarterly magazine of the Tanzania Communications Regulatory Authority, First Quarter. The Regulator magazine.

The Electronic and Postal Communications (Tele-traffic) Regulations, 2018. *Government printer.*

Trinh, T. and Nguyen, H. (2021). "The Determinants of Accessibility of Financial Services in Vietnam". *The Journal of Asian Finance, Economics and Business*.

UCSAF (2020). Functions of the Universal Communications Service Access Fund. https://www.ucsaf.go.tz

Uzawa, Hirofumi (1965). "Optimum Technical Change in an Aggregative Model of Economic Growth". International Economic Review.

Vooren, A. and Alkemade, F., (2010). "The diffusion of infrastructure-dependent technologies". *Innovation Studies GroupUtrecht.*

Waverman, Leonard & Meschi, Meloria & Fuss, Melvyn. (2005). The Impact of Telecoms on Economic Growth in Developing Countries. The Vodafone Policy Paper Series. 3.

Wineman, A., Jayne, T. S., Isinika Modamba, E., & Kray, H. (2020). The changing face of agriculture in Tanzania: Indicators of transformation. *Development Policy Review*, *38*(6), 685-709.

Wooldridge, F. (2001). "Applications of Generalised Method of Moments Estimation". *Journal of Economic Perspectives*.

World Bank Group. (2019). *Tanzania Economic Update, July 2019: Human Capital-The Real Wealth of Nations*. World Bank.

 https://doi.org/10.58548/2025jaep31.2350