

Digital technology and macroeconomic performance in Sub-Saharan Africa

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Abstract

Purpose – This study examines how digital technology affects the macroeconomic performance of SSA countries. Specifically, it examines the impact of digital technology on inflation and economic growth in SSA countries.

Design/methodology/approach – This study uses the system GMM on a dataset spanning from 2000 to 2021 for 37 SSA countries. To measure digital technology, the study used an index generated from three components: fixed cellular subscription, individual internet usage and mobile cellular subscription.

Findings – The findings from the results indicated that digital technology has a linear relationship with inflation, and its effect on inflation is negative both in the short and long run. For economic growth, the results indicated that digital technology effect is initially negative, attains a minimum and begins to rise as digital technology use gets to 54% per 100 people.

Originality/value – To the best of our knowledge, no empirical work has been extensively done in Sub-Saharan Africa to examine the impact of digital technology on macroeconomic performance. This paper explains how digital technology affects key macroeconomic variables such as inflation and economic growth in SSA countries. On economic growth, the findings from this study are in conformity with those of East Africa, with the sole differences arising from the rate at which digital technology facilitates economic growth.

Keywords Digital technology, Digitization, Inflation, Economic growth, Macroeconomic performance

Paper type Research article

1. Introduction

In the works of Gobble (2018), which tries to scoop literature for an accepted definition for digitization, it revealed that digitization is the simple process of transforming analogue information to digital. For the past 25 years, the global economy has undergone a digitization process (Barrera *et al.*, 2018), and its continuous structural changes in economies continue to make the digital economy a major focus (Micossi, 2015). Exchanges of information and communication have proliferated, leading to a significant transformation of numerous processes, including financial and payment systems as well as manufacturing and distribution processes. This has motivated the International Monetary Fund to create a directive that urges international bodies to give criteria for gauging the number of digital transactions and update classification schemes for digital activities and goods (Barrera *et al.*, 2018).

As of Quarter 3 in 2022, the majority of internet users worldwide, specifically over 92%, accessed the internet through their mobile phones, with about 91% doing so through their smartphones. In contrast, around 66% of those surveyed reported accessing the internet through a laptop or desktop computer. Moreover, almost 60% of internet users globally reported using their laptop or desktop devices to go online, while nearly 29% are connected to the internet through a work laptop. Around 60% of people in Africa use their mobile phones to access the Internet.



The digital economy presents opportunities for businesses and consumers to connect with the goods and services more quickly, more effectively and meaningfully (Javaid, Haleem, Singh, & Sinha, 2024a). In the upcoming years, it is anticipated that digitalization will play a big role in driving productivity and economic growth. It will reshape ways of transacting via electronic commerce and online business, enabling flexibility in banking operations and improved communications (Javaid, Haleem, Singh, & Sinha, 2024b). It is currently altering manufacturing processes and structures and producing new goods and services (Brynjolfsson & McAfee, 2014). The digital economy has the potential of changing the market structure of an economy (Charbonneau *et al.*, 2017). People tend to conduct businesses even in their homes with digital technology. Digital technology is observed in our daily lives through access to the internet, data speed, mobile money subscriptions, ownership of credit cards and many more (Kpessa-Whyte & Dzisah, 2022). The frequent use of these services depicts how much digital technology has so much influenced the choices people make every day and the overall money supply in an economy. This may restructure markets, which could have an impact on pricing power and, ultimately, inflation (Charbonneau *et al.*, 2017). The changes in the market structure presents itself through changes in the barriers to entry and increased competition.

Digital technology may be a complement to labour, which can result in higher productivity. Digital technology can increase a company's production frontier by acting as a substitute for labour through automation. In both scenarios, digital technology reduces the cost of production, and this translates into lower prices, which ends up boosting demand.

According to the World Bank, SSA countries GDP growth has been rising steadily from 2016. GDP growth rose from 1.4% in 2016 to 2.19% in 2017 and from 2.19% in 2017 to 2.78% in 2018. However, the onset of COVID-19 brought a decline in the growth rates of the various economies from 2.78% GDP growth in 2018 to -2.07% in 2019.

Another key macroeconomic variable that is affected by the digital economy is inflation. Due to efficiency improvements, automation and new business models, digitalization can reduce firms' operational costs, which has an impact on inflation (Charbonneau *et al.*, 2017). The presence of a digital economy has made it possible for businesses to conduct their activities remotely without the need for physical infrastructures and hence the use of e-money as opposed to physical cash (Javaid *et al.*, 2024a). In a general context, this shift in payment methods from physical cash usage to online transactions leads to a decrease in the total money available in circulation. Such an occurrence could potentially impact monetary policy and its core element, money.

The use of digital technology has the potential to enhance economic growth and reduce inflation; however, it also presents a range of challenges and risks that can impact macroeconomic variables (Akinmutola, Sudwestfalen, & Akinmutola, 2024). Effective policies and regulations are essential to harness the benefits of digital technology while mitigating the negative economic consequences, such as labour market disruptions, income inequality and monopoly power. For example, digital technology disrupts the labour market through job displacements. In cases where digital technology acts as a substitute for labour in the production process, digital technology creates unemployment for the individuals that were initially performing the roles which got substituted with digital technology. Also, digital technology contributes to high income disparity. This is because, high-skill workers in the digital technology industries are being sought after. This causes an increase in income of such people, widening the income gap. Alexandrova, Poddubnaya, Shalenaya, and Savvidi (2019), Li, Kim, Lang, Kauffman, and Naldi (2020), Sarjana, Najib, and Khayati (2021) argued that the digital economy does not always lead to economic growth. Companies may encounter issues such as the fragility and dynamism of competitive advantage supplied by fast-evolving digital technology, greater rivalry, lack of management experience and ignorance of the high significance of digital transformation.

Current data on inflation for SSA countries depicts that inflation rate as gauged by the consumer price index in SSA countries are always changing. The annual inflation rate stood at

3.6% in 2015; however, it jumped to 5.4% in 2016. In 2017, inflation rate was 5.2%, 2018 recorded an inflation rate of 4%. For 2020 and 2021, the values for inflation rate stood at 3.3 and 4.4%, respectively. It is therefore, imperative to examine the impact digital technology has on inflation and economic growth in Sub Saharan Africa.

The main objective of this study is to examine how the digital economy affects the macroeconomy of SSA countries.

The specific objectives are to examine the impact of digital technology on inflation and economic growth in Sub-Saharan Africa countries (SSA).

The rest of the paper is organized as follows: the next section throws light on relevant theoretical and empirical literature works linked to the study. [Section 2](#) presents the research methodology that the study adopts, while [Section 4](#) presents and discusses the empirical results, and [Section 5](#) concludes and suggests policy actions.

2. Literature review

The Solow growth theory was founded by Robert Solow in 1956 in his paper “A Contribution to the Theory of Economic Growth”. The Solow growth model is an exogenous economic growth theory that examines how changes in population growth, savings rates and the pace of technological advancement affect the level of production in an economy over time. The neoclassical growth model demonstrates that there is no long-term increase in output per capita in a long-term stable equilibrium without technological advancements ([Sredojević, Cvetanović, & Bošković, 2016](#)). The Solow growth theory is relevant to this study in that the use of digital technology has gained increased usage in SSA countries over the years, which also indicates an advancement in technology. In the view of the Solow theory, such an activity should lead to a long-run growth in the SSA economies. According to a typical Solow model, economies eventually reach their steady state equilibrium and the only way to sustain development is through technological advancement. Long-term changes in population growth and saving patterns have only level impacts.

Another theory of interest is the modern quantity theory of money. According to this theory, changes in the money supply have a direct impact on the price level in an economy. In light of this study, the use of digital technology reduces the amount of physical money holdings of individuals. Individuals are now able to hold their monies in the form of electronic currency, such as mobile money and plastic money, such as ATM cards. The use of these forms of currency comes with a charge. Based on the idea that individuals are rational, people will only transact when the benefit accruing from transacting outweighs the cost associated with it. The problem of charges associated with transactions thus reduces people’s willingness to transact alternatively, reduces the amount of money in circulation and hence causes a fall in inflation, according to the quantity theory of money.

Lastly, technology acceptance model (TAM) was also used in this paper. The TAM is a concept introduced by Davis in 1989, outlining that the effectiveness of adopting a specific technology is influenced by two fundamental elements. These are perceived ease of use and perceived usefulness ([Davis, 1989](#)). It is a theory that explains the factors that cause people to embrace a change in technology. TAM can be used to track how external stimuli affect internal convictions. This theory is adopted for this study because the use of digital technology is new and whether individuals decide to adopt or not depends on some keen factors which are explained by TAM. When individuals use less effort in operating this new technology and they are able to obtain the results for which they used the technology, then per TAM, individuals will continue to use the technology. Also, the usage of digital technology increases efficiency and reduces the cost of production, which leads to lower prices.

On the empirical side, [Madden and Savage \(1998\)](#) looked at Central and Eastern Europe telecommunications investment and economic growth for a sample of transitional economies in Central and Eastern Europe. The study employed ordinary least squares (OLS) using information from 27 nations in Central and Eastern Europe. The results showed that

investments in telecommunications, particularly as measured by communication lines, contribute favourably to economic growth. The researchers recommended policymakers address the persistent underinvestment in telecommunications lines in CEE countries.

Röller and Waverman (2001) explored the linkage between mobile telecommunications infrastructure and economic growth. Data from 21 Organization for Economic Co-operation and Development (OECD) nations, spanning the years 1970–1990, were used in the study. To endogenize investment in telecommunications, the nonlinear GMM estimate technique was applied to a production function. The results of this study showed that, with elasticities of 0.6 and 0.4, respectively, labour and capital have a significant and positive impact on production. Additionally, the OECD countries' levels of telecommunications investment vary, suggesting that a country's physical location may also influence how well it absorbs digitization. In general, it was discovered that telecommunications infrastructure supports economic expansion in OECD nations. Telecommunications infrastructure accounts for around one-third of economic development in OECD nations.

Albiman and Sulong (2016) studied the long-run impact of ICT on economic growth in SSA countries. The study employed GMM on a dataset spanning from 1990 to 2014. The findings from the study indicated that, for the direct impact analysis, mobile phones and the internet were found to have augmented economic growth. In contrast, for the nonlinear effect, mass penetration of ICT proxies seems to slow economic growth.

Also, Ward and Zheng (2016) examined the impact of mobile telecommunications on economic growth in China. The study divided mobile communications into mobile services and fixed services with an emphasis on the Chinese provinces. Descriptive statistics, OLS with two-fixed effects and system GMM were all used in the research. The results of this study showed that although mobile services add more to economic growth than fixed services, the overall impact of mobile telecommunications – both mobile and fixed services – is positive in China. The research also noted that after 2001, when China was less developed, the matching effect between fixed and mobile services seemed to be small and absent. Prior to 2001, fixed services in Western China had a greater regional impact than mobile services.

Moreover, Solomon and van Klyton (2020) investigated the impact of digital technology usage on economic growth in Africa. They employed a system GMM on 39 African countries from 2012 to 2016. It is significant to highlight that this study used a disaggregated analysis to look at the group of digital technology users who support economic growth in Africa. According to the findings, only individual usage of ICT, as opposed to that of businesses and the government, has a beneficial impact on economic growth. Additionally, a deeper examination of usage patterns reveals that social media and the significance of ICT in the government's vision for the future assist economic growth. Since the study assumes a complementary role between human labour and ICT use, it goes on to claim that improvements in human labour can increase the contribution of ICT to economic growth.

Myovella, Karacuka, and Haucap (2020) studied digitalization and economic growth. He made a comparative analysis between SSA and OECD economies. The study employed a panel dataset from 2006 to 2016. By using GMM, the findings indicated that, digitalization has a positive contribution to economic growth in both groups, with the effect being minimal in SSA countries compared to OECD countries.

Boakye, Nwabufo, and Dinbabo (2022) examined the impact of technological progress and digitization on Ghana's economy. They employed the error correction models on an annual time series data spanning from 2009 to 2019. The conclusion from their findings indicated that utilizing technology promotes long-term economic growth and development. Also, it was noted that ICT investment drives high productivity and foster economic growth. In sum, digitization and ICT are key tools that have the potential to affect the growth rate of an economy and therefore requires attention when the issue of economic development is being looked at.

Muleta Beyene, Bedemo Beyene, and Sore (2023) also investigated the influence of digital technology on the economic growth of SSA countries. They employed GMM on a dataset

ranging from 2010 to 2020. The findings from the results indicated that digital technology has a positive impact on economic growth both in the long and short run. This highlights the pivotal role of digital technology in promoting economic growth.

Yi and Choi (2005) investigated the impact of internet usage on inflation using panel data. This study employed pooled OLS. The finding from this study indicated that there exist an inverse relationship between digitization and inflation. This study continued to make policy recommendations stating that there should be an increase in investment in internet usage. Also, central banks should be more careful in using money supply to control inflation since internet usage can make the effect worse than anticipated.

Buchheim and Kedert (2016) analysed the digitization effect in inflation on European countries. This study seemed to identify the possible channels through which the digital economy can affect the inflation rate. The study employed OLS, FE and AB in its regression analysis using data on 17 European countries with an 11-year duration period. The findings from the study indicated that, digitalization has a significant and negative impact on inflation suggesting that the more digitalized an economy is, the lower the expected level of inflation. When macroeconomic considerations are considered, however, the projected results show that digitization has a fluctuating net effect on the inflation rate, demonstrating that it influences price stability swings. These findings imply that, despite the likelihood of short-term effects, governments should consider digital technological growth while attempting to control inflation.

Csonto, Huang, and Mora (2019) also examined the effect of digitalization on domestic inflation in both emerging and advanced economies. This study employs a two-way fixed effect model on a data spanning from 1990 to 2017 for a sample of 39 economies. The main conclusion from this study is that, digitization appears to be one of the main structural components that determines inflation globally. However, digitization has, on average, a negative effect on inflation rate. Digitization has reduced inflation in the short term, especially since 2012. This is mainly due to digitization effect in reducing the cost of production, although this effect appeared to be small. It is worthy to note that, although digitization appears to reduce inflation, it does not reduce inflation through the inflation expectation channel.

Emara and Zecheru (2022) examined the impact of digitization on domestic inflation. The study verifies a nonlinear deflationary effect of digitization on inflation by using annual data spanning from 2004 to 2018 on 54 countries, including both advanced and emerging nations, and applying a system GMM estimate technique. Their results show that improvements in digitization initially reduce inflation, but once they hit a threshold, further improvements in digitization cause inflation to rise. Furthermore, their results suggest that the reduction in inflation due to the progress in digitization is not as significant for emerging economies when compared to the entire dataset. On the other hand, enhancements in governance and the allocation of resources to human capital have a more noticeable deflationary influence. The research emphasizes that for emerging economies to maximize the positive effects of digitization improvements on domestic inflation, it is crucial to prioritize policies focused on boosting school enrolment, curbing corruption, ensuring adherence to the rule of law and enhancing measures of voice and accountability.

Bejene, Bedemo, and Gebremeskel (2024) studied the determinants of digital technology development in Sub-Saharan African countries. The study employed fixed-effect panel regression on data from 16 countries covering the period from 2000 to 2020. The findings from this study indicated that inflation has a positive impact on digital technology in SSA countries.

The majority of the empirical studies examined employed quantitative approaches to ascertain the link between the variables of interest. As some works argue completely that digitization has a positive impact on economic growth, others argue that digitization can only affect economic growth positively when it is allowed to complement the activities of labour. Also, as most works indicated that digitization can help curb high inflation rates, some suggest digitization only to a certain point, reduces inflation. Above a certain threshold, digitization increases inflation in an economy and the effect is undesirable. The argument of digitization on

macroeconomic issue still remains the most talked about, as the global economy is gradually moving towards the fourth industrial revolution, where the digital economy has taking over most of the economic activities recently.

3. Methodology

In line with the first objective of this paper, which seeks to examine how digitization influences inflation in SSA countries, the study uses the demand-pull inflation theory such that it adopts a general relationship between inflation and a set of regressors represented as

$$\begin{aligned} inf_{it} = & \alpha + \rho inf_{i,t-1} + \beta_1 DigiTech_{i,t} + \beta_2 MS_{i,t} + \beta_3 GovExp_{i,t} + \beta_4 ExtDb_{i,t} + \beta_5 IntRa_{i,t} \\ & + \beta_6 lnExcRa_{i,t} + \rho_i + \theta_t + \mu_{it} \end{aligned} \quad (1)$$

Where the variable inf_{it} represent inflation for country i at time t , $DigiTech_{i,t}$ represents an index of the variables constituting digital technology, $MS_{i,t}$ represents money supply for country i at time t , $GovExp_{i,t}$ represents government expenditure for country i at time t , $ExtDb_{i,t}$ represents external debt for country i at time t , $IntRa_{i,t}$ is the interest rate for country i at time t and $lnExcRa_{i,t}$ is the log of exchange rate values for country i at time t and μ_{it} measures the error term.

Also, in line with the second objective, which seeks to examine the impact of the digital economy on economic growth, this study follows the model specified by [Adeye and Eboagu \(2019\)](#), which uses the Cobb–Douglas production function in estimating the effect of digitalization on economic growth. The model is specified as:

$$\begin{aligned} \Delta \ln Y_{it} = & \alpha_0 + \rho \ln Y_{it-1} + \alpha_1 \ln L_{it} + \alpha_2 \ln K_{it} + \alpha_3 D_{it} + \alpha_4 D_{it}^2 + \alpha_5 ExtDb_{i,t} + \alpha_6 GovExp_{i,t} \\ & + \alpha_7 Inf_{i,t} + \gamma_i + \delta_t + u_{it} \end{aligned} \quad (2)$$

where $\rho = (\alpha_1 - 1)$

where $\Delta \ln Y_{it}$ represents the economic growth rate for country i at time t , $\ln Y_{it-1}$ is the AR (1) endogenous variable which is measured with GDP, L stands for labour, proxied using labour force participation and K stands for capital, which is also captured by gross capital formation. The variable D_{it} represents an index for digital technology for country i at a time t , D_{it}^2 measures the squared term of the digital technology index, $ExtDb_{i,t}$ represents external debt for country i at time t , $GovExp_{i,t}$ represents government expenditure for country i at time t and $Inf_{i,t}$ shows inflation for country i at time t . The parameters $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ and $\alpha_4, \alpha_5, \alpha_6, \alpha_7$ measures the coefficients of the estimate. Also, γ_i represents country dummies, δ_t shows time dummies, ρ measures the speed of convergence and u_{it} is the overall error term of the model.

3.1 Source and data type

This study employed annual data spanning from 2000 to 2021 and covers 34 SSA countries. The digital technology variables employed are mobile cellular subscription, Fixed Telephone subscription and individual internet usage. Data on digital technology were sourced from the International Telecommunication Union, while data on exchange rate, interest rate, money supply, government expenditure, external debt and inflation were obtained from the International Monetary Fund. Also, data on GDP per capital growth rate and capital was sourced from the World Bank, whereas data on labour was obtained from the International Labour Organization.

3.2 Estimation technique

The main estimation technique for this study is Sys-GMM. The Sys-GMM was proposed by [Arellano and Bond \(1991\)](#). The Sys-GMM estimation method involves utilizing both level and initial change equations, offering an alternative to the conventional first difference GMM estimation. The Arellano–Bond approach involves introducing differentiation into the regression equation to eliminate individual-specific effects. This leads to the utilization of past lags of the dependent variable as instruments for the lagged differences of the same variable.

When using traditional panel data approaches, incorporating more distant time lags of the dependent variable reduces the number of accessible observations. For example, if data is captured at T time points, only T-1 delays remain valid after first differencing. When K lags of the dependent variable are used as instruments, only T-K-1 data points are relevant for the regression. This condition creates a conundrum: while adding more lags increases the number of instruments, it decreases the sample size. This problem is effectively avoided by the Arellano–Bond approach.

$$\text{Assume } y = x'\beta + \mu$$

Where y and μ are $N * 1$ vectors,

$\beta = K * 1$ vector of coefficients to be estimated

$X = N * K$ matrix of regressors.

Due to the endogeneity assumption, let there be a matrix z such that its dimension is $N * L$ where $L > K$. It is assumed that the Z matrix consists of variables that exhibit strong correlations with X while being independent from μ . Also, for the purpose of the system GMM, $N > T$.

3.3 Long-run estimates

This study also continues to examine the long-run impact of the variables under study. However, the long-run impact is estimated only for the variables that are statistically significant in the short run. Also, the long-run estimates are generated using coefficients from the system GMM results. The long-run analysis is a very popular in social sciences ([Reed & Zhu, 2017](#)).

Assume a model such that

$$Y_{it} = \beta_0 + \beta_1 Y_{it-1} + \beta_1 X_{1it} + \beta_2 X_{2it} + \mu_{it} \text{ where } |\beta_1| < 1,$$

Then, the long run impact can be calculated as;

$$LR_x = \frac{\beta_x}{1 - \beta_1},$$

Where x is the coefficient of the variable for which its long-run impact is being examined, and LR represents long run.

3.4 Index generation

In order to integrate all three components of digital technology as one unit, this study generated an index using the MINMAX approach proposed by [Liu, Liu, & Halabi \(2011\)](#). The likelihood that future data points will be correctly classified should be maximised while building a classifier ([Lanckriet, Ghaoui, Bhattacharyya, & Jordan, 2002](#)). Minmax focuses on minimizing the maximum cost, which is ideal when we want indexing strategies that perform consistently well even in worst-case queries. The formula for generating this index is given as $\frac{x - Min}{Max - Min}$, where x represents the given value in a dataset, Min represents the minimum

value in the dataset and *Max* is the maximum value in the dataset. The geometric mean is then computed to determine the indexes. Since three variables were used in generating the index, the geometric mean is therefore calculated as $\sqrt[3]{IndInt * MoCeSubs * FixTelSub}$, where *IndInt* represents individual internet usage, *MoCeSubs* represents mobile cellular subscriptions and *FixTelSubs* represents fixed telephone subscriptions. These values are normalized between 0 and 1 where the index values are interpreted based on how the components for the indexing are measured. This method for computing the index are robust (Liu *et al.*, 2011). Notable papers that have also used the MinMax normalization approach are Talukder, Hipel, and vanLoon (2017) and Mazziotta and Pareto (2022).

4. Results and discussion

4.1 Summary statistics

Table 1 gives account of the basic descriptive statistics about the variables under study. As a measure of central tendencies, the mean shows that, in measuring GDP per capita growth rate, the mean of the observation is approximately 0.67%, whereas the mean of external debt is approximately 53% of GDP. Inflation has a mean value of 8.9%. The mean value for money supply also approximates to 18 annually, and the mean exchange rate is 5.192475, whereas in measuring digital technology, on average, the digital technology index is 0.116 and that it ranges from 0 to 1 as given by the maximum and minimum values. The average values for labour and capital are approximately 66 and 24, respectively. The average value for government expenditure was recorded to be approximately 15% of GDP. For lending rate and inflation, the average values are 14 and 8.91%, respectively. The vast differences between the averages of the variables under study basically stems from the differences in measurement units. While external debt, exchange rate, money supply, labour, capital, government expenditure and lending rate are measured in percentages, GDP per capita growth rate is measured in raw values.

Table 1. Variable description and expected signs

Variable	Variable description	Measurement	Expected sign	
			Objective one	Objective two
Digital technology (DigiTech)	IndInt	Individuals using the Internet (% of population)	Negative	Positive
	MoCeSubs	Mobile cellular subscriptions (per 100 people)		
	FixTelSubs	Fixed telephone subscriptions (per 100 people)		
Exchange rate	ExcRa	Official exchange rate (LCU per US\$, period average)	Positive	N/A
Labour	LFP	Labour force participation rate, (% of total population aged 15–64)	N/A	Uncertain
Capital	CapForm	Gross capital formation (% of GDP)	N/A	Positive
Money supply	MS	Broad money growth (Annual %)	Positive	Positive
External debt	ExtDb	External debt stocks (% of GNI)	Positive	Uncertain
Government expenditure	GovExp	General government final consumption expenditure (% of GDP)	Uncertain	Uncertain
Interest rate	LendRa	Lending interest rate (%)	Negative	N/A
GDP growth rate	GDPG	The log difference between GDP per Capita	N/A	N/A
Inflation	inf	Annual inflation growth rate	N/A	Negative

Source(s): Authors' construct

The results of the descriptive statistics carried out are presented in [Table 2](#). As a measure of the spread of the data, this study uses the standard deviation values. The standard deviation measures the variation or dispersion in the data set. A larger standard deviation indicates that the dataset values are more distant from the mean, while a smaller standard deviation implies that the values are nearer to the mean. The lower the standard deviation, the more reliable the dataset and vice versa. Similar to the results of the mean, higher values of the variables also influence the standard deviation. GDP per capita growth rate has a standard deviation of approximately 2.167, whereas external debt has a standard deviation of 46. Money supply, exchange rate and digital technology index reported a standard deviation of 28.768, 2.98 and 0.137, respectively. For labour and capital, the standard deviations are approximately 11 and 10, respectively. Government expenditure reported a standard deviation value of 6.480, and the lending rate had a standard deviation of 11.636, whereas the standard deviation for inflation was approximately 31.

The steep gaps in the variations between the mean and the standard deviation are an indication that the variables under study have different measurements and therefore, there is a need for rescaling the log of the variables discussed above.

4.2 Empirical results

4.2.1 Short run results for the effect of digitalization on inflation. [Table 3](#) shows the short-run results of the GMM estimation where the dependent variable is inflation. The results suggest that digital technology has a negative relationship with inflation in the short run. The result indicated that an increase in the digital technology index reduces inflation for SSA countries. The reported coefficient is -1.173 , which is statistically significant at 1%. This indicates that when keeping all other variables unchanged, there is an average reduction of 1.2% in short-term inflation for every unit increase in the utilization of digital technology. The use of digital technology increases productivity through either reduced costs or effective communications. Also, digital technology opens the world market, which tends to create better-informed consumers, increasing competition and hence reduces mark-up on prices, which eventually lowers prices of goods and thus reducing inflation. Also, this finding is consistent with the works of ([Çoban, 2022](#); [Coffinet & Perillaud, 2017](#); [Yi & Choi, 2005](#)). The negative impact of digital technology on inflation, as explained by the QTM, can be seen through the increased efficiency, price transparency and competition it brings to the economy. These factors can lead to an increase in real output and constrain the upward pressure on prices, assuming the money supply remains relatively stable.

In addition, money supply reports a positive coefficient of 0.633 in the short run, and this is statistically significant at 1%. This indicates that when keeping all other variables unchanged,

Table 2. Basic descriptive statistics

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
GDPPG	748	0.670	2.165	-17.616	13.187
ExtDb	748	52.987	46.139	3.895	429.738
MS	748	17.882	28.768	-58.172	485.547
lnExcRa	748	5.192475	2.980094	-3.112977	22.62881
DigiTech	748	0.116	0.137	0	0.913
LFP	748	66.424	10.538	41.595	89.45
CapForm	748	23.684	9.856	1.525	79.401
GovExp	748	14.85626	6.479703	0.9517466	43.48379
LendRa	748	13.755	11.636	2.45	103.16
Inflation	748	8.907	30.511	-16.860	557.202

Source(s): Authors' construct

Table 3. Short run results, dependent variable and inflation

Variable	Co-efficient	Standard error	p-value
L.inf	0.116***	0.032	0.001
DigiTech	-1.173***	0.216	0.000
MS	0.633***	0.034	0.000
GovExp	0.091	0.100	0.369
ExtDb	0.044***	0.004	0.000
IntRa	-0.727***	0.054	0.000
lnExcRa	-0.906***	0.206	0.000
Constant	7.451***	2.505	0.005
No. of groups			34
No. of instruments			26
No. of countries			37
Prob > F			0.000
AR (1)			0.394
AR (2)			0.256
Hansen test			0.378

Source(s): Authors' construct

there is an average increase of 0.63% in short-term inflation for every percentage increase in money supply. External debt has a positive coefficient of 0.044 in the short run, which is statistically significant at 1%. This coefficient means that, holding all other factors constant, on average, a unit increase in the percentage of external debt to GNI increases inflation by 0.04% in the short run. In the short term, there is an inverse relationship between the interest rate and inflation. coefficient of 0.727, which is statistically significant at 1%. Economically, this finding implies that, holding all other factors constant, on average, a percentage increase in interest rate reduces inflation by 0.73% in the short run. Exchange rate also had 0.009% effect on inflation in SSA countries. However, government expenditure increased inflation by 0.09%, although this effect was not statistically significant.

4.2.2 Long-run results for the effect of digitalization on inflation. According to the results presented in [Table 3](#), there is a long-term adverse impact of digital technology on inflation. The coefficient in the long run is -1.3264 and holds significance at the 1% level. This negative coefficient implies that, holding all other factors constant, in the long run, a unit increase in digital technology reduces inflation by 1.33%. The long-run estimate depicts the short-run influence, but the impact of the long run is higher than that of the short run. The summary for the long-run results is shown in [Table 4](#).

4.2.3 Short-run results for the effect of digitalization on economic growth. [Table 5](#) shows the short-run results of the GMM estimation where the dependent variable is economic growth. At the initial stages, digital technology reduces economic growth, as shown by a negative coefficient of -6.817, which appears to be statistically significant at 1%. Generally speaking, digital technology ensures connectivity, financial inclusion and access to

Table 4. Long run results, dependent variable and inflation

Variable	Coefficient	Standard error	p-value
DigiTech	-1.3264***	0.2731	0.000
MS	0.7161***	0.0346	0.000
ExtDb	0.0503***	0.0052	0.000
IntRa	-0.8222***	0.0824	0.000
lnExcRa	-1.025***	0.2278	0.000

Source(s): Authors' construct

Table 5. Short run results, dependent variable and GDP growth

Variable	Co-efficient	Standard error	p-value
L.GDPG	-0.176***	0.017	0.000
DigiTech	-6.817***	0.614	0.000
DigiTechSq	6.348***	0.66	0.000
ExtDb	-0.009***	0.002	0.000
GovExp	-0.057***	0.014	0.000
Infl	-0.048***	0.005	0.000
lnLFP	-0.295	0.373	0.435
lnCapForm	0.123	0.151	0.420
Constant	4.091**	1.698	0.022
No. of groups			34
No. of instruments			27
No. of countries			37
Prob > F			0.000
AR (1)			0.010
AR (2)			0.098
Hansen test			0.170

Source(s): Authors' construct

information, which helps an economy grow. However, these positive impacts cannot be realized when certain measures are not in place. Most SSA countries are coupled with poor infrastructure, restricted access to energy or internet connectivity, regulatory impediments, expensive cell service charges and a larger proportion of their population lacking in digital skills. These factors can influence the way people handle their mobile cellular subscriptions and hence its negative impact on SSA countries. However, as the use of digital technology increases, its effect on economic growth becomes positive such that the effect is now 6.348, which is also statistically significant at 1%. The turning point can be computed from the estimated coefficient using the formula $\frac{DigiTech}{2 * DigiTechSq}$. This yields a value of 0.5369. This can be explained as, as the digital technology index, which seeks to measure the depth or usage of digital technology, gets to 54% per 100 people, the effect of digital technology on the economy begins to be positive. This result is in line with the expectation of the study. The study anticipated a positive impact of digital technology on economic growth. Also, this finding is in line with the Solow growth model. The theory depicts that in the long run, changes in technological advancement leads to economic growth. The findings of the study support this argument.

In addition to the key observation, it was realized that other variables that affects economic growth, including the lag of GDP, external debt, government expenditure and inflation, exhibited a negative and significant impact on economic growth in the short run.

4.2.4 Long run results for the effect of digitalization on economic growth. Similarly, the turning point for the long-run estimates can be calculated using the formula $\frac{DigiTech}{2 * DigiTechSq}$. By applying this formula, the long-run turning point for digital technology is 0.54. This implies that, in the long run, as the digital technology index, which seeks to measure the depth or usage of digital technology, gets to 54% per 100 people, the effect of digital technology on the economy begins to be positive. These results are summarized in [Table 6](#).

5. Conclusion and policy implication

The study sought to examine the impact of digital technology on macroeconomic performance in SSA countries. To do this, the study examined digital technology's impact on inflation and economic growth. To measure digital technology, the study used three variables to generate an

Table 6. Long run results, dependent variable and GDP growth

Variable	Coefficient	Standard error	p-value
DigiTech	-5.798***	0.5754	0.000
DigiTechSq	5.399***	0.6054	0.000
ExtDb	-0.0073***	0.0017	0.000
GovExp	-0.1364***	0.0326	0.000
Inf	-0.0412***	0.0045	0.000

Source(s): Authors' construct

index for digital technology and proceeded to estimate the regression using system GMM. The results indicated that the use of digital technology has a negative impact on inflation in SSA countries. This is to say, as more individual in SSA countries turn to digital technology, it reduces costs and promotes effective communication which goes to help the macroeconomy by reducing the overall price level of goods and services.

Secondly, digital technology has a U-shaped behaviour when it comes to economic growth. At the initial stages of digital technology use, it reduces economic growth. This is as a result of the technicalities associated with its use. SSA countries are often coupled with challenges such as poor infrastructure and network issues, which makes a shift to digital technology difficult. However, as more people switch to the use of digital technology, the effect tends to be positive. This is because a high usage of digital technology prompts policymakers to correct the challenges associated with its use.

The findings from the results indicated that digital technology has a linear relationship with inflation, and its effect on inflation is negative both in the short and long run. For economic growth, the results indicated that the digital technology effect is initially negative, attains a minimum and begins to rise as digital technology use gets to 54% per 100 people.

It is therefore recommended that governments in Sub-Saharan African (SSA) countries, such as Ghana, Kenya and Rwanda, allocate targeted investments towards the deployment of high-capacity fibre-optic broadband backbones in underserved peri-urban areas, initiate phased rollouts of 5G infrastructure beginning with economic zones and university campuses and digitize key public services – such as national ID systems, land registries and health records – using interoperable platforms supported by robust cybersecurity frameworks.

Also, they should integrate digital competencies into national education curricula and workforce development programmes. To examine the full impact of the digital economy, future studies can continue to explore this field by looking at the impact of the digital economy on other macroeconomic variables such as unemployment. Also, future studies can assess the heterogeneous effect among different countries from different regions of the world by grouping the countries based on some common characteristics.

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