

Research Article

Government Spending and Economic Growth Nexus: A Contemporary Evidence in Sub-Saharan Africa

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Abstract

Motivated by empirical debates concerning the relationship between government expenditure and economic growth, this study examines the short and long-run effects of government expenditure on economic growth in 41 Sub-Saharan African countries from 2012-2022. The System GMM estimation technique was employed for the panel data obtained from World Development Indicators and the e-government Development Index. The safety of the data was duly checked by employing the LLC and IPS methods for unit root. The result of the study asserts that government expenditure adversely affects the economic growth of SSA in both the short and long run. The finding from the system GMM reveals that a one percentage change in government final consumption expenditure is associated with a 0.0342 percent decline in GDP per capita growth in the short run, while it leads to a 0.0045 decline in the GDP per capita growth of SSA countries, all other things kept constant. This shows that the negative effect of government expenditure in the long run is lower than its adverse effect in the short run. Further, unlike the short run, the adverse effect of the government expenditure is found to be insignificant in the long run. The policy implication is that SSA countries should carefully monitor their government spending in both the short and long run. Further, fiscal authorities of SSA countries are advised to direct the government expenditure to profitable projects. Finally, the faster GDP per capita growth in SSA countries demands a sharp focus on development sectors.

Keywords

Government Expenditure, Economic Growth, Sub-Saharan Africa, System GMM

1. Introduction

Over the years, the relationship between government expenditure and economic growth has engrossed the attention of economic literature. As government expenditure is one of the fiscal policy tools, literature is still arguing the importance of the investigation that links government expenditure and

economic growth [21-23]. However, the empirical works available lack consensus. For instance, empirical studies such as [28, 4, 35, 26, 42, 37] reported a positive relationship between government expenditure and economic growth, whereas [39, 36, 27, 32, 41] found an adverse effect of gov-

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ernment expenditure on economic growth.

The debate on the effect of government expenditure and economic growth is not only at the empirical studies level; it is also sharply debated among theories. The Keynesian theory, named after one of the big names in economics, John Maynard Keynes, advocates the fact that government expenditure enhances economic growth, while the sharp attack on this fact was made by Wagner, who established a relationship between increasing economic activities and government expenditure. According to Wagner's theory, the rise in government expenditure is nonrandom. It is due to the increase in economic activities [7, 8]. This confirms the fact that the causal effect runs from government expenditure to economic growth. The other theory with a different view is classical theory, one of the prominent theories in economics, we believe, asserts that government expenditure unquestionably deters economic growth in connection with the 'no government intervention' principle. In the middle of this, we see another theoretical perspective dubbed Ricardian equivalence emerge with the view of a forward-looking agent's decision. In this view, the model of Ricardian equivalence believes that government expenditure remains neutral (does not have any effect) on economic growth [24, 25, 34]. This implies that examining the effect of government expenditure on economic growth has both theoretical and empirical grounds.

The present study differs from other similar studies in some important ways. First, it applies the dynamic panel system GMM (two-step) to assess the effect of government expenditure on economic growth in SSA. The choice of the dynamic panel system GMM is not slapdash. It is superior to other models in that it takes care of endogeneity, heterogeneity problems, and autocorrelation, and relieves possible pre-conceptions in estimation [33, 14]. Besides, it delivers a solution to the problems associated with time-invariant individual heterogeneity, among others. Secondly, our study's support is two-fold. Methodologically, it adopts the dynamic panel system GMM, which has been infrequently used in an analysis of the effect of government expenditure on economic growth. Nevertheless, this does not mean that the author is a forerunner of the econometric technique, the two-step system Generalized Method of Moments (GMM). Practically, the research contributes to the small but mounting literature on government expenditure and economic growth in SSA countries during the last decades of the 21st century [17, 18, 29].

The comprehensive objective of our present study is to empirically investigate the impact of government expenditure on economic growth in SSA countries for which relevant macroeconomic data is accessible for the period 2012-2022; eleven years of data, starting with 2012 and ending with 2022, is not arbitrary. It attempts to capture the linkage between government expenditure and economic growth during the last decades, ranging from the time of the global financial crisis (GFC) to the global COVID-19 pandemic that challenged entire government policy and government expenditure in

particular. Further, the study attempted to provide new insights with updated data.

As a result of contradicting empirical literature on the link between government expenditure and economic growth, it is difficult to make any vigorous decision on the influence of government expenditure on economic growth in SSA from existing studies. Therefore, this novel paper examines the short and long-run effects of government expenditure on economic growth in the SSA region using updated data along with recent methodology. Unambiguously, this paper contributes to the current literature debate on government expenditure and economic growth. Further, it will serve as a policy input as the entire globe executes sustainable development goals and Africa is instigating Agenda 2063.

The rest subdivisions of the paper are organized in the following ways. First, in section 2, there is a literature review of theoretical and empirical studies. Secondly, in section 3, there is a detailed discussion of the methodology, data, and model specification. Thirdly, empirical results and discussions were carried out. Finally, section 5 is the conclusion, recommendations, and suggestions for future study were carried out.

2. Review of Literature

Empirical literature that linked government expenditure to economic growth reported mixed results. As a result, we classified the literature based on its findings. Consequently, various recent studies reported a positive effect of government expenditure on economic growth. Similarly, [34] in their very recent empirical study, found a positive relationship between government expenditure and economic growth in thirty-two SSA countries from the period of 1985-2021. Employing panel MG and PMG estimation techniques, their study found that infrastructural development needs to receive great attention in SSA countries [19, 20].

A study that covered large panels of sample countries found that public expenditure positively affects the economic growth of 59 developing countries across the globe. From the panel data employed from 1990 to 2019, they confirmed that the Keynesian framework of government expenditure, the government expenditure enhances growth, still works in developing countries [4, 5]. Similarly, another study that employed system GMM to investigate the link between public spending and economic growth in ECOWAS found that the type of government spending matters. Accordingly, expansionary government shock positively influenced economic growth while spending contraction adversely affected the economic growth of the region over the study period from 2005-2017 [31, 35]. Further, their study confirmed the presence of an inverted U shape between public expenditure and economic growth.

As literature reports contradicting findings, we categorized the literature based on its findings. Accordingly, the negative effect of government expenditure on economic growth is re-

ported by numerous empirical studies. For illustration, the recent empirical findings of [38, 40, 44] revealed that government expenditure fails to affect the economic growth of SSA countries. Their study further revealed that the interaction of the variable with good governance also does not affect the economic growth of SSA countries. Their study indicated that the effectiveness of the government expenditure needs improvement.

The effect of public spending and natural resources on economic growth is investigated in West Africa, and concluded that natural resources adversely affect public spending and, in turn economic growth of WEAMU countries from the pooled mean group estimation technique employed in the model [40, 41]. The recent scientific writing of [27, 28] found that general public spending has a negative and significant effect on economic growth, while spending on public order was found to have an ambiguous effect on the economic growth of 25 European Union countries for the period of 1996 to 2017. The analysis from panel GMM also revealed that expenditures on social protection negatively affected the economic growth of the region during the study period.

The empirical work that studied the effect of government expenditure on the economic growth of OECD from the period 2000 to 2019 in 25 member countries explained that the spending effect is based on several factors. From the panel GMM method of analysis estimated in the model, their study found that public spending on consumption and social spending has no significant effect on economic growth. This raises the question of the productivity of the government expenditure across the member countries [32, 43].

The study of Chu employed OLS fixed effects and GMM estimation technique's to investigate the link between the compositions of government expenditure and economic growth of 59 economies (37 high-income and 22 low- to middle-income) from 1993 to 2012 and found that the shift in

the government expenditure from nonproductive to non-productive in both groups of countries is associated with the rise in their corresponding economic growth in the short run [14, 15]. However, the significant component-based impact of government expenditure on economic growth is observed in the long run. Thus, in the long run, government expenditure adversely impacts the economic growth of countries.

3. Method and Data of the Study

3.1. Data Sources and Variable Descriptions

The panel data for this study is acquired from the World Bank's World Development Indicators [45-47] and the e-government Development Index [51, 57-59]. The data on e-government was extracted from the E-governance Development Index (EGDI). E-government data refers to the online availability of government and the web connections to deliver its services. E-government index is the weighted average of three indices, that is, web connectivity, telecom infrastructure, and skilled labor. Forty-one (41) SSA countries are used in this research due to data unavailability for some important variables for a certain number of countries; Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Congo, Dem. Rep., Congo, Rep., Cote d'Ivoire, Equatorial Guinea, Eswatini, Ethiopia, Gabon, The Gambia, Ghana, Guinea Guinea-Bissau, Kenya, Lesotho, Madagascar, Mali, Mauritius, Mozambique, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Table 1. Variable description and data source.

Variable and short	Data description	Source	Expected sign
GDP per capita growth (GDPR)	Annual percentage growth rate of GDP per capita based on constant local currency.	WDI	Dependent Variable
General government final consumption expenditure (GEXP)	General government final consumption expenditure includes all government current expenditures for purchases of goods and services.	WDI	+/-
Inflation, consumer prices (INFL)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	WDI	
Gross fixed capital formation (GFCF)	Average annual growth of gross fixed capital formation based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars.	WDI	+/-
Taxes on goods and services (TAX)	Taxes on goods and services include general sales and turnover or value-added taxes, selective excises on goods, selective taxes on services, taxes on the use of goods or property, taxes on the extraction and production of minerals, and profits of fiscal monopolies.	WDI	+/-

Variable and short	Data description	Source	Expected sign
Population growth (POP)	The annual population growth rate for year t is the exponential rate of growth of the midyear population from year t-1 to t, expressed as a percentage.		-
Trade (TRADE)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.		+/-
E-Government Development Index (EGDI)	The E-Government Development Index reflects how a country is using information technologies to promote access and inclusion of its people. The EGDI is a composite measure of three important dimensions of e-government, namely: the provision of online services, telecommunication connectivity, and human capacity.	EGDI, UN	+

Source: Author's building, WDI, World Development Indicator, EGDI denotes E-Government Development Index (EGDI).

Table 1 presents the variables of the study. Accordingly, 8 variables (one dependent and seven independent variables) were used in the study.

3.2. Model Specification

This study employs the endogenous growth theory that was

popularized following the work of Barro, a well-known macroeconomist, and models government expenditure in the Cobb-Douglas production function as a public good. This type of modeling was used previously [3, 9, 35, 56]. Following their study, we adopt the augmented Cobb-Douglas production function contextualized as:

$$RGDPG = f[K, GEXP, A, POPN] = RGDPG_{it} = K_{it}^{\alpha} GEXP_{it}^{\beta} (A_{it} POPN_{it})^{1-\alpha-\beta} \quad (1)$$

Equation (1) modeled economic growth ($RGDP$), the one on the left-hand side as a function of government expenditure ($GEXP$), following the Cobb-Douglas production function.

Where $RGDPG$ denotes real GDP, GDP per capita growth, $GEXP$ is government expenditure, K is the stock of available

capital, $POPN$ denotes the available labor resource of the SSA captured by population growth, i shows the number cross cross-sections (countries) while t denotes the periods of the study.

Incorporating explanatory variables in the context of our studies, the model is given as:

$$RGDPG_{it} = (RGDPG_{it-1} GEXP_{it}, EGDI_{it}, GFCF_{it}, INFL_{it}, POPN_{it}, TAX_{it}, TRADE_{it}) \quad (2)$$

Where, $RGDPG_{it-1}$, is lag 1 of the dependent variable. It is likely to affect the real GDP of the current period. $GEXP_{it}$ General government final consumption expenditure (% of GDP) as a proxy of government expenditure $EGDI_{it}$ The E-Government Development Index reflects how a country is using information technologies to promote access and inclusion of its people. $GFCF_{it}$ Is the growth fixed capital formation gross fixed capital formation (annual % growth), a proxy of investment? $POPN_{it}$ Is population growth (annual %), which is the proxy of labor, $INFL_{it}$, Is inflation, consumer prices (annual %), which is the proxy of macroeconomic stability in the model, $TRADE_{it}$ Is trade (% of GDP),

which is the proxy for trade in the model. TAX_{it} taxes on goods and services (% of revenue),

Equation (2) contextualized the model by incorporating the explanatory variables in the model. The models in this study have improved over the previous ones as they introduced variables such as the e-government development index that reflect how a country is using information technologies to promote access and inclusion of its people. It is the online government's availability to appropriately serve the community.

Assuming a nonlinear relationship between dependent and explanatory variables, the model can be written explicitly as:

$$RGDPG_{it} = \beta_0 + RGDPG_{it-1}^{\beta_1} GEXP_{it}^{\beta_2} EGDI_{it}^{\beta_3} GFCF_{it}^{\beta_4} INFL_{it}^{\beta_5} POPN_{it}^{\beta_6} TAX_{it}^{\beta_7} TRADE_{it}^{\beta_8} \quad (3)$$

Equation (3) presents the nonlinear relationship between independent variables and dependent variables. It is a model before converting it to the natural logarithm.

Taking the natural logarithm of both sides of equation (3) yields the finally estimated system GMM, which is now converted to a linear relationship, and is written as:

$$RGDPG_{it} = \beta_0 + \beta_1 RGDPG_{it-1} + \beta_2 GEXP_{it} + \beta_3 EGDI_{it} + \beta_4 GFCF_{it} + \beta_5 INFL_{it} + \beta_6 POPN_{it} + \beta_7 TAX_{it} + \beta_8 TRADE_{it} + \eta_i + \varepsilon_{it} \quad (4)$$

Where, ε_{it} idiosyncratic error component of the equation and η_i Is the 'unobserved heterogeneity' error component.

All others are defined under equation (2).

Equation (4) depicts the system GMM model to be esti-

mated in the form of a natural logarithm. The natural logarithm is preferred to clarify the interpretation of results.

3.3. Model Estimation Techniques and Justification of System GMM

The estimation of the model is carried out using the system GMM dynamic panel estimator following the novel contribution of [10, 11, 55]. The estimation technique is selected for a reason; this method jointly estimates the equation in levels and first differences, restricting that the coefficients in the level and differenced equations are equal. Another superiority of this estimation technique is that it uses instruments in the level equation that are the lagged first differences of the variables. This means the GMM-type instruments for the differenced equation are the lagged levels of the variables.

Similarly, in the differenced equation, the time-invariant and country-specific sources of heterogeneity are removed, while the equation in levels allows one to exploit large cross-country variations in the variables. Furthermore, an empirical study witnessed that the use of appropriate lags of right-hand side variables as instruments allows one to address problems of measurement errors, omitted variables, and endogeneity. The validity of the GMM instruments is tested using the Hansen-J -J statistic of over-identifying restrictions [18].

According to Westerlund, a well-known econometrician, the system GMM performs better than difference GMM when the time dimension of the panel dataset is short and the outcome variable shows persistence in estimating empirical growth models [50]. This best fits our empirical study case in our empirical research, the link between government expenditure and economic growth. Another justification of the

system GMM for our study goes to the fact that the difference GMM estimators are weak and may lead to problematic statistical inferences, whereas this is not the case with system GMM. Using lagged differences of the explanatory variables as instruments for the equation in level, along with the conventional use of lagged levels of independent variables for the equation in first differences, overcomes the weak instrument problem. From another angle, the system GMM also performs very well in terms of precision and bias [52].

Viewing the model in terms of the efficiency of the estimators, empirical evidence shows that the two-step system GMM estimator provides more efficient estimators compared to the one-step system GMM. This is one of the main reasons why the system GMM was chosen to estimate the parameters of the model in this study. From the angle of robustness, the two-step GMM provides a covariance matrix that is robust to heteroskedasticity and autocorrelation. This means the standard errors show a downward bias, and using robust standard errors gives consistent estimates in the presence of panel heteroskedasticity and autocorrelation problems [10].

On top of this, as our study considered this issue in advance, our final results of the model are corrected for heteroskedasticity, and all threats related to this are carefully eliminated. Additionally, the two-step GMM gives a robust Hansen *J*-test for over-identification, unlike the one-step system GMM. Thus, we selected the two-step system GMM procedure of estimation with robust standard errors to estimate our model, abolishing the problems attached to it [6].

4. Results and Discussions

This section discusses the results of the study.

4.1. Descriptive Statistics

Table 2. Results of descriptive statistics of the study.

Variables	RGDPG	GEXP	EGDI	GFCF	INFL	POPN	TAX	TRADE
Mean	.8777478	15.30986	.4212198	6.679481	10.17921	2.423949	32.30525	69.11052
Std. Dev.	1.906704	.4573296	.137491	10.39559	6.441867	.0912619	2.201842	3.296198
Min	-4.590094	14.43252	.1407	-4.921708	4.433442	2.223601	28.43507	61.50024
Max	3.026249	16.09456	.7357	36.33633	24.34548	2.506879	34.96292	74.81447
Skewness	0.0000	0.0138	0.0069	0.0000	0.0000	0.0000	0.0000	0.0069
Kurtosis	0.0000	0.0005	0.1115	0.0000	0.1221	0.4304	0.0000	0.1115
Observation	440	440	440	440	440	440	440	440

Source: Authors' computation from STATA 15. Refer to Table 1 for more information about variables.

Table 2 presents descriptive statistics of the data with the main objective of having information about its nature before

proceeding to further analysis. Accordingly, the descriptive statistics revealed the measure of central tendency through mean, a measure of dispersion through standard deviation, and measures of normality (through Kurtosis and Skewness). The mean value of annual GDP per capita growth (annual% %) (RGDPG) in SSA countries is found to be 0.877. The corresponding minimum and maximum values are -4.590094 and 3.026249, respectively, while the standard deviation of the annual real GDP per capita growth is 1.906704. As far as kurtosis and Skewness are concerned, the data is symmetric around the mean; it is normally skewed, while kurtosis is also found to be zero, indicating a bell-shaped normal distribution. This implies that the average annual real GDP per capita growth in SSA is less than 1, reflecting the fact that Africa is a developing country.

Similarly, the average value of the government expenditure (GEXP) in SSA countries is observed to be 15.30986 with a deviation from the mean of 0.4573296 during the period under consideration. The Kurtosis of the variable is positive (0.0005) but less than the normal kurtosis ($0.0005 < 3$), reflecting platykurtic, while it has a long right tail with positive Skewness (0.0138) and mirroring normal Skewness. This implication of the descriptive statistics regarding GEXP is that government expenditure among SSA during the study period (2012-2022) does not significantly vary. This might be attributed to the common distinctive features of SSA countries.

Nearly over the last decades of the 21st century (2012-2022), the average value of the e-government development index (EGDI), an index calculated by the UN reflects how a country

is using information technologies to promote access and inclusion of its people, is found to be 0.4212198 with the corresponding 0.1407 and 0.7357 minimum and maximum values respectively. The standard deviation of the EGDI is 0.137491, showing that there is only low variation in the e-government development of the SSA countries during the study. The further implication from the result is that the three indicators of e-government development, provision of online services, telecommunication connectivity, and human capacity, show only slight variation across SSA countries.

4.2. Econometric Analysis: Unit Root Test

This study employed two popular unit root tests in panel data: Levin, Lin Chu (LLC) and Im, Pesaran Shin (IPS) unit root tests. We applied the LLC and IPS tests for unit root following the recommendations of Levin and Lin Chu [52]. LLC test for panel unit root test is employed as it is superior over others as it provides the opportunity of conducting joint test for a small number of independent time whereas IPS unit root test is employed as it countenance for a heterogeneous coefficient of the series and provides alternatives of testing at individual unit roots statistics [30, 48-50]. The two unit root tests perform better in panel data, especially in macroeconomic research [16]. We employed two methods together to have sufficient evidence regarding the unit root of the variables. The results of the unit root tests carried out in the study are provided as follows in Table 3.

Table 3. Results of the LLC and IPS panel unit root tests.

Variables	LLC unit root test		IPS unit root test	
	Adjusted t* statistics	p-value	Z-t-tilde-bar	p-value
loggRGDPG	-9.4963 (-17.9802)*	0.0000	-8.4861 (-2.2656, -3.2588)*	0.0000
LoggGEXP	-13.3240 (-20.0436)*	0.0000	-6.4647 (-2.0330, -2.6065)*	0.0000
loggEGDI	-44.6726 (-23.1695)**	0.0286	-1.690 (-1.740, -1.830)*	0.0000
loggGFCF	-13.6691 (-26.1949)	0.0000	-11.3238 (-2.5922, -4.8552)*	0.0000
loggINFL	-2.0589 (-7.4969)**	0.0198	-5.9480 (-1.9735, -2.5467)**	0.0063**
loggPOPN	-49.1542 (-13.2546)*	0.0000	-13.2215 (-0.2326, -0.5218)*	0.0000
loggTAX	-17.6328 (-21.9115)*	0.0000	-2.3307 (-1.5572, -1.7177)**	0.0099**
loggTRADE	-8.3656 (-15.4227)*	0.0000	-4.9903 (-1.8633, -2.2415)*	0.0000

Source: Author's computation from STATA 15; *, **, and *** show significance at 1%, 5%, and 10% level of significance, respectively. Under the LLC unit root test, in parentheses are unadjusted t statistics, while the results in parentheses represent the t-tilde-bar and t-bar under the IPS unit root test. All variables are in log form.

As it is indicated in Table 3, the LLC unit root test depicts that all variables are stationary at the level. This indicates that

none of the panel variables included in our model contains a unit root. Furthermore, except for inflation (INFL) and

E-government development index (loggEGDI), which are found to be significant at 5% all series of the models are significant at a 1% percent level of significance. This reflects that all variables of the study are stationary at a level under the LLC unit root test. Motivated by having sufficient information regarding our variables, we repeated the unit root test with another test dubbed as IPS test. The result of the IPS unit root test also revealed that panels are stationary at levels, showing that all variables of the study are free from the random walk, which is a desirable result. It also enables us to proceed with

further analysis.

4.3. Hausman Test of Model Selection

This study employed the Hausman test to identify whether our data best fit with either system GMM or difference GMM. The work of [12, 13] witnessed that the Hausman test is superior to others in choosing between systems and different GMM.

Table 4. The result of the Hausman test of model selection.

S. no.	Tests carried out	L1. loggRGDPG
1	Pooled OLS model	0.0814
2	Fixed Effect Model	0.0067
3	Difference GMM model (two-step)	0.0042
4	Final decision	System GMM is more appropriate

Source: Author's computation from STATA 15, L1. loggRGDPG denotes the first log of the real.

Table 4 displays the result of the Hausman model selection. Following the test, the coefficient of lag-one of the dependent variable (L1. loggRGDPG) estimated through pooled OLS (0.0814) is greater than the estimated result of the fixed effect model (0.0067). Further, the result estimated using the two-step difference GMM (0.0042) is the lowest. This implies that this particular data best fits with system GMM compared to the difference GMM. Thus, this study employed the system GMM estimation technique to examine the short and long-run effects of government expenditure, government digitalization, and economic growth.

5. Discussion of Results

This section discusses the result of the short-run and long-run effects of government expenditure on economic growth in 41 SSA countries using a two-step system GMM estimation technique.

5.1. Short-run Effect of the Government Expenditure on the Economic Growth of SSA

Although various studies investigated the effect of government expenditure on economic growth in the short and long run, only a few studies examined the relationship in the presence of government digitalization (e-government) in the model. This study contributes to the literature in doing this.

Table 5 displays the short-run effect of government expenditure on the economic growth of SSA countries using the

two-step system GMM, fixed effect, and random effect from the study period of 2012-2022. Accordingly, government expenditure (LoggGEXP) adversely and significantly affects economic growth in the short run during the sample study periods 2012-2022. More specifically, the coefficient of the LoggGEXP is negative (-0.034296), reflecting that one percentage change in government final consumption expenditure in SSA countries is associated with, all other things kept constant, a 0.0342 percent decline in economic growth (GDP per capita growth) of SSA countries. This finding of our study is consistent with the works of [27, 32, 41]. Furthermore, the lag of the GDP per capita growth (L1. loggRGDPG) is found to be positive and significant with a coefficient of 0.013152. This result implies that a one percent rise in last year's GDP per capita growth, all other things kept constant, leads to a 0.0131 rise in the current GDP per capita growth in SSA countries. This makes logical sense as last year's cumulative capital enhances this year's growth by providing capital.

Regarding control variables, government digitalization (loggEGDI), the so-called e-government enhances economic growth. The result of the study found that a one percent increase in the e-government development index (loggEGDI), all other things kept constant, is found to be associated with a 0.0420 percent rise in economic growth in SSA countries. Thus, the finding of the study reveals that government digitalization is a contributor to the economic growth of SSA Africa as it boosts the online availability of government to serve citizens appropriately. The findings of our study regarding this are consistent with the empirical works of [52].

The result of our study further confirmed that inflation (loggINFL), population growth (loggPOPN), and Tax

(loggTAX) hurt the GDP per capita growth of SSA countries during the sample study in the short run. All other factors remained constant; a one percent rise in inflation measured by annual consumer prices is associated with a 0.0491 percent decline in the GDP per capita growth in SSA countries, while a one percent increase in population growth rate is associated with a 0.026 fall in the GDP per capita growth of SSA countries. This shows that inflation and population growth are the major challenges to the GDP per capita growth of SSA countries over the last decades. This is true as the world faced the increased cost of living due to the extended effects of the world financial crisis and the deadly COVID-19 pandemic during the last decades (2012-2022). On the other hand, a one percent rise in tax (loggTAX) on goods and services as a percentage of goods and services, all other things remaining constant, leads to a 0.0499 decline in the GDP per capita growth of SSA countries. This reflects that increased tax on goods and services is an evil economic growth of SSA countries. This is consistent with the works of [1, 2].

Contrary to this, the result of the study revealed that Gross fixed capital formation (loggGFCF) and Trade (loggTRADE) are the major contributors to growth in SSA countries in the short run. This shows capital formation and increasing the role of trade as a percentage of GDP is very helpful for the GDP per capita growth of countries. The larger the resources allocated for capital formation and trade, the better is economic growth of SSA countries. All other factors remained constant; our study conveyed that a one percent rise in gross capital formation in SSA countries is associated with a 0.0660 percent rise in GDP per capita growth in the short run. This reflects that gross capital formation is a significant contributor to economic growth in SSA. Similarly, a one percent rise in the growth of trade as a percentage of GDP in SSA, all other factors remaining fixed, is associated with a 0.0413 decline in GDP per capita growth of SSA countries. The result remained consistent across the models estimated using fixed effect, random effect, and two-step system GMM. The findings of the present study are consistent with [53, 54].

Table 5. Results of the two-system GMM, the short-run effect (2012-2022).

Variables of the study	Shorts of variable	System GMM result (two-step) (1)	Fixed effect model (2)	Random effect model (3)
Lag of GDP per capital growth	L1. loggRGDPG	.013152**[0.000] (.0132777)	0.006712**[0.000] (.0216148)	.081488**[0.046] (.0409222)
Government Expenditure	LoggGEXP	-.034296**[0.000] (3.75e-10)	-.005453**[0.000] (0.3699796)	-.025453***[0.091] (0.6997961)
E-government	loggEGDI	.042002**[0.003] (8.57e-06)	.061427**[0.013] (.2141203)	.045548**[0.035] (.0229764)
Gross fixed capital formation	loggGFCF	.066011**[0.000] (3.11e-07)	.0904218**[0.017] (.6142781)	.0904059***[0.065] (.0330531)
Inflation	loggINFL	-.049130**[0.003] (4.47e-07)	.046901**[0.001] (.2031647)	.647232**[0.006] (.2141203)
Population growth	loggPOPN	-.026376***[0.078] (.0000358)	-.066607***[0.182] (.6160033)	.057696*[0.045] (0.4816535)
Tax	loggTAX	-.0499095*[0.000] (.0005005)	-.0662112**[0.017] (.0828062)	.047663 [0.000] (.0443474)
Trade	loggTRADE	.041363**[0.000] (0.0001283)	.07431**[0.000] (0.0253051)	0.08557**[0.000] (0.0574993)
Constant		-67.05066	-72.18643	-71.98698
Diagnostic (Robustness check) of the results				
Number of observations		440	440	440
Number of countries		41	41	41
Number of groups		40	40	40
Number of instruments		19	19	19
F (39, 352)			594.91	
AR(2) [p-value]		0.581		

Variables of the study	Shorts of variable	System GMM result (two-step) (1)	Fixed effect model (2)	Random effect model (3)
Hansen test [p-value]		0.298		
Wald chi2(8)				5286.13
Prob > chi2			0.0000	0.0000
Wald chi2(8)			5286.13	

Source: Author's computation from STATA15; in [] are p-values while in () are robust standard errors. ***, **, and * denotes 10%, 5%, and 1% level of significance respectively. All variables are in the natural log form.

5.2. Robustness Check of the Results

The bottom portion of Table 5 reflects the robustness of the estimated results using system GMM, fixed effect, and random effect models. The result of the study shows that the Hansen test [p-value] is 0.298 and the model is well-identified. The value is not significant, reflecting that overall instruments used in the model are valid and the entire instrument set is good. Further, AR (2) [p-value] is found to be 0.581, showing our model is free from the fear of second-order serial correlation. This also implies that the lags of the dependent variable used as an instrument are free, not endogenous. Thus, our model is free from the threat of endogeneity. This is the desired result, reflecting that our result is good. In estimating the model, we used a robust option showing that the variance-covariance matrix is heteroskedastic and autocorrelation consistent. This is

once again the desired result that convinces the reader to believe the result and conclusion of the study. In addition to this, the result of our model reveals that the number of instruments (19) is lower than the number of groups (42), reflecting that the model is free from instrument proliferation, as we used the collapse option during estimation. The number of observations (440) is also sufficient to run system GMM. Thus, our model has passed the entire test, and the model is the desired model.

5.3. The Long-run Effect of Government Expenditure on the Economic Growth of SSA Countries (2012-2022)

In this section, we generated the long-run coefficients of the system GMM model to understand the effect of the government in the long run.

Table 6. Result of the two-step system GMM, the long-run effect (2012-2022).

Variable	Shorts of variable	Long run coefficients	Command executed to generate the long-run coefficient
Government Expenditure	loggGEXP	-.00457774 [0.173] (.0180986)	nlcom (_b[loggGEXP])/(1-_b[L.loggRGDPG])
E-government	loggEGDI	.0488015** [0.000] (.0001824)	nlcom (_b[loggEGDI])/(1-_b[L.loggRGDPG])
Gross fixed capital formation	loggGFCF	.4117822** [0.000] (1.89e-07)	nlcom (_b[loggGFCF])/(1-_b[L.loggRGDPG])
Inflation	loggINFL	-.0099854 [0.234] (9.30e-07)	nlcom (_b[loggINFL])/(1-_b[L.loggRGDPG])
Population growth	loggPOPEN	-.0623443 [0.000] (.0000289)	nlcom (_b[loggPOPEN])/(1-_b[L.loggRGDPG])
Tax	loggTAX	.048273** [0.0190] (9.71e-07)	nlcom (_b[loggTAX])/(1-_b[L.loggRGDPG])
Trade	loggTRADE	.013305** [0.000] (.0000412)	nlcom (_b[loggTRADE])/(1-_b[L.loggRGDPG])

Source: Author's computation from STATA 15, all variables are in the natural log form.

Table 6 displays the long-run effect of government expenditure on the economic growth of SSA countries in the long run. The result shows that government expenditure continued to affect economic growth negatively in the long run. However, the adverse effect of the government's final consumption expenditure is found to be insignificant in the long run. The coefficient of government expenditure in the long run is found to be negative (-0.00457774), implying that a one percent rise in the government expenditure in the long run, with all other factors remaining constant, is associated with a 0.0045 percent decline in the GDP per capita growth of SSA countries. This shows that the negative effect of government expenditure in the long run is lower than its adverse effect in the short run.

Coming to control variables of the study, government digitalization, proxied by the e-government development index, is found to be a significant contributor to GDP per capita growth in the long run. The coefficient of e-government (loggEGDI) is found to be positive (.0488015), reflecting that a one percent rise in the government digitalization (e-government development index) is associated with a 0.0488 percent rise in the GDP per capita growth of SSA countries. The result of our study further indicated that the long-run positive effect of government digitalization is larger than its positive effect in the short run. This further implies that government digitalization enhances economic growth in both the short and long run, but has a larger effect in the long run in SSA countries.

Contrary to this, inflation and tax remained insignificant in the long run, while Gross fixed capital formation, population growth, and trade are the control variables that affect the economic growth of SSA countries significantly. Our study found that inflation continued to negatively influence the economic growth of SSA countries in the long run, while tax (loggTAX), which is the tax on goods and services as a percentage of economic growth, positively impacts economic growth. Although the negative effect of the tax (loggTAX) in the short run is converted to positive, it is found to be insignificant in the long run. Finally, the findings of our study revealed that gross fixed capital formation and trade positive effect on economic growth, while population growth remains to negatively affect the GDP per capita growth of SSA countries.

6. Conclusion and Recommendation

This study investigated the short and long-run effects of government expenditure on the economic growth of 41 SSA countries using dynamic panel GMM from the period of 2012-2022. Eleven years of balanced panel data were obtained from the World Development Indicator (WDI) of the World Bank and the E-governance Development Index (EGDI), dependable data sources across the globe.

The study concludes that government expenditure adversely and significantly affects the economic growth of SSA in the short run, while the long-run effect of government expenditure on economic growth is negative but insignificant. The short-run

coefficient of government expenditure is 0.0045 while the long-run coefficient is 0.0342; both short and long-run coefficients are negative. The overall conclusion from the findings is that government expenditure is less harmful in the short run compared to the long run ($0.0045 < 0.0342$) in SSA countries. The policy implication is that SSA countries should carefully monitor their government spending in both the short and long run. Further, fiscal authorities of SSA countries are advised to direct the government expenditure to profitable projects. The further policy implication is that SSA countries need to focus more on development sectors by limiting government final consumption expenditure.

Similarly, our study concluded that government digitalization captured through the e-government development index is enhancing the economic growth of SSA in both the short run and the long run. However, the result from the two-step system GMM revealed that the long-run effect of government digitalization is larger than its short-run effect ($0.0488 > 0.0420$). This implies that SSA countries need to invest more in digitalization infrastructure, both in the short and long run. Further, SSA fiscal authorities need to increase online fiscal availability, telecommunication infrastructure, and human capacity.

The findings of the study further revealed that inflation adversely affects the economic growth of SSA countries. The adverse effect of inflation is significant in the short run, while it is insignificant in the long run. This implies that SSA countries need to carefully manage macroeconomic stability in both periods. Further, the population growth rate is found to be negatively contributing to the economic growth of SSA both in the short and long run. The policy implication of this result is that the SSA needs to manage the population growth rate and apply the policies that tend to control the population growth rate. Contrary to this, the tax on goods and services was found to hurt economic growth in the short run, while its positive effect in the long run is insignificant. Thus, fiscal authorities in SSA need to reduce the tax rate on goods and services as it discourages economic growth and hampers economic growth.

The other conclusion of our study is that gross capital fixed formation and trade as a percentage of GDP are found to be positively and significantly affecting the economic growth of SSA in both the short and long run. This implies that more resources need to be directed towards gross capital formation if faster GDP per capita growth is anticipated in the region. Further, the authorities of SSA countries need to boost intra-Africa and inter-regional trade to boost the contribution of trade to economic growth.

Abbreviations

EG-DI	E-governance and Development Index
GDP	Gross Domestic Product
GMM	Generalized Method of Moment
IPS	Im, Pesaran Shin

LLC Levin, Lin Chu
 SSA Sub-Saharan Africa
 WDI World Development Indicator

Author Contributions

Isubalew Daba Ayana: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing - original draft, Writing - review & editing

Wondaferahu Mulugeta Demissie: Supervision

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Ethical Standards

All scientific ethical standards were followed in the manuscript.

Data Availability Statement

The data for this study is available at the World Bank and the e-government development index (EGDI) of the UN. The URL is provided as:

<https://databank.worldbank.org/reports.aspx?source=World-Development-Indicators> and

<https://publicadministration.un.org/egovkb/en-us/Reports/U-N-E-Government-Survey-2022>, respectively.

Conflicts of Interest

The authors declare no conflicts of interest.

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