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Article

An Empirical Analysis of an E-government System for Economic Growth in ECOWAS Countries

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Abstract: In many ECOWAS countries, the decision-making process for public service delivery has long remained shrouded in secrecy, rendering the general public largely uninformed. Integrating information and communication technology (ICT) into public service delivery seeks to break these barriers. This study, therefore, investigates the impact of e-governance on economic growth among ECOWAS countries, with the specific objectives of examining the effect of four components of e-governance as well as other postulated determinants on economic growth. By employing annual data across 16 ECOWAS countries spanning from 2003 to 2021, using system generalised method of moment (SGMM) and panel-corrected standard error (PCSE) techniques. The results from the PCSE and SGMM estimations show that e-governance positively influences economic growth among ECOWAS countries both in the long- and short-run. Furthermore, the study identifies the significant influence of various control variables on economic growth, persisting in both short and long-run analyses, except for the labour force variable in the short run. This underlines the intrinsic correlation between e-governance and economic growth. Consequently, it becomes imperative for stakeholders within the sub-region to meticulously link investments in e-governance with measurable economic growth outcomes. By doing so, these investments can substantiate expansive initiatives in public service delivery, while simultaneously bridging the historical gap of opacity that has separated citizens from effective government management.

Keywords: E-governance; ICT; public sector management; economic growth; ECOWAS; panel analysis

Introduction

The advancement of ICT has emerged as a pivotal driver of productivity and economic growth. Technological advancement is recognised by macroeconomic models as a vital component of the production process that significantly impacts overall growth (Majeed & Ayub, 2018). In the contemporary landscape, modern information technologies have given rise to a knowledge-based economy, shifting the focus from the consumption of finite natural resources to intellectual resources, ICT, science-intensive industries, and modern services. This transformation has ushered in a qualitatively new technological era for national economies. Additional empirical evidence emphasizes ICT is important for promoting economic growth (Sinha & Sengupta, 2019; Mansour, 2022).

The potential for e-government, or the integration of ICT technology into the public sector, to greatly improve fiscal results and economic performance is considerable. It is noteworthy that the impact on the public external debt stock may differ (Noah, 2023). ICT and e-government have diverse meanings. ICT pertains to technological innovations that make it easier for people to access information through telecommunications, whereas e-government includes the provision of services using these technological advancements (Malik, Majeed & Luni, 2019).

In an era in which ICT is advancing quickly and digitalisation is becoming more and more important, technology's transformative power has been instrumental in redefining conventional wisdom in the areas of financial services, governance, and economic advancement. According to recent data from the global e-government ranking, African countries are significantly more willing to adopt e-government initiatives, which is indicative of encouraging improvements (Adams & Paul, 2023). The Economic Community of West African States (ECOWAS) member nations have adopted standard practice, rather than just an option, with e-government technologies becoming increasingly popular. Increased advocacy for the digitalisation of most government services and interactions by the business sector and citizens alike is exacerbating this trend and forcing governments to embark on large-scale ICT projects without a thorough comprehending the nature of the technology involved or the projects' actual scope (Heeks, 2003; Noah, 2023).

However, considerable regional differences continue to exist, mostly due to differences in national development levels. Different potentials for sustainable growth are implicitly implied by these discrepancies (Zioło *et al.*, 2022). Literature has underscored that the benefits of ICT have not been uniformly distributed across all nations, with developing countries, including ECOWAS nations, often lagging in adopting ICT infrastructure as a catalyst for economic growth, unlike their more technologically advanced counterparts (Matthess & Kunkel, 2020). In the context of ECOWAS countries, governments have yet to fully harness the potential of this technological advancement in governance and in building meaningful connections with their citizens.

This contrasts with the comprehensive embrace of e-government observed in many developed and developing nations. Similar to governments globally, those in developing nations, including ECOWAS member states, grapple with challenges such as excessive expenditure, inadequate service delivery, and a deficiency in responsiveness and accountability. Although strides have been made in initiating good governance reforms to address these issues, the progress in implementing these reforms has been slower than expected. Nevertheless, there is a consensus within the academic discourse that e-government holds the potential to significantly enhance economic performance (Malik *et al.*, 2019). E-government presents a promising pathway for progress, offering opportunities to streamline government processes, foster citizen and business engagement, and ultimately stimulate economic growth (Kiwanuka *et al.*, 2023).

The assessment of e-government's role in driving sustainable economic growth has remained a relatively underexplored area, particularly within the specific context of ECOWAS countries. This dearth of research is noteworthy, considering that economic growth is a fundamental objective for both governments and nations, directly influencing the prosperity and overall well-being of their citizens. E-government systems are seen as having the potential to catalyze economic growth through various avenues. These systems can streamline bureaucratic processes, reduce administrative costs, improve the business environment's efficiency, and stimulate innovation. In doing so, they create an atmosphere that is favourable to economic growth and development. Even though a lot of research has been done on the connection between ICT and economic growth (Srivastava & Panigrahi, 2016; Haftu, 2018; Adeleye & Eboagu, 2019), and others have investigated how governance affects economic growth (Hashem, 2019; Wang, Wang & Wei, 2023), there remains a paucity of research dedicated to comprehending the economic effects of e-government, especially in the context of ECOWAS nations, with most existing studies focused on developed nations (Khan & Majeed, 2019; Abdel-Azim, Salman & El-Henawy, 2020).

Despite e-government's critical role in information dissemination, essential service provision, and citizen and stakeholder engagement in the economic system, to the best of our awareness, little attention has been paid by the previous research on the impact of e-government on economic growth in ECOWAS countries. In light of this, this study's main objective looks into how e-governance affects economic growth within ECOWAS countries. It specifically assesses the effects of four key components of e-governance, along with the postulated determinants of economic growth. This investigation is conducted by utilizing annual data spanning from 2003 to 2021 across 16 ECOWAS countries, employing SGMM and PCSE techniques. The subsequent sections of this paper are arranged as follows: a comprehensive review of relevant literature is in Section Two, the research methodology is explained in Section Three, the study's findings are presented and discussed in Section Four, and Section Five encapsulates the study's conclusion and implications.

Literature of Review

Economic growth signifies the ongoing expansion of an economy's capacity to produce goods and services, resulting in an increased potential output. This growth process entails a continuous improvement in an economy's productive capabilities as it advances. It is quantitatively assessed by measuring the percentage rise in real gross domestic product (GDP). Furthermore, economic growth is marked by favourable changes in key macroeconomic variables over time. Another dimension of economic growth pertains to the rise in national income per capita. This entails a quantitative examination of this progression, with a specific emphasis on the relationships among the internal variables. In a broader context, economic growth involves the augmentation of GDP, gross national product (GNP), and national income (NI), ultimately contributing to a nation's overall wealth. This expansion is assessed both in absolute and per capita terms and encompasses structural transformations within the economy (Haller, 2012).

The use of ICT tools and infrastructure in public administration to empower citizens, improve public service delivery, foster transparency, and increase the effectiveness of public policy is known as e-government (Malik & Majeed, 2020). E-government, according to UNDP (2006), is the process of using ICT tools to perform public services and disseminate information. In a similar vein, Von Haldenwang (2004) characterises e-government as the integration of ICT into public administration and planning. E-government basically makes sure that information is easily accessible, effective, and transparent by utilizing contemporary technology in the public sector (Elisa *et al.,* 2023).

Traditionally, the "e" prefix denotes activities conducted electronically or in a digital format. Within the context of e-government, e-technology refers to the application of electronic ICTs to a range of government tasks in areas like customs, agriculture, education, healthcare, and governance. E-government offers new ways for the public and private sectors to engage, and it should be seen as a complement to traditional government methods of service delivery and management (Misuraca, 2007). While it is true that governments in developing countries have been employing information technology (IT) for over four decades, the transition to e-governance represents a significant shift from IT to ICTs, as well as from IT to information systems (IS). Earlier models tended to segregate IT from the core of administrative reforms, often perceiving IT as the ultimate objective of reform endeavours. Nevertheless, the contemporary approach integrates IS at the very core of reform initiatives, recognising their pivotal role in driving constructive transformations (Heeks, 2020). The connection between ICT and economic growth has been the subject of numerous theories and schools of thought. However, the main focus of this research is on the important theories that provide the framework for accomplishing its goals. Early theories of economic growth, notably the Classical and Neoclassical theories, can be used to understand the theoretical relationship between e-government or ICT in general and economic growth.

The widespread view amongst classical economists is that an economic system produces surplus value, which, when saved or converted into capital, drives the system's expansion. What is left over from the social product after it has been distributed among goods that are required for labourers' survival and procreation is known as surplus value. According to classical economics, technological advancement plays a pivotal role in driving economic prosperity within society by enhancing labour productivity while maintaining the same workforce. Famous for developing Smith's theory of development, Adam Smith (1776) is one of the notable classical economists who made important contributions to the philosophy of economic growth. The main idea of Smith's thesis is that advances in technology and higher productivity serve as stimulants for societal output development.

The neoclassical growth theory places significant emphasis on capital accumulation and the corresponding decision to save as pivotal factors influencing economic growth. This theory encompasses two primary factors of production, namely capital, and labour, as determinants of output. Additionally, it introduces an externally determined factor, technology, into the production equation. Notably, scholars like Solow and Swan (1956) have made substantial contributions to this theory. According to the Solow-Swan growth theory, growth is viewed as a production function with physical capital, labour, and technology interacting technically. The approach emphasizes that capital, labour, and technological inputs are what propel growth.

Despite the compelling rationale for investigating the connection between economic growth and e-government, particularly from an economic policy perspective, there is a noticeable dearth of empirical studies on this subject in the existing literature. Apart from the growth theories that emphasize the significance of labour, capital, technology, and resources as the major determinants of economic growth, previous research has also elucidated the role of institutional components and macroeconomic variables in driving economic growth (Saidu, Ahmed & Jakada, 2018; Zomchak & Starchevska, 2023; Suharto, Murti & Haryono, 2023). However, the assessment of e-government's role in driving sustainable economic growth has remained a relatively underexplored area, particularly within the specific context of ECOWAS countries. One of the very few studies that have considered this, especially for developed countries, is the one conducted by Majeed and Malik (2016). Their study examined the bilateral relationship between economic growth, e-government, and trade using a simultaneous equation model for 147 countries worldwide. Findings from the study revealed that e-government stimulates trade and economic growth and that there is a bilateral relationship between e-government and trade, economic growth, and e-government. It was discovered that there is a unilateral causation between trade and economic growth.

Similarly, Khan and Majeed (2019) used both GMM and two-stage least square (2SLS) methodologies to examine the growth effects of ICT and e-government for a sample of eight South Asian economies from 1980 to 2016. The study's empirical results demonstrated that, across all models, e-government and ICT have positive and significant growth benefits. The study found that the deployment of ICT infrastructure, both generally and specifically in the public sector, can have a significant positive impact on the South Asian region. Additionally, Adam (2020) used PLS-SEM to investigate the mediating role of institutional quality among economic development, e-government, and ICT. Their study's empirical findings showed a strong correlation between the advancement of ICT and the growth of e-government, e-government and institutional quality, e-government and economic development, and institutional quality and economic development. The research findings indicate that the enhancement of ICT development's contribution to economic success can be reinforced indirectly through the effects of institutional quality.

Theoretical Framework and Specification of the Model

This research is grounded in the Neo-classical growth framework, with a specific focus on the Solow-Swan model, serving as the theoretical underpinning. The choice of this framework aligns with the established norm in empirical studies, considering the extensive application and significance of the Solow-Swan model, particularly concerning the central variables of interest, such as e-government. The association between economic growth and e-government is elucidated through an aggregate production function, which is expressed as:

$$Y = Af(L.K) \quad \text{.....(1)}$$

where Y is output (GDP), L is labour, K is capital, and A is total factor productivity (TFP).

Based on equation 1, we can derive a change in output as:

$$\Delta Y = \frac{\partial Y}{\partial L}.\Delta L + \frac{\partial Y}{\partial K}\Delta K + \frac{\partial A}{\partial A}.F(L,K) \quad \text{……(2)}$$

$$where: \frac{\partial Y}{\partial L} = MPL, \frac{\partial Y}{\partial K} = MPK$$ and the MPL and MPK, in turn, represent the marginal productivity of labour and marginal productivity of capital respectively. Therefore, Equation (2) can be reformulated as:

$$\Delta Y = MPL.\Delta L + MPK.\Delta K + F(L,K).\frac{\Delta A}{A} \quad \text{……..(3)}$$

Dividing equation (3) through Y yields:

$$\frac{\Delta Y}{Y} = \left(\frac{MPL}{Y}\right).\Delta L + \left(\frac{MPK}{Y}\right).\Delta K + \frac{\Delta A}{A} \quad \text{……..(4)}$$

We obtain the following by multiplying and dividing the first term of Equation (4) on the right side with L and the second term with K:

$$\frac{\Delta Y}{Y} = \left(\frac{MPL}{Y}.L\right).\Delta L + \left(\frac{MPK}{Y}.K\right).\Delta K + \frac{\Delta A}{A} \quad \text{.....(5)}$$

where, in a perfectly competitive condition (as a result of which factor inputs are rewarded with their respective marginal products), $\frac{MPL}{Y}.L$ is the proportion of labour in aggregate production, while $\frac{MPK}{Y}.K$ is the proportion of capital in aggregate production. Let the share of labour and capital be denoted as *1-α* and *α* respectively (so that the total output is exactly exhausted by the shares of labour and capital). Then, Equation (5) can be re-written as:

$$\frac{\Delta Y}{Y} = (1-\alpha)\frac{\Delta L}{L} + \alpha\frac{\Delta K}{K} + \frac{\Delta A}{A} \quad \text{.....(6)}$$

According to equation (*6*), economic growth is the result of multiplying the proportion of labour-by-labour growth, the proportion of capital by capital growth, and the growth of total factor productivity. To assess the influence of e-government on economic growth, we enhance the Neoclassical growth equation employed in this research by introducing '*A*,' which signifies the level of technology or e-government. This variable encompasses multiple dimensions of productivity and efficiency. Building upon the earlier discussion, the linear productivity growth model can be formulated as follows:

$$\left(\frac{\Delta Y}{Y}\right)_t = \lambda_0 + \lambda_1\left(\frac{\Delta L}{L}\right)_t + \lambda_2\left(\frac{\Delta K}{K}\right)_t + \lambda_3 X_t + \varepsilon_t \quad \text{.....(7)}$$

where $\left(\frac{\Delta Y}{Y}\right)_t$ = economic growth, $\left(\frac{\Delta L}{L}\right)_t$ = labour force growth, $\left(\frac{\Delta K}{K}\right)_t$ = growth of capital stock,

and *X* represents the variable of interest (e-government). For notational convenience and measurement of variables, henceforth the economic growth, labour force, and capital stock are replaced by GDP per capita (*EGT*), labour force (*LBF*), and capital stock (*CPS*). With these modifications, the above Equation (7) can be rewritten in panel format as:

$$EGT_{it} = \alpha_0 + \alpha_1 LBF_{it} + \alpha_2 CPS_{it} + \alpha_3 EGV_{it} + \varepsilon_{it} \quad \text{.....(8)}$$

where *EGV* represents e-government, and Equation (8) represents the empirical growth model to be specified for estimation in the long run, while the short run empirical growth model is specified using GMM estimate. Regarding the dynamic model that uses the GMM technique, the Arellano-Bover, Arellano-Bond, and Blundell-Bond estimators of GMM are the assumptions that the dynamic models in this study follow. As a result, Equations (9) and (10) as described by Baltagi and Levin (1992) represent the simplified models:

$$EGT_{it} = \beta_0 + \beta_{1i} EGT_{it-1} + \Phi_{1it}\beta + \upsilon_{it} \quad \text{.....(9)}$$

where Φ_{1it} = *LBF, CPS, and EGV,* with 1 x k dimension. Using the first difference in Equation (9) as a proxy for the models' objectivity and coherence:

$$\Delta EGT_{it} = \beta_0 + \beta_{1i}\Delta EGT_{it-1} + \Delta\Phi_{1it}\beta + \upsilon_{it} \quad \text{.....(10)}$$

Dynamic models are used in this study to assess the relative contributions of e-government, labour force, and capital stock on economic growth among ECOWAS countries. These models also account for potential biases arising from the endogeneity of specific regression variables. Positive *a priori* expectations are expected for every parameter in the model.

Methodology

1. Measurement and Sources of Data

GDP per capita serves as a proxy for economic growth, labour force participation (measured as a percentage of the total population) represents the labour force, gross fixed capital formation (constant 2015 US$) represents the capital stock, and the e-government index, which is a composite measure of four key aspects of electronic governance (such as online service, electronic participation, telecommunication infrastructure index, and human capital index), represents the state of e-government. The World Bank's World Development Indicators provide statistics on economic growth and capital stock, the International Labour Organization provides data on labour force, and the United Nations' Public Institutions and Digital Government provides information on e-government.

2. Analytical Techniques

To achieve the objectives of this study, a range of statistical techniques is employed. Panel regression analysis, correlation analysis, and descriptive statistics are all included in these techniques. Given the characteristics of the micro panel data being studied, the SGMM technique for dynamic panel regression and static panel regression with PCSE estimation are both included in the panel regression.

3. Location and Scope of the Study

The study uses secondary data from sixteen ECOWAS nations that include: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. The analysis adopts a panel regression approach, with a focus on the outcomes of unit root and cointegration tests. The cointegration test investigates possible long-run connections among the variables, while the unit root test evaluates data stationarity. The study encompasses the period from 2003 to 2021, a strategic selection due to significant telecommunication liberalisation and ICT adoption within ECOWAS countries during this timeframe. Additionally, this extended period increases the temporal coverage of previous studies on the subject.

Findings

1. Descriptive and Correlation Analyses

A concise summary of the panel series variables is given in Table 1, where the mean, maximum, minimum, and standard deviation are among the statistics shown in the table's upper half. The first column lists these statistical parameters, while the second, third, fourth, and fifth columns correspond to economic growth (EGT), e-government (EGV), labour force (LBF), and capital stock (CPS), respectively.

The results presented in Table 1 reveal that EGT has a mean value of $1140.7, a median of $782.4, a maximum of $3,318.9, a minimum of $390.4, and a standard deviation of 714.5, illustrating significant variation in GDP per capita across ECOWAS countries. Additionally, the mean, median, maximum, minimum, and standard deviation for EGV are as follows: 0.240, 0.223, 0.596, 0.048, and 0.107, respectively. Notably, LFP and CPS also display considerable standard deviations of 8.9 and 10.1 per cent, accompanied by mean values of 62.5 and 22.8 per cent, as well as maximum values of 79.5 and 65.2 per cent, indicating a wide range of values for these variables.

In the lower section of Table 1, the correlation results among the variables are provided. EGT displays positive correlations with EGV and CPS while indicating negative correlations with LFP. EGV also exhibits positive relationships with CPS but is negatively correlated with LFP. Furthermore, a negative correlation exists between LFP and CPS. Importantly, none of the correlation coefficients among the explanatory variables exceeds 0.8, signifying the absence of substantial multicollinearity concerns within the model, thus affirming its reliability (Asteriou & Hall, 2016).

Table 1. The descriptive and correlation analyses

Variables	EGT	EGV	LBF	CPS
Mean	1140.663	0.240394	62.48050	22.77842
Median	782.3606	0.223400	61.63300	20.44129
Maximum	3318.933	0.596000	79.52000	65.18867
Minimum	390.4248	0.047715	44.29800	5.885067
Std. Dev.	714.5019	0.107141	8.879145	10.05751
		Correlation matrix		
	1.000			
EGT	-----			
	0.533	1.000		
EGV	(0.000)	-----		
	-0.409	-0.328	1.000	
LBF	(0.000)	(0.000)	-----	
	0.484	0.069	-0.355	1.000
CPS	(0.034)	(0.245)	(0.000)	-----

Authors' computation (2023)

2. Unit Root and Cointegration Tests

To evaluate the level of stationarity of each variable employed in the model, the unit root test, presented in Table 2, uses panel unit root tests. This analysis is conducted to avoid the occurrence of spurious regression results that may arise when employing the panel ordinary least squares (panel OLS) method with non-stationary series. The results from the unit root tests indicate that all the variables (economic growth - EGT, e-government - EGV, labour force - LBF, and capital stock – CPS) exhibit stationarity when examined in their first difference forms. Consequently, it can be inferred that the series are of the same order.

Table 2. Panel unit roots test results

Series	Stationary	PP- Fisher	ADF- Fisher	LLC	IPS	Decision
EGV	Level	1.967	6.924	2.030	4.440	
		(1.000)	(1.000)	(0.979)	(1.000)	
	First Diff.	80.554***	76.220***	-3.893***	-4.224***	I(1)
		(0.000)	(0.000)	(0.000)	(0.000)	
CPS	Level	24.203	31.045	0.345	1.043	
		(0.763)	(0.413)	(0.635)	(0.851)	
	First Diff.	158.936***	101.269***	-8.868***	-6.626***	I(1)
		(0.000)	(0.000)	(0.000)	(0.000)	
EGT	Level	30.947	26.461	0.441	2.324	
		(0.520)	(0.743)	(0.670)	(0.990)	
	First Diff.	125.693***	79.389***	-5.138***	-4.826***	I(1)
		(0.000)	(0.000)	(0.000)	(0.000)	
LFP	Level	25.335	28.717	-4.292	6.300	
		(0.792)	(0.634)	(0.000)	(1.000)	
	First Diff.	142.247***	86.517***	-5.448***	-8.422***	I(1)
		(0.000)	(0.000)	(0.000)	(0.000)	

*Authors' computation (2023). Notes: PP-Fisher, ADF – Fisher, Levin-Lin-Chu (LLC), and Im-Pesaran-Shin (IPS), (Null: Panels contain unit roots). Values in the parentheses ( ) are the p-values of the test statistic, *, **, and *** indicating rejection of the null hypothesis at 10, 5, and 1% significance levels.*

To verify whether cointegration exists between the model's variables, the panel Kao Engle-Granger cointegration test is applied. Therefore, this study proceeds with the panel Kao Engle-Granger cointegration test, adhering to the model specification for cointegration tests that pertain to the long-term equilibrium. The empirical findings, as shown in Table 3, indicate that there is a long-run equilibrium between economic growth, e-government, capital stock, and labour force in ECOWAS countries. This suggests that the combined

panel series encompassing economic growth, e-government, labour force, and capital stock exhibit long-run relationships.

Table 3. Panel Kao Engle-Granger cointegration test results

Test	**t-statistic**	**p-value**
Economic growth model	-2.381***	0.009

*Authors' computation (2023). Notes: At a 1% significance level, the null hypothesis is rejected, as shown by ****

3. Presentation of Panel Regression Results

In line with the study's objectives, which involve evaluating the influence of e-government (EGV) and the postulated determinants (labour force - LBF and capital stock – CPS) on economic growth - EGT within ECOWAS countries, both static (PCSE) and dynamic models (SGMM) are employed. Table 4 presents the short- and long-run estimations, respectively.

Table 4. Panel regression estimates for economic growth

Variables	(PCSE) Model (1)	(PCSE) Model (2)	(SGMM) Model (3)	(SGMM) Model (4)
EGV	3.049***		0.203***	
	[9.66]		[3.25]	
	(0.000)		(0.001)	
LFP	-11.163***	-8.417***	1.324	-1.500
	[-4.92]	[-2.87]	[0.56]	[-0.58]
	(0.000)	(0.004)	(0.572)	(0.563)
CPS	1.305***	1.490***	0.121***	12.915***
	[4.92]	[5.09]	[3.31]	[3.48]
	(0.000)	(0.000)	(0.001)	(0.000)
EPI		1.293***		6.409
		[2.70]		[0.09]
		(0.007)		(0.925)
ONS		1.764***		-8.292
		[4.56]		[-0.11]
		(0.000)		(0.912)
HCI		1.668***		4.586
		[7.78]		[0.76]
		(0.000)		(0.449)
TII		1.071***		1.525***
		[3.32]		[2.83]
		(0.001)		(0.005)
L.EGT			1.020***	1.008***
			[77.57]	[70.56]
			(0.000)	(0.000)
Constant	-0.629	-1.255**	-0.197	-6.524
	[-1.16]	[-1.99]	[-1.12]	[-0.35]
	(0.244)	(0.047)	(0.262)	(0.723)
Observations	285	285	270	270
Wald X^2	868.62***	1291.53***	12004***	12052***
	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.436	0.479		
Number of countries	16	16	16	16

*Authors' computation (2023). Note: The values enclosed in parenthesis [ ] and ( ) are p-values and t-statistics, respectively. Also, the significance levels for ***, **, and * are 1%, 5%, and 10%, respectively.*

Model 1 displays the PCSE estimates of the coefficients for the overall effects of e-government, labour force, and capital stock on economic growth, while Model 2 presents the PCSE estimates of the coefficients for the individual components of e-government (electronic participation - EPI, online service - ONS, human

capital index - HCI, and telecommunication infrastructure index - TII), labour force, and capital stock on economic growth. Model 3 exhibits the SGMM estimates of the coefficients for the aggregate or overall effects of e-government, labour force, and capital stock on economic growth, and Model 4 illustrates the SGMM estimates of the coefficients for the individual components of e-government (EPI, ONS, HCI, and TII), labour force, and capital stock on economic growth.

Discussion

After undergoing essential tests and procedures, this study proceeds to analyse the individual contributions of each explanatory variable within the PCSE regression models. The empirical results of the PCSE estimation in Model 1 indicate that capital stock and e-government coefficients are positive and statistically significant, while the coefficient of the labour force is negative but statistically significant. This implies that e-government and capital stock have positive effects on economic growth, while the labour force has a negative impact. The implication of this is that a one per cent increase in e-government and capital stock leads to an approximately 3.049 and 1.305 per cent increase in economic growth among ECOWAS countries in the long run, respectively. Conversely, a one per cent decrease in the labour force results in a 1.116 per cent increase in economic growth. These observed effects align with *a priori* expectations and are consistent with findings from earlier studies reported by Khan and Majeed (2019), and Adam (2020). However, the observed effect of labour force participation contradicts *a priori* expectation but is in line with related studies reported by Sahid (2014), and Maestas, Mullen, and Powell (2023). This discrepancy could be attributed to issues like underemployment, skills development, gender disparities, youth unemployment, and health challenges within the labour force in many ECOWAS countries.

The results of the PCSE in Model 2 reveal that the coefficients of capital stock, online service, telecommunication infrastructure, and human capital are positive and statistically significant, while labour force is negative but statistically significant. These imply that capital stock, electronic participation, online service, human capital, and telecommunication infrastructure have positive effects on economic growth, while the labour force has a negative impact. Implications of these are that a one per cent increase in capital stock, electronic participation, online service, human capital, and telecommunication infrastructure leads to approximately 1.490, 1.293, 1.764, 1.668, and 1.071 per cent increases in economic growth among ECOWAS countries, respectively. Conversely, a decrease of one per cent in the labour force leads to a rise in economic growth by 8.417 per cent. These observed effects align with *a priori* expectations and are consistent with findings from earlier studies reported by Santiago, Koengkan, Fuinhas, and Marques (2020) and Adam (2020). However, the observed effect of labour force participation contradicts *a priori* expectation but is in line with related studies, such as Altuzarra, Gálvez-Gálvez, González-Flores (2019), and Yildirim and Akinci (2021).
The overall explanatory power of the variables in Models 1 and 2 is evaluated using the Wald chi-square statistic, resulting in values of 868.63 and 1291.53, both with p-values of 0.000. This indicates that the models fit the data well and have good explanatory power. In other words, all the explanatory variables, including e-governance and its components, labour force, and capital stock, prove to be reliable predictors of economic growth.

Furthermore, the results of the SGMM estimation in Model 3 reveal that the coefficients of the one-period lag of economic growth, e-government, and capital stock are positive and statistically significant in the short run, but labour force is statistically insignificant during this period. This suggests that the one-period lag of economic growth, e-government, and capital stock have a positive influence on economic growth. Implications of this are that a one per cent rise in the one-period lag of economic growth, e-government, and capital stock leads to an approximate increase of 1.020, 0.203, and 0.121 per cent, respectively, in economic growth among ECOWAS countries in the short run. These findings also align with *a priori* expectations and are consistent with earlier research, including studies conducted by Khan and Majeed (2019) and Adam (2020).

Additionally, the SGMM estimation results in Model 4 reveal that only the coefficients of one-period lag of economic growth, capital stock, and telecommunication infrastructure are positive and statistically significant in the short run, but electronic participation, labour force, online service, human capital are statistically insignificant during this period. This suggests that the one-period lag of economic growth, capital

stock, and telecommunication infrastructure positively influence economic growth. The implications of this are that a one per cent increase in the one-period lag of economic growth, capital stock, and telecommunication infrastructure leads to an approximate increase of 1.008, 12.915, and 1.525 per cent, respectively, in economic growth among ECOWAS countries in the short run. These observed effects align with *a priori* expectations and are also consistent with findings from earlier studies, including those reported by Malik *et al.* (2019), and Adam (2020). However, the lack of significance for electronic participation, online service, and human capital coefficients might be attributed to factors such as low digital literacy, bureaucratic barriers, and resistance to digitalisation. Additionally, the significance of the lag of economic growth indicates that past economic growth levels influence current economic growth, suggesting that past failures in achieving sustainable economic growth may lead to present shortcomings in this regard. The Wald chi-square statistic is also used to assess the overall explanatory power of the variables in Models 3 and 4. The results show values of 868.63 and 1291.53, both with p-values of 0.000. This suggests that the models have excellent explanatory power and fit the data well. Put differently, every explanatory factor—the labour force, capital stock, and e-governance and its components—proves to be a good indicator of economic growth.

Conclusion

The interplay between e-government and financial development has gained notable attention and relevance. Remarkably, previous research has given little focus to the examination of e-government's contribution to sustainable economic growth, particularly in the specific context of ECOWAS nations. In light of this, this study explores how e-governance affects economic growth in ECOWAS nations. It conducts a comprehensive assessment of the impacts of four critical components of e-governance, in conjunction with other controlling variables that influence economic growth. This inquiry is carried out using annual data from 2003 to 2021, covering 16 ECOWAS countries and applying PCSE and SGMM methodologies.

Based on the empirical outcomes obtained through PCSE estimations, it can be concluded that a significant and positive long-term connection exists between economic growth and the explanatory variables encompassing e-government, capital stock, online service, electronic participation, telecommunication infrastructure, and human capital index. Conversely, labour force participation demonstrates adverse effects on economic growth. Moreover, the SGMM results also show that all the explanatory variables (e-government, capital stock, and telecommunication infrastructure) positively influence economic growth in ECOWAS countries in the short run. However, it's worth noting that the labour force, electronic participation, online service, and human capital appear to have no short-run influence on economic growth. Additionally, the results show that past economic growth levels influence present economic growth, implying that previous failures to achieve sustainable economic growth can lead to ongoing challenges in this context.

In line with the empirical results and the conclusions drawn from the analysis, this study recommends that ECOWAS countries prioritize investments in and enhancement of their e-government initiatives. Emphasis should be placed on improving digital services, streamlining administrative processes, and ensuring convenient access to online government services. This strategic focus not only contributes to long-run economic growth but also fosters transparency and efficiency in public administration. Additionally, ECOWAS nations must continue investing in the expansion and enhancement of communication networks, with a particular focus on improving the reach and calibre of telecommunication services, especially in rural and underserved areas, to reduce the digital divide.

To improve the calibre of the labour force and boost productivity and overall economic growth, policymakers should also actively promote social safety, good education, skill development, and access to healthcare. Concerning the insignificant short-run effects of variables such as electronic participation, online service, and human capital, governments should demonstrate leadership by adopting digital solutions to minimise bureaucratic hurdles and improve public services. This can be achieved through measures like reducing paperwork, streamlining approval processes, and creating user-friendly interfaces for citizens and businesses.

Furthermore, it is imperative to enforce robust data privacy and security regulations to build trust in digital technologies, safeguarding individuals and organizations from data breaches and cyber threats. Finally, given the influence of past failures to achieve sustainable economic growth on current performance,

governments must prioritise sustainable growth. Policymakers should develop comprehensive strategies that address the factors contributing to both short- and long-run economic growth, ensuring consistency in their efforts.

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