

Research Article

ICT Development, E-government Development, and Economic Development: Does Institutional Quality Matter?

Ibrahim Osman Adam

University for Development Studies, Wa, Ghana

Abstract

Interest in the role and contribution of ICT development, e-government development, and the quality of a nation's institutions on economic development is profound. While extant research shows that the impact of institutions on national development is different across countries generally, the literature overlooks the role institutional quality plays in either the ICT development–economic development or the e-government–economic development nexuses. Relying on publicly available archival data, this study explores the mediating relationship of institutional quality by using Partial Least Squares Structural Equation Modeling (PLS-SEM). Our results show a significant relationship between ICT development and e-government development; e-government development and institutional quality, e-government development and economic development; and institutional quality on economic development. Also, the contribution of ICT development to economic prosperity can further be strengthened indirectly via the impacts of institutional quality. This study contributes to the theoretical discourse on the impact of ICT development and e-government development on economic development and the mediating effects of institutional quality. It offers implications for practice and policy.

Keywords: ICT development, e-government development, economic development, institutional quality, PLS-SEM

Introduction

The level of information and communication technology (ICT) development is touted as having considerable potential to enhance economic growth and promote the economic development of nations. The International Telecommunication Union (ITU, 2007) defines *ICT* as an efficient parameter of technological advancement that revolutionizes production, logistics process, and decision making. It is therefore unsurprising that ICT constitutes an essential component of economic activities such as trade and provision of government services (Yousefi, 2011). The provision of government services via online channels to promote service access and delivery to citizens, businesses, and other stakeholders is achievable through electronic government (e-government) (Srivastava & Teo, 2007, 2010). *E-government development*, on the other hand, is the extent to which the interactive features of the World Wide Web and Internet technologies are used to conduct government's business (Kunstelj & Vintar, 2004; West, 2004).

There is weak and ambiguous empirical evidence on the contribution of ICT investments to economic growth for low-income, emerging, and, in particular, developing countries (Niebel, 2018). A great deal of research has been conducted on the impact of ICT development in general and ICTs in particular on economic development (Avgerou, 1998; Bankole, Osei-Bryson, & Brown, 2015; Hatakka, Devinder, & Sæbø, 2016; Thapa & Sæbø, 2014). While most studies have confirmed the existence of a causal relationship between ICT and

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growth (Dutta, 2001; Madden & Savage, 1998), a few cases exist where there is no evidence of causality from ICT to GDP (Shiu & Lam, 2008). There is a wide array of literature that presents a negative evidence of the digital divide and ICT effects in terms of Internet abuse or misuse of development (Haywood, 1998; Ishida, 2015), while others proffer a positive light on ICT-led national development and improvement in the quality of life (Kim, 2013).

E-government development is increasingly seen as a recipe for a successful transaction of government business that can lead to economic development by most countries (Srivastava & Teo, 2006). While a great deal of research has been conducted on the evolution and development, adoption, and implementation of e-government (Srivastava, 2011), there have been relatively fewer studies on the impact of e-government (Skiftenes Flak et al., 2009). Extant research on the impact of e-government provides evidence that a country's e-government development has the potential to offer several benefits through enhanced service delivery (Al-Kibsi, De Boer, Rea, & Mourshed, 2001; Von Haldenwang, 2004; West, 2004), increased democratization (Von Haldenwang, 2004; West, 2004), reduction in corruption, increased government transparency (Bertot, Jaeger, & Grimes, 2010; Shim & Eom, 2008), economic performance, and business competitiveness (Srivastava & Teo, 2007, 2008).

Research into the effects of ICT development on economic growth and into e-government development on economic development has been silent on the effects the quality of a country's institutions could have on these dichotomies. Institutional quality is a broad concept that entails law, individual rights, and high-quality government regulation and services (Iheonu, Ihedimma, & Onwuanaku, 2017) as well as the quality of contract enforcement, property rights, and shareholder protection (Levchenko, 2007). Few studies have empirically investigated the impact of institutional quality on economic growth (Nawaz, Iqbal, & Khan, 2014; Valeriani & Peluso, 2011). While these studies show that the impact of institutions on growth differs across countries, the literature misses the role institutional quality plays in either the ICT development–economic development or the e-government development–economic development nexuses.

This study is particularly interested in three variables—ICT development, e-government development, and institutional quality—as key national-level growth parameters that determine a country's economic development. Although research exists that connects ICT development and economic development, as well as e-government and economic development, it is often limited by the assumption of a direct causal relationship with economic development. This study, therefore, aims to deepen the discourse on the debate over the effects of ICT development and e-government development on economic development by examining the mediating role of institutional quality.

The rest of this article is organized as follows. First, we draw on the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) and the IT impact literature to hypothesize the relationship between ICT development, e-government development, institutional quality, and economic development. This is followed by the methodology. Thereafter, using data from 76 countries (see Appendix 1 for the list of countries), we test the formulated hypotheses. After a discussion of the results, we present the implications for research and practice and the conclusions.

Theory and Hypothesis Development

Technology-Organization-Environment (TOE) Framework

This study is informed by the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as the theoretical lens in a cross-country context to examine the mediating role of institutional quality in the nexus of ICT development, e-government development, and economic development. In the TOE framework, there are three contextual elements that influence the adoption decisions as well as the technological innovations of a firm (Tornatzky & Fleischer, 1990). These include technological context, organizational context, and environmental context. *Technological context* refers to the technologies available to the firm. *Organizational context* involves organizational features or resources such as the quality of internal controls, human resources, etc. *Environmental context* explains the surrounding conditions in which the firm operates. The interplay of these three contextual factors influences a firm's decision to adopt an innovation.

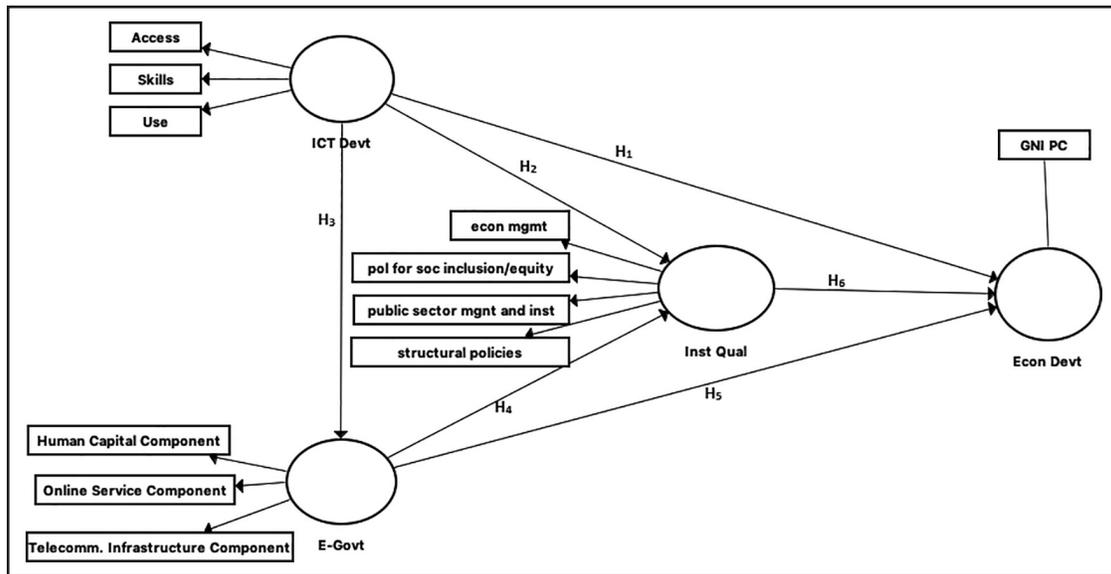


Figure 1. Research model: Integrating institutional quality into ICT development, e-government, and economic development.

In this article, the TOE framework is extended to technological innovations at a country level, where technological adoptions lead to some impact. In the national-level context, where there is an interplay of ICT development, e-government development, and economic development, the role of a country's institutions is critical in creating the needed impact. We, therefore, conceptualize that ICT development (as measured by ICT access, the ICT skills of the population, and the level of ICT use) and e-government development initiatives constitute the technological context. The organizational context involves the size of the firm, financial resources, the quality of internal controls, human resources, and market resources (Gibbs & Kraemer, 2004). We, therefore, see institutional quality as the organizational context. In the national context, the citizens are the most critical stakeholders in e-government initiatives (Flak & Rose, 2005). The quality of a country's institutions is, to an extent, influenced by the quality of human resources and policies. Therefore, the wider organizational context is seen in terms of the quality of the state institutions. The national environment includes the economic environment (Srivastava & Teo, 2010), and so it is in this light that this study uses economic development to represent the environmental context.

Existing research has shown that the TOE framework has broad applicability and can be used to explain phenomena across technological, industrial, and national contexts (Baker, 2012) as well as the adoption of interorganizational systems (Mishra, Konana, & Barua, 2007). In the following section, the theoretical linkages among ICT development, e-government development, institutional quality, and economic development are presented. The diagrammatic representation of the research model, informed by the TOE framework and with accompanying hypotheses, is presented in Figure 1 above.

ICT Development and Economic Development

Within the last couple of decades, researchers (Hassen & Svensson, 2014; Heeks, 2010) have sought to assess the use of ICTs and their development implications, asserting the widespread impression that ICT development can play a substantial role in socioeconomic development, especially in developing countries (Palvia, Baqir, & Nemati, 2018). Researchers have argued that it is possible to reduce inequality in accessing ICTs since a wide range of development objectives can be achieved as a result. However, skepticism toward achieving these objectives has also been stated in the literature (Fors & Moreno, 2002; Kuriyan, Ray, & Toyama, 2008; Patel,

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Gali, Patel, & Parmar, 2011), making the notion of the impact of ICT intervention on development inconclusive (Thapa & Sæbø, 2014).

There is evidence of the use and linkage of ICT infrastructure as a conduit for development (Shirazi, 2008). However, while recent literature presents evidence of ICT's significant contribution to economic and social transformation in developed countries (Sepehrdoust, 2018), it is not exactly so for less-developed countries (Bollou, 2010). This is supported by Avgerou (2003), who posits that the tool-and-effect association suggested in the discourse of ICT and economic development is dubious and misleading as well as contentious (Singh, Díaz Andrade, & Techatassanasoontorn, 2018) and that few economies have historically developed an institutional setting that sustains the mutual reinforcement of ICT innovation. These indicate the need for further studies and thus lead to this hypothesis:

H₁: The level of ICT development in a country is positively associated with its economic development.

ICT Development and Institutional Quality

ICT development in telecommunications infrastructure in terms of access, skills, and use may impact institutional quality in various ways. For instance, Lio, Liu, and Ou (2011) and Shim and Eom (2008) have found that adoption of the Internet can reduce corruption. In addition, ICT infrastructure has been shown to have a positive impact on democratic freedom of expression. This, in turn, can positively influence government accountability and, eventually, institutional quality (Shirazi, 2008). Through e-government, telecommunications infrastructure provides opportunities for ICTs to enhance government service delivery, administrative management, and citizen engagement (Kudo, 2008). Furthermore, development of telecommunication services appears to be conditioned by the institutional parameters that can deepen the digital divide between countries (Asongu & Nwachukwu, 2016). This leads to the hypothesis:

H₂: The level of ICT development in a country is positively associated with its level of institutional quality.

ICT Development and E-government

The day-to-day activities of a country's citizens are a critical part of the government's business. To fulfill government responsibilities through e-government, the Internet and related ICT infrastructure must be readily accessible and usable. This can only be achieved if the needed ICT infrastructure is in place to support government-to-citizen and government-to-business interactions. Therefore, the presence of a well-developed "ICT infrastructure is vital for the development of e-government" (Srivastava & Teo, 2010, p. 274), and if there is poor or no ICT infrastructure, the e-government development is greatly impaired. ICT plays a critical role in e-government development because e-government relies on different kinds of information and computer technology to deliver government services to citizens through an online medium (Siau & Long, 2006). The role of ICT in e-government development is also supported by the fact that the more mature the e-government development of a country, the more reliant the country is on the state of the ICT infrastructure. This is because the lack of ICT infrastructure can limit access of a section of a country's population to e-government services (Singh, Das, & Joseph, 2007). This means that given a lack of reliable technological infrastructure, e-government development may never be realized (Koh, Ryan, & Prybutok, 2005; Singh et al., 2007). This leads to the following hypothesis:

H₃: The level of ICT development in a country is positively associated with its e-government development.

E-government and Institutional Quality

E-government strengthens institutions in differing ways, by streamlining and enhancing the bureaucratic culture in the public sector. This is so because ICTs are seen as cost-effective and convenient avenues for openness and transparency, thereby reducing corruption (Bertot et al., 2010). In countries that have enacted transparency laws, the implementation of such laws has been tied to ICT-based initiatives through e-government (Relly

& Sabharwal, 2009). ICTs can help a country reduce corruption by promoting good governance, strengthening reform-oriented initiatives, enhancing relationships between government employees and citizens, and monitoring and controlling behaviors of government employees (Shim & Eom, 2008). Technology has opened domains of information that only a few years ago were unthinkable, thus enabling institutions to be more transparent in the handling of information and processes, thereby enhancing citizen access to information from public institutions and vice versa. This enables diverse citizen groups—by age, gender, disability, etc.—to access services with ease (Eger & Maggipinto, 2009). This leads to the fourth hypothesis:

H₄: The level of e-government development in a country is positively associated with its institutional quality.

E-government and Economic Development

There are several ways ICTs in the form of e-government can impact performance at the country level by improving its efficiency and effectiveness (Alpar & Kim, 1990; Dewan & Kraemer, 2000). For instance, evidence shows that basic Internet use enables technology at the local government level, which leads to a proliferation of e-government and, ultimately, to the economic welfare of the population (Clark, Gillett, Lehr, Sirbu, & Fountain, 2003). This is further supported by Porter (2003), who found that national economic performance depends on the country's technological development. Therefore, investments in ICTs are seen as a key driver of productivity growth (Niebel, 2018). This means we can conclude that a nation's e-government development impacts its economic performance. This leads to the hypothesis that:

H₅: The level of e-government development in a country is positively associated with its level of economic development.

Institutional Quality and Economic Development

It is widely acknowledged that robust institutional arrangements of a country are a key determinant of economic and political developments (Acemoglu, Johnson, & Robinson, 2005; Acemoglu, Johnson, Robinson, & Thaicharoen, 2003). A strong, trade-based country requires appropriate regulations of its financial markets, strong rule of law, protection of intellectual property rights, and institutions that fight corruption (Barro, 1997; Rodrik, 2000). This explains why any country with unstable institutions is riddled with corruption and weak legal systems that will not attract the required capital for production and export (Bankole et al., 2015; Gyimah-Brempong, 2002; Gyimah-Brempong, Paddison, & Mitiku, 2006). To support this, Shirazi, Gholami, and Higón (2009) showed a positive relationship between institutional quality and economic freedom as an indicator of trade, which can ultimately contribute to economic development. This, then, leads to the suggested hypothesis:

H₆: The level of institutional quality in a country is positively associated with its economic development.

Method

Data

In this study, data from many countries aggregated at the national level was required. However, collecting primary data from all these countries was constrained by the resources and time that needed to be expended to conduct such research. Therefore, to ensure that the hypothesis could be tested, we explored several reliable secondary data sources used in similar past research. Four main data sources were used: (1) International Telecommunication Union's *Measuring the Information Society Report 2016* (ITU, 2017), (2) *United Nations Global E-Government Survey 2016* (UN Report, 2016), (3) *The World Bank's Country Policy and Institutional Assessment* (World Bank, 2016), (4) *World Bank's World Development Indicators 2016* (World Bank, 2016).

Data from the *United Nations E-Government Survey* covers 95 low-income countries across the world. The ITU database, however, provided data for 176 countries, while the data from the *E-Government Survey* and

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Table 1. List of Variables, Indicators, and Sources of Data.

Serial Number	Latent Variable	Measure/Indicator	Source
1	ICT development	ICT Development Index <ul style="list-style-type: none"> • ICT Access • ICT Use • ICT Skill 	ITU
2	E-government development	E-government Development Index <ul style="list-style-type: none"> • Online service component • Telecommunication Infrastructure Component • Human capital component 	World Bank Division for Public Administration; Development Management
3	Institutional quality	Country Policy and Institutional Assessment <ul style="list-style-type: none"> • Economic management cluster average • Policies for social inclusion/equity cluster average • Public sector management and institutions cluster average • Structural policies cluster average 	World Bank Division for Public Administration; Development Management
4	Economic development	Gross National Income per capita	World Development Report

the *World Development Indicators* covered 193 countries. Since the variables used were taken from these reports, the study only considered data for those countries that was available in all reports. The common data points were analyzed across all reports, which resulted in the analysis of 76 countries. Indicators missing less than 5% of their data were mean replaced (Hair, Hult, Ringle, & Sarstedt, 2016).

Constructs, Variables, and Measures

Drawing from the research model in Figure 1, four latent variables (constructs) are considered in this study: (1) ICT development, (2) e-government development, (3) institutional quality, and (4) economic development. ICT development is measured by the ITU ICT development index (ITU, 2017), which is based on 11 ICT indicators, grouped in three clusters: access, use, and skills. In this study, the three clusters of indicators are used to measure ICT development. The e-government development construct is measured by three indicators of a country: the online service index, the human capital index, and the telecommunication infrastructure index gleaned from the UN E-Government Survey (UN, 2016). The institutional quality construct is measured by the World Bank's Country Policy and Institutional Assessment (CPIA). The CPIA is a diagnostic tool that assesses countries' quality of policies and the performance of institutional frameworks. The CPIA has four indicators that examine the coherence of economic management, structural policies, the degree to which its policies and institutions promote equity, and social inclusion.

Method of Data Analysis

The study used partial least squares structural equation modeling (PLS-SEM) over covariance-based SEM techniques such as LISREL or AMOS for several reasons. First, PLS uses minimal restrictions on measurement scales and sample sizes as well as on the residual distributions (Chin, 1998; Chin & Newsted, 1999). In addition, in PLS analysis there is no assumption of true independence of the variables, which leads to more reliability in the results (Tobias, 1995). Apart from these, PLS is robust against data structural problems such as skew distributions and omissions of regressors (Cassel, Hackl, & Westlund, 1999; Gefen, Straub, & Boudreau, 2000).

In the next section, a further description of the measures employed in this study and their reliability and validity is provided.

Table 2. Construct Reliability and Validity.

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
E-govt	0.805	0.842	0.884	0.718
Econ Devt	1	1	1	1
ICT Devt	0.945	0.945	0.964	0.901
Inst Qual	0.892	0.939	0.922	0.749

Data Analysis

SmartPLS 3.2.8 (Ringle, Wende, & Becker, 2015) was used as the data analysis tool. To understand the relationship between ICT development, e-government, institutional quality, and economic development, the PLS algorithm was run, and the following assessment of the measurement and structural model was performed.

Assessment of the Measurement Model

All model variables were reflective constructs. This meant their indicators were manifestations of the intended constructs (Hair et al., 2016). In analyzing the data, the PLS bootstrapping technique with 5,000 resamples (Chin, 2010) was run to assess the significance of the model linkages.

Since all constructs were reflective, the measurement model was tested for reliability and validity before the structural model was assessed. The assessment included an estimation of internal consistency for reliability, convergent validity, and discriminant validity (Hulland, 1999; Nunnally, 1978). Each construct loaded significantly on its corresponding constructs (Gefen & Straub, 2005), and these were all higher than the cutoff point of 0.708 (Hair, Risher, Sarstedt, & Ringle, 2019) as depicted in Figure 2 (Hulland, 1999). This means each indicator was a good measurement of the latent construct. The minimum indicator loading was 0.741.

Several criteria were used to assess construct reliability and validity. First, to assess for internal consistency, Cronbach's alpha and Fornell-Larcker's composite reliability (Fornell & Larcker, 1981) were used. All coefficients of the Cronbach's Alpha exceeded the minimum of 0.7 (Nunnally, 1978) and ranged from 0.805 to 1.000. The rho A was similarly in line with the Cronbach Alpha, and all exceeded a minimum of 0.7. The composite reliabilities exceeded the minimum of 0.7 and were considered adequate (Fornell & Larcker, 1981). This demonstrated adequate internal consistency. All the Average Variances Extracted (AVEs) were greater than the 0.5 recommended minimum (Fornell & Larcker, 1981; Hair et al., 2019).

To assess further for discriminant validity, the cross-loading was examined as an additional measure. As can be seen in Table 3, the loadings exceeded the cross-loadings. For example, Skills loads high on its corresponding construct ICT Devt (0.920), but much lower on constructs E-govt (0.767), Inst Qual (0.235), and Econ Devt (0.676). Therefore, analysis of the cross-loadings suggests that discriminant validity has been established.

Results of the PLS analysis for the structural model are shown in Figure 2, which depicts the cross-loading as captured in Table 3 as well as the path coefficients and the R². The R² for E-government Development (E-govt), Institutional Quality (Inst Qual), and Economic Development (Econ Devt) were 0.558, 0.146, and 0.746, respectively.

Next, the study examined the discriminant validity of the constructs. Although discriminant validity can be assessed using the Fornell-Larcker criterion (Fornell & Larcker, 1981), Henseler, Ringle, and Sarstedt (2015) proposed a newer approach called Heterotrait-monotrait ratio of correlations (HTMT), which is based on the multitrait-multimethod matrix. They argue that traditional approaches cannot reliably detect the lack of discriminant validity in some research scenarios. The Fornell-Larcker criterion and the cross-loadings are considered inadequate in detecting discriminant validity compared to the HTMT criterion. Therefore, to avoid causing a misleading interpretation of the results of causal effects, use of the HTMT criterion was adopted because the HTMT criterion is considered highly sensitive and specific in detecting discriminant validity problems (Ab Hamid, Sami, & Sidek, 2017). The results in Table 4, where the HTMT ratios are different from 1, show there is no discriminant validity.

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Table 3. Indicator Item Cross-loadings.

Indicator	ICT Devt	E-govt	Inst Qual	Econ Devt
Access	0.977	0.697	0.281	0.696
Skills	0.920	0.767	0.235	0.676
Use	0.949	0.657	0.262	0.667
Human Capital Component	0.584	0.846	0.271	0.640
Online Service Component	0.470	0.787	0.412	0.575
Telecomm. Infrastructure Component	0.794	0.905	0.307	0.855
Econ mgmt	0.061	0.159	0.741	-0.015
Pol for soc inclusion/equity	0.211	0.368	0.916	0.113
Public sector mgmt and inst	0.326	0.371	0.910	0.217
Structural policies	0.250	0.339	0.883	0.138
GNI PC	0.717	0.831	0.157	1

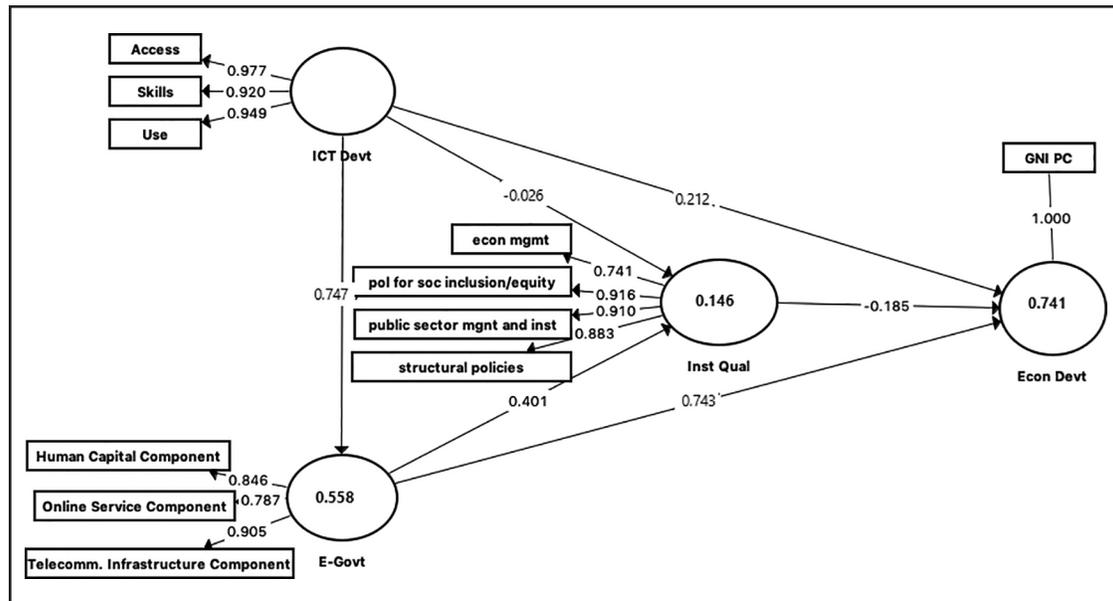


Figure 2. Results of indicator loadings, path coefficients, and R^2 .

Although the assessment confirmed discriminant validity as shown Table 4, we further tested through consistent PLS Bootstrapping. By examining the results in Table 5, it was also confirmed that at the CI Low (2.5%) and CI Up (97.5%) columns, all the HTMTs are different from 1, and discriminant validity is said to be established between these reflective constructs (Wong, 2019), supporting the earlier test in Table 4.

Assessment of the Structural Model

The study assessed for multicollinearity of the independent constructs. *Collinearity* occurs when "redundant indicators are used as single items to measure two (or more) constructs" (Hair et al., 2016, p. 165). If multicollinearity occurs, the redundant indicators must be removed. To assess for this, the variance inflation factor (VIF) is used. As a rule of thumb, the VIF must be 5 or lower to avoid the collinearity problem (Hair,

Table 4. Heterotrait-monotrait Ratio (HTMT).

Construct	E-govt	Econ Devt	ICT Devt	Inst Qual
E-govt				
Econ Devt	0.907			
ICT Devt	0.831	0.737		
Inst Qual	0.430	0.147	0.266	

Table 5. Heterotrait-monotrait Ratio (HTMT).

Relationship	Original Sample (O)	Sample Mean (M)	Bias	2.50%	97.50%
Econ Devt → E-govt	0.907	0.906	-0.001	0.813	0.976
ICT Devt → E-govt	0.831	0.836	0.005	0.533	1.018
ICT Devt → Econ Devt	0.737	0.734	-0.003	0.463	0.889
Inst Qual → E-govt	0.430	0.453	0.023	0.232	0.624
Inst Qual → Econ Devt	0.147	0.182	0.035	0.055	0.284
Inst Qual → ICT Devt	0.266	0.283	0.017	0.100	0.448

Ringle, & Sarstedt, 2011). The rule of thumb in multicollinearity assessment is that each predictor construct's VIF value must be lower than 5 so as to indicate that the variable under consideration is almost a perfect linear combination of independent variables already in the equation (Hair et al., 2011; Hair et al., 2016; Mansfield & Helms, 1982). All the VIF values were below 5 in this study, confirming that multicollinearity was not a problem.

To test the hypothesis for significance, the paths of the structural model were assessed, and the path coefficients and the significance levels were evaluated. To obtain the t-values in SmartPLS 3.2.8, a bootstrapping procedure using a two-tailed t-distribution was run to establish the paths' significance levels. The bootstrapping was run using 5,000 re-samples. The results are presented in tables 7 and 8 and supported by Figure 3.

When a two-tailed t-test is used with a significance level of 5%, the path coefficient is significant when the t-statistic is larger than 1.96. However, the critical t-value is 1.65 given a significance level of 10%, and 2.58 for a significance level of 1% (all two-tailed) (Wong, 2019).

To evaluate the structural model in order to determine its predictive power, the coefficient of determination (R^2) is used. The coefficient represents the exogenous latent variables' combined effects on the endogenous latent variable (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). From Figure 2 the coefficient of determination, R^2 , is 0.741 for the Econ Devt endogenous latent variable. This means the three latent variables (ICT Devt, E-govt, and Inst Qual) explain 74.1% of the variance in Econ Devt. Also, ICT Devt and E-govt together explain 14.6% of the variance of Inst Qual, while ICT Devt explains 55.8% of E-govt. The R^2 ranges between 0 and 1, with higher values indicating higher levels of predictive accuracy.

In addition to checking for collinearity, the effect size of the model needs to be assessed. This shows how much an exogenous latent variable contributes to an endogenous latent variable's R^2 value. The rule of thumb is that $0.02 < f^2 < 0.15$ is weak; $0.15 < f^2 < 0.35$ is moderately weak; $f^2 > 0.35$ has a strong effect.

The breakdown of the hypothesis results presented in Table 7 indicates that H_2 is not supported, while H_1 , H_3 , H_4 , H_5 , and H_6 are supported. The findings in relation to the individual hypotheses are now discussed.

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Table 6. Multicollinearity Statistics: Inner VIF Values.

Construct	E-govt	Econ Devt	ICT Devt	Inst Qual
E-govt		2.449		2.261
Econ Devt				
ICT Devt	1	2.262		2.261
Inst Qual		1.171		

Table 7. Structural Model Hypothesis Testing for Direct Effects.

Hypothesis	Relationship	Std Beta	Std Error	[t-Values]	Decision	95% CI LL	95% CI UP
H ₁	ICT Devt → Econ Devt	0.248	0.112	1.889*	Supported	0.104	0.459
H ₂	ICT Devt → Inst Qual	-0.054	0.215	0.122*	Not supported	-0.479	0.232
H ₃	ICT Devt → E-govt	0.749	0.105	7.136**	Supported	0.561	0.897
H ₄	E-govt → Inst Qual	0.444	0.183	2.196**	Supported	0.195	0.791
H ₅	E-govt → Econ Devt		0.119	6.238**	Supported	0.478	0.85
H ₆	Inst Qual → Econ Devt	-0.171	0.064	2.9**	Supported	-0.27	-0.06

Note: ** $p < 0.1$, * $p < 0.05$.

Table 8. T-statistics of Outer Loadings (IO/STDEVI).

Item	ICT Devt	E-govt	Inst Qual	GNI
Access ← ICT Devt	173.626			
Use ← ICT Devt	67.244			
Skills ← ICT Devt	44.325			
Telecomm. Infrastructure Component ← E-govt		55.717		
Human Capital Component ← E-govt		28.315		
Online Service Component ← E-govt		11.352		
Pol for soc inclusion/equity ← Inst Qual		17.806		
Structural policies ← Inst Qual			15.613	
Public sector mgmt and inst ← Inst Qual			14.995	
Econ mgt ← Inst Qual			5.634	
GNI PC ← Econ Devt				Single item construct

Discussion of Results

Several issues emerged from the findings of this study. First, ICT development in a country was positively related to its economic development. There are strong theoretical grounds and some empirical bases to support the idea that ICT development leads to economic development, despite several studies that raise doubts about this assertion. This makes the debate of ICT's contribution to economic development a contentious one because "the deployment and use of ICT for development is not a consensual activity" (Singh et al., 2018, p. 1). For instance, Madden and Savage (1998), Dutta (2001), Jin and Cho (2015), Chakraborty and Nandi (2003), and Shirazi (2008) confirm a causal relationship between ICT and growth, while Shiu and Lam (2008) state there is no evidence of causality from ICT to GDP. In an attempt to contribute to deepening this discourse, our study has established a positive relationship between ICT development and economic development. That is, as a country's ICT development increases, it can translate to economic development.

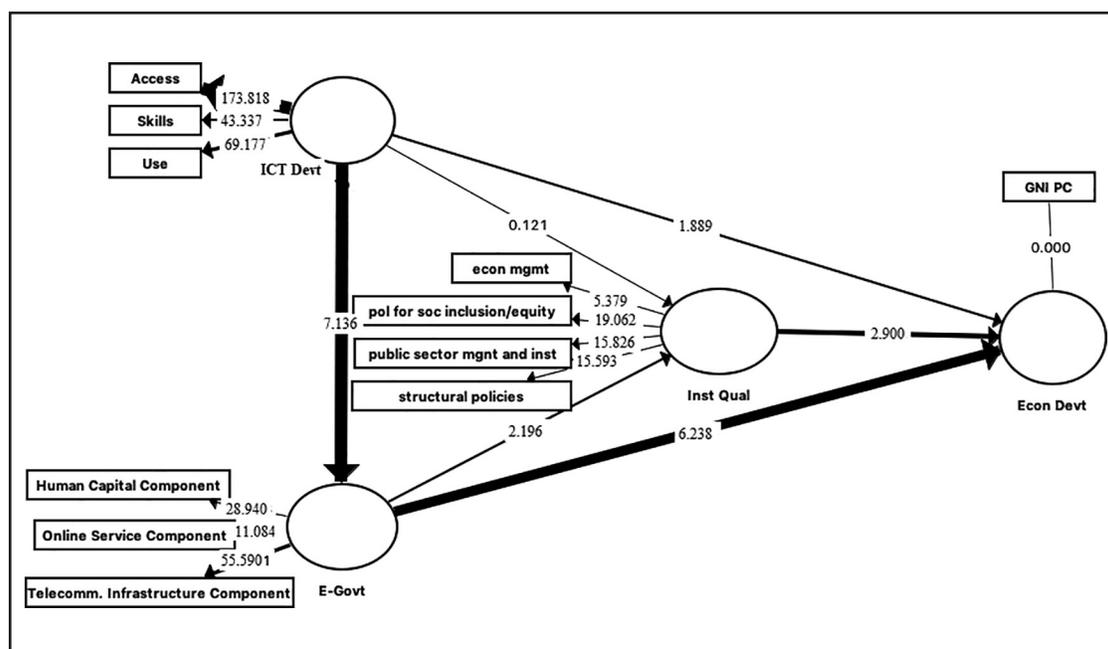


Figure 3. Model hypothesis testing for direct effects.

Table 9. F-square.

Construct	E-govt	Econ Devt	ICT Devt	Inst Qual
E-govt		0.871		0.083
Econ Devt				
ICT Devt	1.261	0.077		
Inst Qual		0.112		

Together, the three latent variables of ICT development, e-government, and institutional quality explain 74.1% of economic development in this study. Although the effect of ICT development on economic development was proven, several other factors accounted for 25.9% of economic development. The study further found that a country's ICT development is not positively associated with the quality of its institutions. Although a country's telecommunications infrastructure provides opportunities for ICTs to be used to enhance government service delivery, administrative management, and citizen engagement (Kudo, 2008) through its institutions, if there is no proper political will and adequate regulatory framework, the implemented technologies may not work. ICT development may be a top-driven initiative and, hence, may not be directly related to the state of public institutions (Srivastava & Teo, 2010). Our results also show that a country's ICT development is positively associated with its e-government development. This is consistent with past studies such as Srivastava and Teo (2010), which confirm that a well-developed ICT infrastructure is critical for e-government development. Where a country lacks sound, reliable technological infrastructure, its e-government development may not be realized (Koh et al., 2005; Singh et al., 2007); therefore, ICT infrastructure is imperative for e-government development (Siau & Long, 2006).

Second, our results show that e-government development is positively associated with economic development and is also positively associated with institutional quality. These findings are consistent with prior

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empirical research (Alpar & Kim, 1990; Clark et al., 2003; Ishida, 2015; Niebel, 2018) showing that ICTs through e-government contribute to economic development. Furthermore, stronger institutional arrangements are critical in determining economic and political developments (Acemoglu et al., 2003; Acemoglu et al., 2005). For instance, a country with weak and unstable institutions will not attract the required capital for production and export (Bankole et al., 2015; Gyimah-Brempong, 2002; Gyimah-Brempong et al., 2006), and this may negatively impact economic development. Finally, our findings supported the assumption that institutional quality is positively associated with economic development. This is affirmed by previous studies (Butkiewicz & Yanikkaya, 2006; Nawaz et al., 2014; Valeriani & Peluso, 2011), which found that institutions are the answers to the longstanding questions concerning how economic growth arises. In the following section, we discuss the study's implications and limitations and offer future research directions.

Theoretical and Practical Implications

Our study makes some important theoretical contributions. First, on one hand, existing studies that have linked ICT development and economic development and, on the other hand, e-government and economic development have not considered that the role the quality of a country's institutions could also play in these dichotomies. By introducing the institutional quality component into the discourse, our study has provided more insight that deepens the discussion. Second, this is one of the few studies to examine how a country's three key national-level growth parameters (ICT development, e-government, and institutional quality) impact economic growth.

From a practical standpoint, our study makes two important contributions. First, our study helps practitioners and policymakers understand the effects of the different parameters of ICT development, e-government and institutional quality on economic development. Second, our study suggests that ICT development and e-government will indirectly affect economic development through institutional quality; that is, an increase in the quality of institutions can enhance economic prosperity. Therefore, practitioners and policymakers should make concerted efforts to enhance the quality of institutions.

Conclusions, Limitations, and Future Research

This study seeks to understand the mediating role of institutional quality on the effects of ICT development on economic development versus the mediating role of institutional quality on the effects of e-government development on economic development using cross-country data and an integrated framework. The results show that a country's ICT development is positively related to its economic development, suggesting that a country's ICT development can lead to economic development. Furthermore, the effect of a country's ICT development is not positively associated with the quality of its institutions. However, a country's ICT development is positively associated with its e-government development, and e-government development is positively associated with economic development and institutional quality. Hence, an analysis of ICT development, along with e-government and institutional quality, is imperative to fully appreciate the relationship to economic performance.

The study is, however, limited in the first instance by our use of secondary data obtained from different sources, which results in reliance on the indices as formulated by the reporting agencies. Although primary data could have provided us better control over the definition of the study's variables, it was not feasible for a few researchers to undertake such a large-scale cross-country data collection exercise, considering the limited resources and time. However, these indices have been formulated by reputable and authorized organizations using suitable statistical procedures.

Second, we analyzed data only from the countries commonly available in all the sources. For instance, we could not include some countries because the data was not commonly available in all the sources. Therefore, discarding some of the countries may not make a significant difference in the results because PLS-SEM places minimal restrictions on sample size and residual distributions (Chin, 1998). Future research may focus on extending the study to cover more countries when more data becomes available. Future research may consider extending this study by introducing other variables such as human capital into the model. ■

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Ibrahim Osman Adam, Senior Lecturer and Head of Department, University for Development Studies, Wa Campus, Ghana. ioadam@uds.edu.gh

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Appendix 1: List of Countries

Afghanistan, Bangladesh, Bhutan, Bolivia, Bosnia and Herzegovina, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Republic of the Congo, Republic of Côte d'Ivoire, Djibouti, Dominica, Eritrea, Estonia, Ethiopia, The Gambia, Georgia, Ghana, Grenada, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Kenya, Kiribati, Kyrgyzstan, Lao People's Democratic Republic, Lesotho, Liberia, Republic of Madagascar, Malawi, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Rwanda, Samoa, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sri Lanka, Swaziland, Sudan, Tajikistan, United Republic of Tanzania, Timor-Leste, Togo, Tonga, Tuvalu, Uganda, Uzbekistan, Vanuatu, Vietnam, Yemen, Zambia, Zimbabwe

Appendix 2: Descriptive Statistics and Correlations.

Item	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
Online service component	0.289	0.203	1										
Telecomm. infrastructure component	0.178	0.124	0.566**	1									
Human capital component	0.478	0.184	0.51**	0.66**	1								
Access	3.653	1.53	0.457**	0.85**	0.533**	1							
Use	1.884	1.582	0.429**	0.815**	0.487**	0.94**	1						
Skills	3.869	1.743	0.554**	0.767**	0.759**	0.842**	0.769**	1					
Econ mgmt	3.233	0.644	0.341**	0.107	0.014	0.106	0.006	0.071	1				
Pol for soc inclusion/equity	3.237	0.475	0.455**	0.284**	0.288**	0.244**	0.26**	0.227**	0.602**	1			
Public sector mgmt and inst	3.026	0.461	0.371**	0.323**	0.316**	0.373**	0.369**	0.343**	0.576**	0.789**	1		
Structural policies	3.216	0.5	0.351**	0.321**	0.244**	0.331**	0.265**	0.248**	0.669**	0.72**	0.689**	1	
GNI PC	4,790.78	4,782.39	0.583**	0.867**	0.648**	0.761**	0.729**	0.739**	-0.021	0.117	0.229**	0.143	1

Note: ** $p < 0.1$, * $p < 0.05$.