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Digital government: ICT and public sector management in Africa

Abstract. This study examines the effect of information and communication technologies (ICT) on public sector management in Africa for the period 1995–2015 using panel GMM model and Toda-Yamamoto causality tests. The empirical evidence shows that ICT has a positive and statistically significant effect on public sector management, meaning that an increase in ICT is associated with improved public sector management. There is also a bi-directional causality between ICT and public sector management, suggesting that ICT spurs public sector management which, in turn, spurs ICT even further. The public sector, civil society and international actors therefore have the responsibility to collaborate on developing policies and applications that will maximize the potential of digital government for every level of the public sector in Africa.

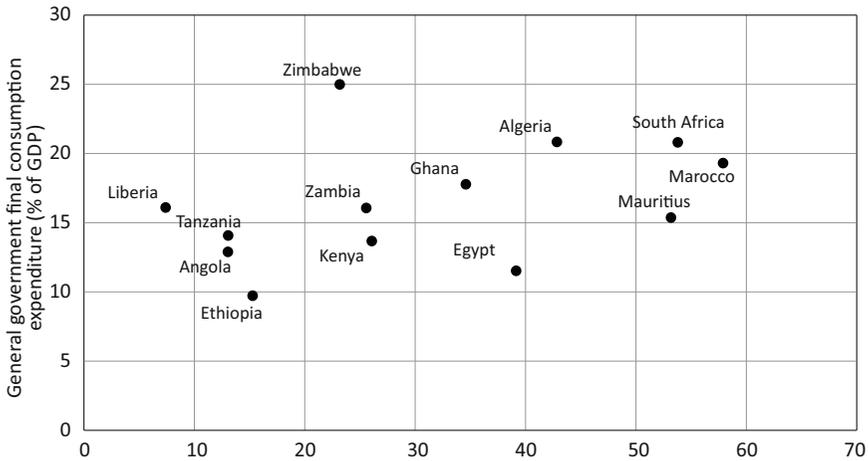
Key words: digital government; ICT; public sector management; public value; e-government

Introduction

What is the effect of information and communication technologies (ICT) on public sector management? The issue of the effect of ICT on public sector management has, over the years, sparked controversies among scholars, policymakers and the media based on varying findings (e.g., Liu and Yuan, 2015; Gil-García et al., 2018). A strand of the literature has suggested that ICT has positive effects on public sector management (e.g. Scupola and Zanfei, 2016; Mimbi and Bankole, 2016). This is buttressed by Figures 1 and 2 which show the correlation of internet usage and mobile penetration with government spending in some selected African countries. Countries with higher internet usage and mobile penetration also have higher government spending

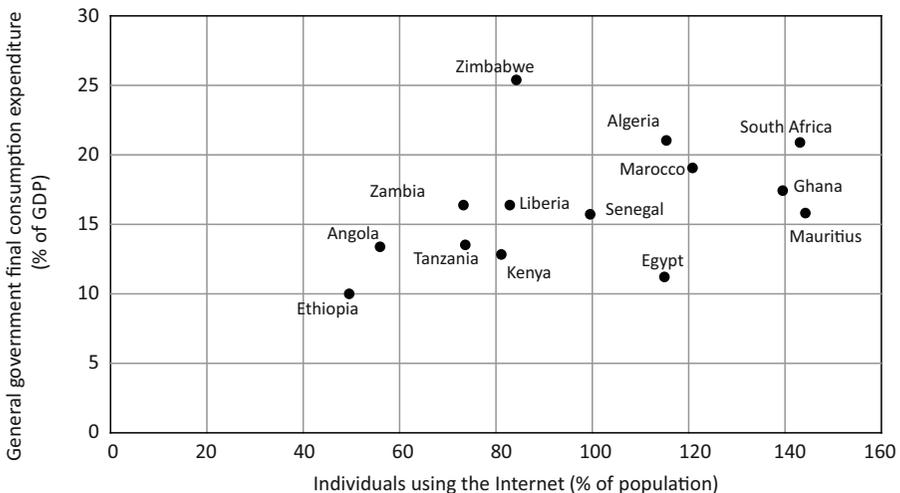
(e.g., Algeria, Mauritius, Morocco, South Africa and Tunisia). Digital government is considered “an essential aspect of innovation, co-production, transparency, and the generation of public value” (Gil-García et al., 2018: 1). However, studies that attempt to understand the role that digital government plays in public management theory and practice are scarce. Moreover, the few studies in the literature are in advanced economies, with little empirical attention to Africa. This study fills the gap.

Figure 1. Internet usage and government spending (2015)



Source: World Bank, 2017.

Figure 2. Mobile penetration and government spending (2015)



Source: World Bank, 2017.

This study deals with a contemporary issue and is of special relevance to Africa, corresponding with a period when almost all governments in African countries have ongoing ICT projects aiming at efficiency of administration and improvement of public sector services (Amegavi et al., 2018; Evans, 2018a; Evans, 2018b; Hwabamungu et al., 2018; Karanja, Sang and Ndirangu, 2018). In many developed countries, within a short period, digital government has evolved rapidly from basic uses of ICT as simple tools to facilitate highly structured administrative work to the integration of ICT throughout government operations. The increasing use of Web 2.0, social media, and mobile and wireless ICT by citizens has greatly influenced the way public services are provided and how citizen engagement processes are delivered (Liu and Yuan, 2015: 140). However, African countries are lagging behind in digital government adoption compared with developed countries. For African countries to successfully adopt ICT, systematic analyses need to be carried out to understand the effect of ICT on public administration. Only when this relationship is clearly understood can innovative ICT be impeccably integrated into African governance structure. Hence, the objective of this paper is to empirically analyze the effect of ICT on public sector management in Africa using the general method of moments (GMM) and Toda-Yamamoto causality approach. The study should be of interest to both researchers and policymakers interested in government information technology implementation, in general, and digital government, in particular.

The rest of the paper is organized as follows: Section 2 presents the theory and review of literature, while Section 3 deals with the data and methodology. Section 4 provides the empirical results while Section 5 discusses the results. Section 6 concludes with policy recommendations.

1. Theory and literature review

Among the theories of information technology, the Technology Acceptance Model (TAM) is one of the most widely used models to describe consumer acceptance of information technology (Adeola and Evans, 2018). TAM has, in recent years, been adapted to study various factors affecting consumers' behavior in the context of health information technology (e.g., Briz-Ponce and García-Peñalvo, 2015; Gao, Li and Luo, 2015; Chen and Lin, 2018; Razmak and Bélanger, 2018). TAM has been constantly and variously expanded, and each of these expansions has been driven by the need to predict the use of new information technology (Venkatesh and Bala, 2008;

Kim and Park, 2012). Combining cultural trends and social context as the key factors, TAM centers on what attributes of a particular technology drive consumers' acceptance of the technology. Therefore, TAM is a useful model for "developing strategies to increase the acceptance of information technology, as it provides a direct relationship between acceptance of the technology, and the technology's perceived usability and ease of use" (Kim and Park, 2012: 2).

An increasing number of studies in the literature have therefore applied TAM to study public sector management or digital government (e.g., Carter and Bélanger, 2005; Lin et al., 2011). For example, Carter and Bélanger (2005) integrate constructs from TAM, Diffusions of Innovation theory and web trust models to study factors that influence citizens' adoption of e-government initiatives. Their findings showed that perceived ease of use, compatibility and trustworthiness are significant predictors of citizens' intention to use a digital government service. Lin et al. (2011) showed how TAM and digital government initiatives positively affect the Gambian government, in spite of the cultural differences within the country. Their study showed that the core constructs of the TAM have strong effects on user-intention towards digital government products. These findings suggest that TAM can be effectively integrated with other theoretical approaches to understand the acceptance of digital government better.

Digital government is the use of electronic communications devices such as computers and the internet to provide public services (Pardo, 2000; Fang, 2002; West, 2005). It refers to the digital interactions of government and between government and the public using a range of ICT. Through the use of ICT as a tool to achieve better governance, digital government encourages citizen engagement and participation in governance (Thomas and Streib, 2003; Chun et al. 2010, Hovy, 2010). Digital government is also referred to as e-government, online government, and internet-based government (Rosenberg, 2018; Wirtz and Daiser, 2018). Through digital government, the government encourage the setting up of websites where citizens can find government information (e.g., regulatory services, public hearing schedules, and issue briefs); two-way communications (between the government and the citizen, a business, or another government agency); transactions (e.g., lodging tax returns, applying for services and grants); and governance (Al-Hujran et al., 2015; Nica and Potcovaru, 2015; Rana and Dwivedi, 2015; Carter et al., 2016).

ICT adoption in public sector management has often been associated with reform programs aimed at reducing inefficiencies generated by bureaucracy (Clegg, 2007). Generally, investments in public sector information systems by governments are associated with organizational transformations

aimed at enhancing efficiency and policy effectiveness (Gil-Garcia and Pardo, 2005; Kamarck, 2007). In this context, ICT in public sector is deployed to enhance organizational efficiency and effectiveness and therefore reduce bureaucracy. ICT is used to coordinate the execution of activities, and hence to deliver public services, with reliance on ICT to increase procedural efficiency. ICT is used to facilitate and support the basic functions of coordination and control of public organizations; functions defined in “the legal-normative set of rules designed to standardize the administrative procedure and the delivery of public services” (Cordella and Tempini, 2015 p. 3).

The issue of the effects of ICT on public sector management has, over the years, sparked controversies among researchers based on varying findings (e.g. Pang et al., 2014; Scupola and Zanfei, 2016; Strielkowski et al., 2017). For example, Strielkowski et al. (2017) applied the multidisciplinary cross-country comparison of Estonia, India and the United Kingdom, analysing the depth of use and the functionality of ICT in the public sector. Their results showed that, if properly implemented and managed, novel ICT might represent a breakthrough in traditional state and municipal management. Scupola and Zanfei (2016) examined the co-evolution of public governance and innovation. Their theoretical and empirical analysis showed that “the transition from a new public management approach towards a networked governance mode implies a greater distribution of knowledge and innovation across different organisational levels within public administrations” (Scupola and Zanfei, 2016: 237). Bannister and Connolly (2014) examined the relationship between ICT, transformative government and such public values. A study of the literature on public values is used to develop a typology of public sector values likely to be affected by ICT. They argued that ICT can and does have transformational impacts on public values, though not always for the better.

In a review of public-value management literature, Pang et al. (2014: 187) argued that the following five organizational capabilities mediate the relationship between IT resources and public value: “public service delivery capability, public engagement capability, co-production capability, resource-building capability, and public-sector innovation capability”. They argued that IT resources in public organizations can help public managers to improve public-value frontiers by nurturing these five organizational capabilities to reduce conflicts among competing values. Criado et al. (2017) examined the factors that make social media successful in Spanish local governments. They showed a direct relationship between organizational, institutional, and environmental factors with the successful use of social media in local public administrations. In a meta-analysis, Karkin et al. (2018: 20) found that ICT-related innovation can promote public values

“mainly through transforming the relationship between government and citizens, improving democratic outcomes such as transparency and public participation, assisting in meeting collective expectations of the public, and enabling knowledge exchange and collaboration across different organizations”.

There is a substantial literature on e-government that discusses ICT as a tool for reducing bureaucracy in government organizations. Some studies have provided a complementary argument, which favored the use of ICT in the public sector to support the operations of bureaucratic organizations. For example, building on the case of the Municipality of Venice, Cordella and Tempini (2015) argued that digital government projects can deliver better services by introducing a new inter-organizational layer of bureaucratic coordination. In other words, ICT can be used to support rather than jettison bureaucracy. Using the concepts of e-bureaucracy and functional simplification and closure, the authors proposed evidence and support for the argument that bureaucracy should be preserved and improved where e-government policies are concerned.

A strand of the literature has emanated from Africa (e.g., Mimbi and Bankole, 2016; Munthali et al., 2018; Evans, 2019). Mimbi and Bankole (2016) examined ICT and public service value creation in Africa. The authors showed that ICT has efficiently transformed public values in Africa. More compelling, they showed that the efficiency of ICT in transforming public values for more than three-quarters of African countries was below fifty percent. Hackney and Tassabehji (2017) found that time and cost benefits are important drivers for an individual's decision to opt for accessing public services online and that citizens are willing to pay a fee to be able to access these services through ICT. Evans (2019) investigated the relationship between internet usage and democracy in Africa. The author showed that internet usage has a significant negative impact on democracy while squared internet usage has a significant positive impact, both in the short- and long-run. The author further provided empirical evidence of a U-shaped pattern and a non-linear relationship between internet usage and democracy, suggesting that as internet usage increases, democracy decreases, but after a certain level of internet usage which is the turning point, democracy starts to increase. There are a few other studies that have considered digital government in Africa (e.g., Bwalya and Mutula, 2016). However, most of the studies are conceptual and micro-based, with little empirical attention to the relationship and the causality between ICT and public sector management. This study fills the gap.

2. Data and methodology

2.1 Data

The annual panel data used in this study covers the period from 1995 to 2016 for 48 African countries.¹ The data on individuals using the internet (% of population), mobile cellular subscriptions (% of population), GDP growth, inflation and general government final consumption expenditure (% of GDP) are sourced from World Bank (2017) database. Data on corruption, government effectiveness, rule of law, regulatory quality, voice and accountability, and political stability and absence of violence are collected from the Economist Intelligence Unit (2016).

The African countries in this study include Algeria, Angola, Botswana, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Republic of the Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.

2.2. Model specification

In line with the theoretical and empirical literature on digital government (e.g., Mimbi and Bankole, 2016; Evans, 2019), the model for this study is given as:

$$Govt_t = \tau_0 + \tau_1 Ict_t + \tau_2 Infl_t + \tau_3 Gro_t + \tau_4 Cor_t + \tau_5 Voa_t + \tau_6 Geff_t + \tau_7 Pols_t + \tau_8 Regq_t + \tau_9 Ict_t \quad (1)$$

where *Govt* is general government final consumption expenditure (% of GDP); *ICT* is information communication technologies; *Infl* is inflation; *Gro* is economic growth; *Cor* is control of corruption; *Geff* is government effectiveness; *Rule* is rule of law; *Regq* is regulatory quality; *Voa* is voice and accountability; and *Pols* is political stability and absence of violence.

ICT is a multi-dimensional concept which no single variable can capture. In this study, therefore, the ICT index (*Ict*) is constructed from the two commonly used ICT indicators in the literature: (i) (ii) log of mobile cellular subscriptions (% of population), and (ii) log of number of internet users

¹ The list of countries is in the appendix.

(% of population). Theoretically, this index of ICT captures most of the information in the original dataset which consists of two ICT indicators. The results from the principal component analysis are shown in Table 1. The eigenvalues show that the first principal component explains the variations better and therefore is the best indicator of ICT in this case. After rescaling, the individual contributions of internet usage and mobile subscriptions are 51.4% and 48.6% respectively. This serves as the basis of weighting to construct the ICT index, denoted as *Ict*.

Table 1. Principal component analysis for the ICT index

	PCA 1	PCA 2
Eigenvalues	2.711	0.134
% of variance	0.958	0.042
Cumulative %	0.958	1.000
Variable	Vector 1	Vector 2
Log of number of Internet users (% of population)	-0.539	-0.113
Log of mobile cellular subscriptions (% of population)	-0.564	0.350

Identification and proxies of the variables are based on the existing literature on the determinants of public value (Afonso, Schuknecht and Tanzi, 2010; Williams and Shearer, 2011; Mimbi and Bankole, 2016; Evans, 2019). GDP per capita and inflation are important economic factors (James et al., 2012; Markusen, 2013). Institutions are also important factors for public value (Bryson, Crosby and Bloomberg, 2014; Mimbi and Bankole, 2016; Evans et al., 2018; Yeager, 2018) as public managers cannot operate in a vacuum, but make decisions within large and complex political and institutional environments.

2.3. Econometric technique

The panel generalized method of moments (GMM) approach is used in this study. Arellano and Bover (1995) and Blundell and Bond (1998) proposed a system GMM estimator which combines differences with the regression in levels and uses the lagged values of the dependent and other explanatory variables as the instruments for the regression in differences and the lagged differences of the explanatory variables as the instruments for the regression in levels. The advantage of the system GMM is that it precludes the problems of heteroscedasticity, autocorrelation, causality inverse and biasedness from omission of explanatory variables.

The Toda-Yamamoto approach to causality technique is used to estimate the causality between ICT and public sector management. The Toda-Yamamoto causality technique is more advanced than other causality techniques such as the conventional Granger causality test (Granger, 1969). The two main advantages of this causality technique are: it is applicable irrespective of the order of integration of underlying variables and irrespective of whether or not the variables are cointegrated (Toda and Yamamoto, 1995).

3. Estimation and empirical results

The GMM estimations are carried out for two sample periods (1995–2015 and 2005–2015) in order to ensure that the results are robust for different periods (Tables 2 and 3). ICT has a positive and statistically significant relationship with government spending, showing that an increase in ICT in the region is associated with improved public sector management. Furthermore, inflation, economic growth, corruption control, government effectiveness, rule of law, voice and accountability, and political stability and absence of violence have significant effects, meaning that political economy and institutions are important for public sector management.

Table 2. GMM estimates (1995–2015). Dependent variable: government spending (*Govt*)

Variable	Coeff.	Std. Error
ICT	10.19*	0.96
Inflation (Infl)	1.18*	0.12
Economic growth (Gro)	3.20*	0.54
Corruption control (Cor)	2.74*	0.47
Voice and accountability (Voa)	5.87**	2.98
Government effectiveness (Geff)	8.74*	2.97
Political stability (Pols)	8.00*	2.53
Regulatory quality (Regq)	-0.66	2.44
Rule of law (Rule)	9.73*	3.44
Adjusted R2	0.74	

Note: *, ** and *** denote the significance level of 1%, 5% and 10% respectively. () denote standard errors and [] denote p-value.

Table 3. GMM estimates (2015–2016). Dependent variable: government spending (*Govt*)

Variable	Coeff.	Std. Error
ICT	9.54*	1.07
Inflation (Infl)	-0.93***	0.58
Economic growth (Gro)	1.19*	0.12
Corruption control (Cor)	3.21*	0.54
Voice and accountability (Voa)	5.57***	3.28
Government effectiveness (Geff)	8.14**	3.30
Political stability (Pols)	8.82*	2.69
Regulatory quality (Regq)	-1.55	2.64
Rule of law (Rule)	8.48**	3.90
Adjusted R2	0.73	

The results of the Toda-Yamamoto causality tests are summarized in Table 4. The empirical results show that there is bi-directional causality between ICT and government spending. This indicates that ICT spurs government spending which, in turn, spurs ICT usage even further in these countries.

Table 4. Toda-Yamamoto causality test results

Direction of Causality	χ^2 -stat
ICT → Govt	10.03*
Govt → ICT	6.40***

Notes: * and *** indicate statistical significance at 1 and 10 percent. The optimal lag length was selected using the Schwarz information criteria.

4. Discussion and implications

The empirical evidence has shown that ICT has a positive and statistically significant effect, meaning that the increase in ICT in the region is associated with improved public sector management. This finding is consistent with previous research on digital government adoption, and provides insights into the way forward for accelerating digital government policy implementation. First, ICT infrastructure is a prerequisite for digital government implementation.

Since ICT is a composite measure of internet and mobile penetration, ICT usage for digital government must embrace not only mobile network coverage or mobile phone subscriptions but also internet technology and web applications.

There is also a bi-directional causality between ICT and public sector management. This indicates that ICT spurs public sector management which, in turn, boosts ICT usage even further in these countries. That is, ICT is a function of public sector management while public sector management is also a function of ICT. This evidence is supported by many studies (e.g., Munthali et al., 2018; Evans, 2019) which suggested that ICT improves public value and public sector management. Generally, investments in public sector information systems by governments are associated with organizational transformations aimed at enhancing efficiency and policy effectiveness (Gil-Garcia and Pardo, 2005; Kamarck, 2007). In this context, ICT in the public sector is deployed to enhance organizational efficiency and effectiveness and therefore reduce bureaucracy.

Another noticeable result is that inflation, economic growth, corruption control, government effectiveness, rule of law, voice and accountability, and political stability and absence of violence have significant effects, meaning that political economy and institutions are important for public value and public sector management. These findings are comparable to studies such as Stea and Harindranath (2006), Bryson et al. (2014), Mimbi and Bankole (2016); Evans et al. (2018), and Yeager (2018). The political economy and institutional considerations play an important role in the underlying rationale for adopting particular policies and practices of digital government. Unique aspects of the culture and background within any given country should be identified and understood as part of the effort to implement digital government (Stea and Harindranath, 2006).

Conclusions

This study has examined the relationship and causality between ICT and public sector management in Africa for the period 1995–2015 using panel GMM model and Toda-Yamamoto causality tests. The empirical evidence has shown that ICT has a positive and statistically significant effect, meaning that an increase in ICT in the region is associated with improved public sector management. There is also a bi-directional causality between ICT and public sector management, suggesting that ICT spurs public sector management

which, in turn, spurs ICT even further in these countries. Furthermore, inflation, economic growth, corruption control, government effectiveness, rule of law, voice and accountability, and political stability and absence of violence has significant effects, meaning that political economy and institutions are important for public value and public sector management.

While the literature has suggested a positive relationship between ICT and public sector management (e.g., Pang et al., 2014; Scupola and Zanfei, 2016; Strielkowski et al., 2017), this study has gone a step further and expanded the literature by empirically examining the relationship and causality between ICT and public sector management. Additionally, the study also provided new insights into the relationship between economic and institutional factors and public sector management. In other words, the study went beyond the inquiry of the relationship between ICT and public sector management and revealed the significance of economic and institutional factors on public sector management. In this manner, the study shows that ICT and economic and institutional factors play significant roles in public sector management.

The findings of this study have several important policy implications for policymakers. The study has shown that ICT has a positive and significant relationship with public sector management. The implication is that, as many African economies begin to tread the path of digital government, ICT should be the building block upon which modern African public sector management is built. Through the combined use of ICT for the creation, development and interlinking of a variety of social, institutional and technological ecologies to deliver public services which are perceived as legitimate, innovative, useful and welfare-enhancing, ICT solutions can enhance the capacity of public managers in Africa. This may further benefit the community by bringing together “the public sector, civil society and international actors, as well as by improving consultation with, and participation by, all spheres of society and achieving a more participatory process of governance and decision-making” (Navarra and Cornford, 2005: 10). In view of this, policymakers and public managers need to pay more attention to ICT trends to ensure that the potential gains are fully maximized. All stakeholders have the responsibility to collaborate to develop policies and applications that will maximize the benefits of ICT at every level of public sector in Africa. Obviously, almost all governments in African countries have ongoing ICT projects aimed at efficiency of administration and improvement of public sector services. ICT infrastructural enhancements aimed at reducing the costs of internet bandwidth will contribute to the speedy implementation of enlarged digital government.

It is important to note that developing digital government in Africa will require huge technical knowledge, experience, and financial investment.

African countries will need to tap into resources and expertise of local, regional, and international participants as stakeholders. Important stakeholders must be involved in the digital government efforts: citizens, professionals, academia, businesses, governments, international agencies, technology developers, suppliers, users, and other decision-makers. Efforts should be made to use ICT as tools for the integration of ICT throughout government operations. Governments should take advantage of the increasing use of Web 2.0, social media, and mobile and wireless ICT to influence the way public services are provided and how citizen engagement processes are delivered.

There is ample room for future studies. Right now, digital government is enmeshed in often vague definitions, conceptualizations, and measurements. In order to make progress, however, public administration scholars and practitioners should address the challenges associated with current definitions, conceptualizations, and measurements, in part through further conceptual refinement, the advance of suitable typologies and measures, and rigorous empirical investigation. Further studies are needed to consider how ICT could be channeled for the real struggles public managers face, especially within different political and cultural contexts in Africa. A good starting point would be to build further research into the extent to which policies and institutional arrangements are better suited to produce a system to enhance participation in digital government and the delivery of new digital government services.

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