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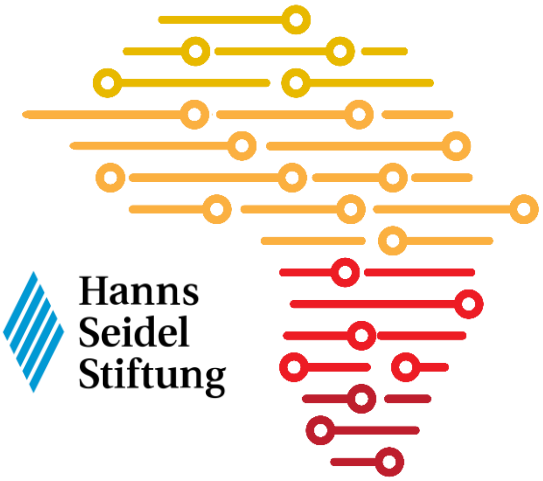
African Governance in the Digital Age



Governance and Africa's financial development amid sustainable digitalisation

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Abstract

The technological revolution presents opportunities for financial development in Africa. However, the opportunities need to be supplemented with good governance to ensure efficiency and optimal welfare gains. It is therefore worth investigating whether governance, as well as digitalisation shocks, are crucial for the relatively underdeveloped nature of the financial system of such countries and regions. This study therefore examines the impact of governance and digitalisation shocks on financial development in Africa. Specifically, the study tests out the triple-helix model on five uniquely selected African regional representative countries, namely Botswana, Democratic Republic of Congo (DRC), Nigeria, Rwanda and Tunisia for robust and comparative policy estimates. Notably, the study utilised data from the World Development Indicators of the World Bank Group (2023). It adopts the Bayesian Vector Auto-Regressive (VAR) empirical modelling to achieve this objective. The technique was utilised after the model stability test was carried out, using the auto-regressive roots test. The

impulse response function across Africa is inferred from the model simulation. The study's findings and recommendations contribute to the literature and economic agents (such as multinationals), empirical evidence of the theoretical reflections of digitalisation and governance on financial development in Africa.

Introduction

Digitalisation refers to "the integration of digital technologies into business processes" (Ku et al., 2020). Hess et al. (2016) note that digitalisation impacts three organisational dimensions: (i) externally concentrating on the digital enhancement of customer experience; (ii) internally impacting business operations, decision-making and organisational structures; (iii) holistically influencing all market divisions and roles, frequently leading to entirely new business models. This implies that digitalisation provides companies with the opportunities to succeed by having the dexterity to respond quickly to developments (Xu et al. 2019). Furthermore, this may be applied as information and communication technology (ICT) being implemented via automated systems for decision-making within the private sector supply chain management; or ICT being applied through the implementation of back-end digital systems; or the digitalisation of paper-based systems.

On one hand, digitalisation is undoubtedly one of the best gifts to human innovation in the 21st century. Evidently in the financial sector, ICT continues to bring about transformation in processes and eases operations. It has established ICT as a catalyst for improvement in the standard of living, quality of life, and consequently, human development. Although developed countries are more advanced in ICT utilisation, the variety of expressions in ICT allow underdeveloped countries to keep up as well. Sub-Saharan African countries take the lead in mobile phone penetration causing an upsurge in mobile money and creating financial access to people who would previously have been regarded as '*unbankable*' (Beecroft et al., 2020; Karakara and Osabuohien, 2019). However, the immense benefits experienced in digitalisation do not necessarily provide insulation from the downsides. Indeed, as ICT becomes more multi-faceted and offers better solutions, the challenges that stem from embracing it also become more complex and challenging. It is of particular importance in the financial sector due to its sensitive nature, and the apparent negative effect that procedural obstructions in this sector could have on the economy and human development. The 2019 Global Risk Report listed monetary loss due to cyber fraud among the disruptive impacts of ICT and as a leading global risk, with the potential for more severe consequences in the future (Collins, 2019).

On the other hand, Stefanski et al. (2012), state that in many ways, good governance – government effectiveness – is at the core of financial development. Elikplimi et al., (2016) further posit that the effect of governance on financial development differs from country to country, and is influenced by political stability and their ability to control corruption. Scholars also seem to agree that corruption in African societies is a significant detriment to financial development (Kurul and Yalta, 2017). However, the challenges policymakers and finance hub regulators face, determine where to draw the line between healthy innovation, and sanction ethical behaviour that is driven by competition (Macmillan, 2016).

The importance of financial system development for equitable economic growth is well acknowledged (Park and Mercado, 2015). This is because the financial sector, whether directly or indirectly, contributes favourably to the growth of an economy. Basic strategies for a successful government are set up to boost savings, investment and income, and the importance of a functioning financial sector in this respect cannot be overstated (Muye and Muye, 2017). According to the World Bank (2016), the financial sector promotes economic growth through technological progress and capital accumulation by mobilising savings, encouraging the inflow of foreign capital, providing information on viable investments and optimising capital allocation. Financial development can also reduce the volatility of the economy by providing a variety of instruments and information to help households and firms cope with adverse shocks through consumption and investment smoothing. The International Monetary Fund (2015) also reveals that the variety of instruments used by the financial sector reduces economic volatility through consumption and investment smoothing. As a result of the benefits identified, countries whose financial sector are well developed tend to grow faster in the long run (World Bank, 2016).

Decades ago, Africa's financial sector used to be relatively underinvested and unexplored (Lamikanra, 2015) and financial services in Africa have achieved remarkable success. In recent years, African policymakers have made significant progress in transforming the sector to reach its highest potential. Currently, the sector continues to transform the lives of many of its populace through the provision of employment to a wide range of people. It has facilitated credit access and facilities for small to medium enterprises (SMEs) and has enabled the ease

of monetary transactions, thereby promoting trade and commerce. There is, therefore, no refuting that the financial sector in Africa has played a pivotal role in reducing poverty.

However, despite the laudable achievement of the sector, coupled with a series of economic reforms, many of the emerging economies in Africa are yet to witness the kind of financial development that has taken place in the developed world. According to the World Economic Forum (2016), most countries in Africa are still lagging in terms of banking and insurance products and sustainable financial standards. Due to the underdeveloped nature of most African countries, they have been found to be more vulnerable to financial shocks.

The relatively low financial development performance in Africa may discourage international investors from considering African countries with regard to capital investment inflow, especially because there would be other countries in other world regions that have economically-friendly and financially developed economies. Financially underdeveloped countries tend to risk being financially inefficient and risk achieving most of the sustainable development goals (SDGs). The failure of African countries to achieve the SDGs would imply retrogression in the level of development compared to the other regions across the world. These issues highlight the need for the governments of African countries to intervene and take deliberate steps to address financial underdevelopment in the African region.

Overall, as ICT progresses, it creates more opportunities for financial development, curbs poverty and leads to development. At the same time, these advancements open avenues for financial fraud and monetary loss, both publicly and privately. However, rather than celebrate its benefits alone, it is vital to employ strategies to meet the growing complexities of the negative consequences embedded in the use of ICT for financial processes. Good governance, which is expressed as government's effectiveness in its responsibilities, is needed to guide these strategies by putting in place appropriate policies to control ICT-related financial transactions. These policies must be developed at a pace that matches the dynamic nature of technological innovations. This paper examines the impact of good governance and digitalisation on financial development in Africa.

Without functional legal sanctions, the possibility of ending financial corruption would be a daunting task. This is because these laws are necessary to discourage intending perpetrators, frustrate ongoing efforts towards financial fraud, and bring those who are caught in the act to book. This is where governance comes in, since a favourable political and legal environment cause innovation for technological advancement to thrive (Zenello et al., 2015). In the same vein, the rule of law and government effectiveness in implementing the law would set the tone to combat financial fraud and lead to financial development.

The research question being addressed by the study is: to what extent does the impact of governance shocks impact financial development in Africa? Moreover, what is the extent of digitalisation shocks on financial development in Africa? These objectives motivate this study to examine how governance shocks affect financial development in Africa. Notably, this study extends a study by Ejemeyovwi et al. (2021), which explored the impact of the digital economy on financial development in Africa.

The current study differs by further selecting five strategic countries to test out the hypotheses posited above. To address this research question, the study is structured as follows: in the next section, a literature review is carried out to provide a thorough understanding of the related research and identify knowledge gaps, thereby making a significant contribution to the knowledge base. The following section discusses the methodology used to achieve the study's objectives. The fourth section presents the empirical results and discussions, while section five presents a summary, recommendations and suggestions for further studies.

Literature review

The impact of governance on financial development in the literature has varied over time (Anayiotos and Toroyan, 2009). The governance structures of a country determine the interaction between political, social and economic elements. As such, particular attention should be placed on improving governance related to financial sector development by ensuring access to information and by adequately protecting contracts and property rights. Effiong (2016) declares that the outcome of an empirical analysis on the effect of governance

and financial development would depend on what governance factors are employed in the empirical model. This statement was corroborated by Kurul and Yalta (2017) who assert that not all aspects of governance quality could affect development variables.

Evidence from the literature on financial development primarily focused on its contribution to economic growth (Okafor et al., 2016; and Tayssir and Feryel, 2018) and trade flows (Osabuohien et al., 2017) without much emphasis on the determinants of financial development (Trinugroho et al., 2015, Osuagwu and Nwokoma, 2017). These studies establish the importance of financial development in achieving trade flows, economic growth and inclusive growth, for both advanced and emerging economies. This is a truism. Furthermore, the literature on financial development focused on more specific determinants of financial development including aspects of governance such as creditor rights protection (Adeleye et al., 2017; Farla, 2014), information sharing and financial deepening (Sahay et al., 2015).

The role of ICT adoption on financial deepening (Asongu and Nwachukwu, 2017; Chithralega and Varalakshmi, 2016) which all missed out the existence of governance shocks and its relationship as a significant macro- and micro-determinant of financial development. Farla (2014) investigates the extent to which governance characteristics are related to countries' level of financial deepening (credit depth). The study utilised a panel date for 81 countries (1994–2005). The variables utilised were property rights, contracting and competition institutions (sourced from institutional profiles databases) and private sector credit. Other variables used were malaria, temperate zone, religion, external debt, savings, inflation, exchange rate, contract and composite. Descriptive analysis was carried out using tools such as scatter plots, percentages and so on. In contrast, the econometric analysis used the Hausman-Taylor estimator with Amemiya-MaCurdy (AM) method which seeks to control for endogeneity of the governance indicators, unlike the Ordinary Least Squares (OLS) with panel-corrected standard errors (PCSE) and fixed effects vector decomposition (FEVD) methods. The findings suggest that the development of formal property rights, competition, and contracting institutions had a positive relationship with private sector credit ratio to gross domestic product (GDP). The study did not consider the addition of information and communication technology.

Yongfu (2010) examines the relationship between political governance and the supply side financial development, using 90 developed and developing countries. The study uses dynamic panel data to look at the impact of the democratic process on financial development in a broader sense. The study initially carried out a before-and-after event comparison to study the most crucial governance change (autocratic to a democratic regime change). Furthermore, it carries out econometric analysis by comparing the estimates of the bias-corrected least squares dummy variable (LSDV) estimator with the system generalised method of moments (GMM) estimator. Three variables were used to capture financial development: liquid liabilities, private credit, commercial-central bank. The study reports a positive feedback effect and interaction effects between economic and political liberalisation. Furthermore, the findings suggest that governance reform within an open economic environment exerts an additional impetus on investment, economic growth and financial development. The study did not take into account that the 90 countries achieved improved governance at different times in history, thus the use of the panel data for analyses will provide an average estimate, which may not apply to some of the selected countries.

The findings by Asongu and Nwachukwu (2017) show that the interaction between ICT and financial formalisation (bank deposits/money supply) decreases financial activity and financial informalisation (financial deposits – bank deposits/ money supply) increases financial activities. Despite the adverse marginal effects of financial informalisation, the overall net effect is positive. The study further discusses implications for mobile/internet banking, implications for a quiet life as found in Asongu and Odhiambo (2019c), and the implications for ICT in reducing information asymmetry and surplus liquidity.

Avgerou (2010) noted that, while it was commendable that research into the potential for ICT to effect change in socio-economic processes was being conducted, it is also essential to establish the process or variables through which ICT performs this function. Oluwatobi (2014) noted that an enabled governance environment is a requirement for innovation and making productive contributions to economies. Institutions influence ICT adoption by instilling a sense of security and confidence among African citizens, which encourages them to embrace ICT adoption and innovative products, ultimately enhancing financial development. An

enabling governance environment (knowledge economy element) is required theoretically to enable financial development and to maximise the benefits for financial development.

In line with the concept of digitalisation, Ejemeyovwi et al. (2021) examine the interaction of ICT adoption and innovation, and the role that digitalisation interaction has on financial development in Africa and the five sub-regions. The study highlighted the importance of the interdependency between ICT and innovation with the digital economy matrix. The study also utilised Bayesian Vector Auto-Regressive modelling to ascertain the impact of shocks from digitalisation on financial development in Africa and its regions, further emphasising the importance of digitalisation (ICT-innovation interaction) on financial development in Africa – a model that is lacking in Africa.

There have been attempts on the empirical linkages between digital economy elements in literature, however, the connection between elements such as ICT-innovation interaction, institution and financial development in Africa is yet to be empirically established. This points to the fact that a digitalisation-driven economy may influence financial development. The current study thus builds on 'ICT-innovation interaction' – digitalisation introduced by Ejemeyovwi et al. (2021) and further explores how shocks to this digitalisation would impact financial development in Africa as an omitted determinant in literature.

Methodology

Data, variables, measurement and sources

To achieve the study's objective, five data sets are utilised. The data sets comprise five selected regional representatives – Tunisia, Nigeria, Rwanda, Democratic Republic of Congo (DRC), Rwanda and Botswana, representing the five sub-regions in Africa. The choice of selection of the representative countries for the specific approach is intuitive with regard to the characteristics of relatively high ICT adoption, as well as relatively low financial development.

Botswana and Tunisia represent special cases and were selected uniquely despite their financial development averages being above the African average (20%). These two countries

were added to test out the hypotheses in a slightly different scenario for a robust and comparative analysis and discussion.

The study used annual time-series data, sourced from the World Bank, that was converted to quarterly data by the authors to allow for the data to be approximately normal. This is one of the major requirements for carrying out time-series analysis in line with the central limit theorem/law of large numbers (Kwak and Kim, 2017). By implication, the conversion of the time-series data for each country will allow the number of observations to be sufficient enough (from about 20 observations per variable to about 80) to carry out the analysis. Notably, the selected time period (2000Q1 to 2019Q4) was informed by (i) a paucity of data; (ii) the fact that this period witnessed the introduction, commercialisation of ICT and ICT sector deregulation in most African countries such as Nigeria, various financial sector reforms in Africa and, similarly, a significant increase in research and development in Africa. The significant performance informed the choice of selected countries in terms of their financial development, as well as their innovation, ICT adoption and institutional development among their sub-regional counterparts considered sufficient to analyse the dynamic nature of the regions. Furthermore, the selected period was informed by harmony in data availability.

Notably, owing to the relatively small time-series data for the selected regional representatives, the study resorts to converting the annual time-series data to quarterly data for the data sets to be of normal distribution and to prevent over-parameterisation, to ensure reliability of the results. However, one of the limitations of converting annual data to quarterly data is that the converted data does not guarantee more information about the variables, but it increases the degree of freedom. Another limitation of the conversion is that converted data is usually assumed to be linear for a more sensible and smoothed result. The statistical process of conversion is done using E-views 10 software.

This study utilises a financial development index as a holistic measure of financial development. This distinguishes the study from other studies that emphasised the use of popular contemporary measures, such as a segment of financial development – for example, financial depth (measured by domestic credit to ratio to the private sector) to measure financial development as found in Osabuohien et al. (2017). However, in line with Yongfu

(2010), governance in this study is captured by government effectiveness as sourced from the World Bank's world Governance Indicators. A disaggregated financial sector development segment is also dominant in literature and can be discouraging, as seen in Yongfu (2010). The study acknowledges that there is no single universally agreed measure of financial development and therefore derives a composite index using the principal component analysis (PCA).

The various proxies of financial development in the literature show the level of credit availability, which strongly and directly influences availability, stability, liquidity, solvency, efficiency and economic activities. However, it is worth noting the inadequacy of these proxies.

This study therefore aligns with the school of thought that advocates for the use of principal component analysis (PCA) to derive a composite index that captures the various segments of financial development as argued in the literature holistically. The need for PCA to derive a financial development index is justifiable because of the various aspects of financial development. Using one facet of the financial sector to represent the whole sector could lead to misleading results and inaccurate policy estimates. However, if faced with budget constraints and competing alternatives, a policymaker may not know which dimension to prioritise, other than using factor analysis that informs the strongest components in the index percentage.

PCAs are typically done using either macroeconomic or microeconomic financial indicators (Adeleye et al., 2017), however, this study utilises macroeconomic indicators due to the paucity of data and because the scope of the study requires macroeconomic indicators. The variables utilised include: private sector credit to GDP (financial depth); depositors with commercial bank (financial access); private domestic credit from financial institutions (financial activity); deposit money bank assets on Central Bank assets (financial size); Banks Z Score (financial stability); and Bank credit to bank deposit (financial efficiency). Table 1 describes the variables used in the study.

Table 1: Description of variables and data sources

S/N	Variable	Measurement	Data Source
1.	Financial development (FD)	Composite Index	Author's Computation
1a.	Financial depth: Private sector credit to GDP ratio	Percentage of GDP	World Bank Group, 2023
1b.	Financial access: Depositors with commercial bank	Per 1000 people	World Bank Group, 2023
1c.	Financial activity: Private domestic credit from financial institutions	Percentage of GDP	World Bank Group, 2023
1d.	Financial size: Deposit money bank assets on Central Bank assets.	Percentage	World Bank Group, 2023
1e.	Financial stability: Banks Z Score	Index	World Bank Group, 2023
1f.	Financial efficiency: Bank credit to bank deposit	Percentage	World Bank Group, 2023
2.	Number of internet users	Per 100 people	World Bank Group, 2023
3.	Innovation (INN)	Unit	World Bank Group, 2023
4.	Digitalisation: ICT – innovation interaction (ICTIN)	Unit	Authors' computation
5.	Governance: government effectiveness	Index	World Bank, 2020
6.	Gross domestic product growth rate (GDPR)	Percentage	World Bank, 2020

Theoretical framework

Triple helix model

The triple helix model of innovation is a theory that posits that development can be fostered by the knowledge economy, which constitutes three sectors which interact with each other: universities, industries and government. The theory, formulated by Etzkowitz (1940) and revised by Etzkowitz and Leydesdorff (1997), posits that the role of universities is to provide education to individuals and essential research innovations for industries. Industries are expected to build on the innovations of the universities to produce commercial goods and render services. The government, in turn, is expected to provide funding as well as regulations through intellectual property law and its enforcement.

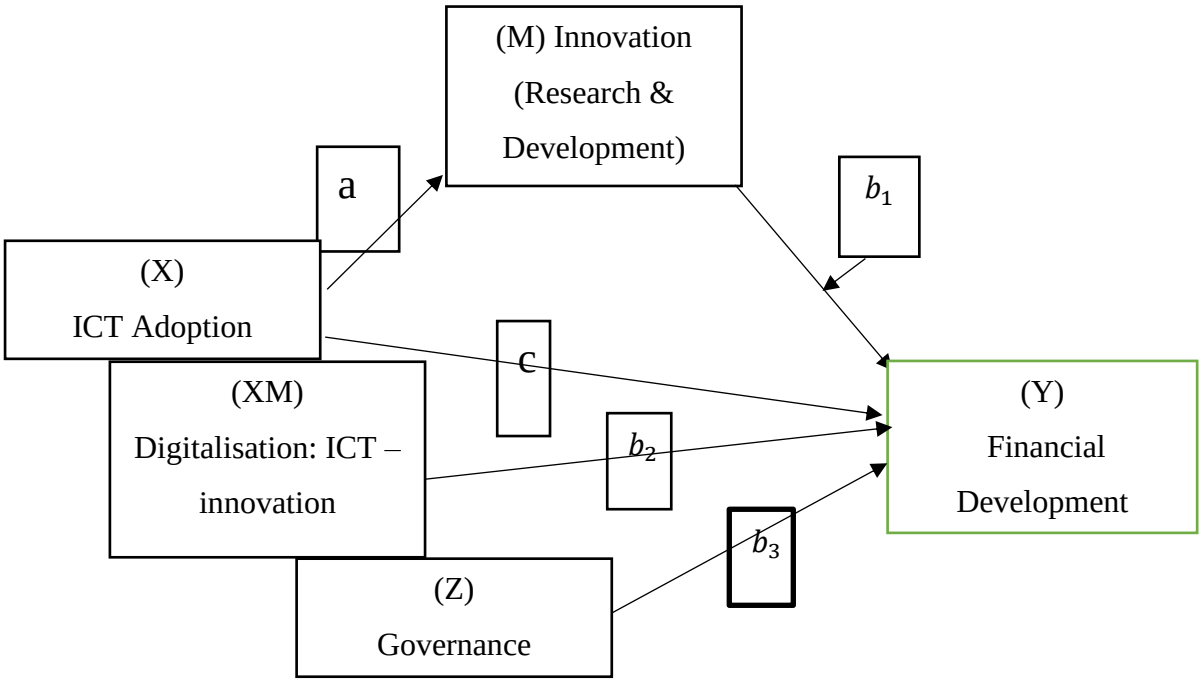
The empirical model

In line with this the theoretical framework of this study, and the operationalisation of the empirical models of Asongu et al. (2017) and Yongfu (2010), this research formulates a model that, significantly, introduces digitalisation, expressed as the ICT-innovation interaction variable to encapsulate digitalisation and government effectiveness to represent institutions as determinants of financial development. This extension is in line with Ejemeyovwi et al. (2021).

The digital economy - governance - financial development model in Figure 3.1 is based on the proposition that ICT adoption needs to interact with innovation (digitalisation) amid good governance, to affect financial development. This implies that among the conditions necessary for financial development to occur, the interaction of ICT adoption with innovation (digital economy) and institutions, needs to be improved somewhat.

The moderation model allows *X* to moderate its own indirect effect on *Y* by *X* as in Figure 1. In equation form, an independent variable is the moderator, and the indirect effect of *X* on *Y* through *M* is the product of the effect of *X* on M from equation 3.1. It quantifies the relationship between *X* and the indirect effect of *X* on *Y* through *M*. *X* is functioning as a linear moderator of its own indirect effect. *Z* in contrast creates an enabling environment for the moderation of ICT and innovation.

Figure 1: Digitalisation – governance – financial development model



The study adopts the linear explicit functional form given that the characteristics of the empirical model follow the major assumption of the fixed proportion (Leontief production function) compared to the non-linear production function adopted by most empirical studies.

The fixed proportion production function assumes that there is no substitutability between factors. Therefore, if usage of one input is increased without a corresponding increase in another, the output will not change. This implies that the determinants in the model must be simultaneously improved upon. Applying this assumption to the context of this study suggests that digitalisation and governance need to increase simultaneously and significantly. In other words, they should be complementary, and one should not be substituted for the other, to successfully drive financial development in Africa.

The empirical model is expressed as follows:

$$\mathrm{FD_{it}} = \beta_0 + \beta_1\,\mathrm{ICTIN_t} + \beta_2\mathrm{GOV_t} + \beta_3\mathrm{GDPR_t} \quad (3.1)$$

Where *FD* represents financial development; *ICTIN* represents Information and communication technology-innovation interaction, which captures digitalisation; *GOV* represents governance, captured by government effectiveness; *GDPGR* represents the gross

domestic product growth rate. Notably, governance is captured by an institutional variable called government effectiveness; the effectiveness of government in carrying out its responsibility measure indicates the nature of the political economy. Importantly, in the empirical model, the study drops the individual values of innovation and ICT adoption to reduce the possibility of multicollinearity in the model. The values are also dropped because the focus of the study is not to find the marginal and net effects. It is worth noting that for the hypothesis testing, digitalisation and governance are shocked in the BVAR model to reveal the outcome on financial development, in line with the objective of this paper.

The estimation technique

The study utilises the impulse response function (IRF) of the BVAR framework to estimate the model parameters and further test the hypotheses. The BVAR is vital in explaining, with forecast accuracy, the effects of political economy shocks on financial development in Africa (Osabuohien et al., 2021). The study utilises the impulse response function (IRF) of the BVAR to estimate the model parameters and further test the hypotheses. The BVAR is vital in explaining, with forecast accuracy, the effects of governance and digitalisation shocks on financial development in Africa.

Notably, the Litterman (1980) working paper prior to the Bayesian VAR framework is utilised by the study, based on statistical characteristics such as the non-stationarity trend regularly observed among time-series data, the observation that more recent values of a series contain far more information on the current value than past values of the series, and the past values of a given variable have more information on its current state that past values of other variables (Osabuohien., 2021). The BVAR framework is necessary to generate the impulse response function (IRF) and variance decomposition (VD) for the imposed shocks included in the model. The IRF and VD produce the estimates of the shock impact across the selected countries for the selected time period. Furthermore, the IRF simulates the effect of a shock to one variable in the system on the conditional forecast of another variable (Adediran, 2018).

Impulse response functions are essential in studying the interactions between variables in a VAR model and clearly show the reactions of variables to shocks in the model. The impulse

response function takes into account how the dependent variables in a VAR system respond to the shocks of each of the explanatory variables. Notably, if there are 'n' variables in the system, then 'n' impulses can be generated. The impulses generated are derived by expressing the VAR model as a vector moving average, and for this study, the utilised impulse definition is the generalised impulse due to the invariable nature of the IRF despite the variable ordering. Notably, the variables' variations in VAR models are accounted for by their lags, and coefficients, other than the dependent ones, are assigned smaller relative variance. Additionally, the variance-covariance matrix of the error term is assumed to be fixed and known.

Results and discussion

The analysis commences with the BVAR auto-regressive root test, a test used to determine if the data is stable enough to be utilised in the BVAR analysis. Notably, the BVAR model roots lie within the unit, as shown in Appendix A.

Ascertaining the impact of governance shocks on financial development in Africa

Governance in this study, measured by government effectiveness, indicates the ability of the government to carry out its responsibility and, in this case, tackle the issues of ICT adoption for financial development. With regard to the analysis of how financial deviation responds to a governance shock, Table 2 shows the IRF results for the selected countries representing each African region. The trend is also reflected in the IRF graph in the Appendix A.

Table 2: Response of financial development to governance shocks in African countries

Period	Botswana (SAC)	Democratic Republic of Congo (CAC)	Nigeria (WAC)	Rwanda (EAC)	Tunisia (NAC)
1	-0.000551	0.001188	-0.015493	-0.000915	0.010592
2	-0.001061	0.000823	-0.006286	-0.000500	0.003848
3	-0.000806	0.000161	-0.002365	-0.000157	0.001533
4	-0.000520	0.00004	-0.000829	-0.000003	0.000682
5	-0.000322	0.0000127	-0.000258	-.0000004	0.000337
6	-0.000198	0.0000035	-0.000006	0.0000003	0.000184
7	-0.000123	0.00000096	-0.0000002	0.0000003	0.000108
8	-0.000007	0.00000026	0.000001	0.0000002	0.000006

Mixed effects were observed in the empirical test of governance shocks in the selected countries. Table 2 shows us that three out of five sample data sets reported a positive impact, while two countries reported negative effects. The countries that showed a positive influence in alignment with a priori expectations were Botswana, Nigeria and Rwanda. The DRC and Tunisia reflected a negative impact that was not in line with a priori expectations.

The negative effects seen in the DRC and Tunisia may be strongly influenced by the individual values of the countries within that region. African countries are known for their relatively weak political institutions, and this may have shaped the outcome. Some African countries are characterised by political leaders and government officials who are interested in their own gains rather than in the public interest. This leads to ineffectiveness, which will negatively influence financial development values.

In Botswana, as seen in Table 2 (Column 2), financial development responds rapidly to a one standard deviation governance shock negatively from the first time period to the second time period. However, between about the second time period and the eighth, the response became positive. For DRC, as shown in Table 2 (Column 3), financial development responds to a one standard deviation governance shock negatively from the first time period to the last time period, having an overall negative impact. This implies that in DRC, far more than

governance shocks is required for it to have a positive impact on financial development. For Nigeria, as indicated in Table 2 (Column 4), financial development responds increasingly positively to a one standard deviation shock in institutions from the first to the second period. From about the third to the eighth period, the response continued to increase but at a slower rate.

For Rwanda, as seen in Table 2 (Column 5), financial development responds to a one standard deviation governance shock positively from the first period to the third-year period at an increasing rate. From around the third to the eighth period, the rate of increase diminished and remained almost constant with infinitesimal changes. In essence, the potential for financial development as a result of governance shocks is fast and on the whole impressive, in Rwanda. In Tunisia, as evidenced in Table 2 (Column 6), financial development responds to a one standard deviation governance shock negatively from the first period to the second period at an increasing rate. From about the third to the eighth period the response declined further, but at a slower rate. This means that significant improvement in governance development is required in Tunisia before it can drive financial development.

Ascertaining the impact of digitalisation shocks on financial development in Africa

Table 3 shows the impulse response function (IRF) results for the selected countries' data sets representing each African region. The trend is also shown clearly in the IRF graph in Appendix B.

Table 3: Response of financial development to digitalisation in African countries

Period	Botswana (SAC)	Democratic Republic of Congo (CAC)	Nigeria (WAC)	Rwanda (EAC)	Tunisia (NAC)
1	-0.032434	0.009370	-0.011556	-0.001075	-0.001468
2	0.000488	0.000624	-0.005285	-0.000976	-0.000469
3	0.000021	0,00008	-0.002321	-0.000269	-0.000314
4	-0.0000002	0.000008	-0.000997	-0.000012	-0.000250
5	0.0000002	0.0000009	-0.000417	0.000047	-0.000184
6	0.000000001	0.00000009	-0.000169	0.000047	-0.000129
7	0.000000007	0.000000009	-0.000065	0.000033	-0.000087
8	0.00000000003	0.000000009	-0.000024	0.000022	-0.000059

For the digitalisation shocks hypothesis, among the five country representatives, DRC, the selected central African country, reported a negative impact of digitalisation shock on financial development, which negates the a priori expectation. This is shown in Table 3 Probable factors contributing to this situation may include the ongoing political crises in the country due to civil rights activism and war in the country, as well as its unstable financial and economic system. These conditions could cause unusual and irregular economic variable behaviour, which could explain why this study's empirical findings may not be applicable to the reality in DRC.

For Botswana, as seen in Table 3 (Column 2), financial development responds to a one standard deviation shock from digitalisation positively from the first period to the third year, at an increasing rate. Notably, from about the third year to the eighth, the response remained almost constant with infinitesimal changes. This indicates that in response to a digitalisation shock, financial development in Botswana is expected to show immediate positive results, with little time required for the development to be fully realised. For DRC, as reflected in Table 3 (Column 3), financial development responds increasingly negatively to a one standard deviation shock from digitalisation from the first period to the second period. This suggests that financial development in DRC may respond rapidly to digitalisation shock, but at a

negative rate. This further shows that there is substantial and considerable potential to increase financial development in Central Africa.

In Nigeria, Rwanda and Tunisia, the potential for financial development as a result of digitalisation is rapid and impressive. For Nigeria, as seen in Table 3 (Column 4), financial development responds to one standard deviation shock in digitalisation positively from the first period to the fourth period at an increasing rate. From about the fifth to the eighth period, the response remained almost constant with infinitesimal changes similar to that of Tunisia. For Rwanda, as seen in Table 3 (Column 5), financial development responds to one standard deviation shock from digitalisation positively from the first period to the third-year period at an increasing rate. From about the third period to the eighth period, the rate of increase declined and remained almost constant, with infinitesimal changes. For Tunisia, as shown in Table 3 (Column 6), financial development responds to a one standard deviation shock from digitalisation positively from the first to the second period at an increasing rate and, from about the third to the eighth period, the rate of increase remained almost constant with infinitesimal changes. This is similar to the pattern observed in the finding for Africa, shown in Ejemeyovwi et al. (2021). Furthermore, after the third time period, there is a strong tendency for the impressive financial development to be maintained over time.

Discussion and implication of findings

A shock to digitalisation implies a significant positive increase in the interaction between ICT and innovation for the purpose of addressing issues in the financial sector. Usually, in Africa, financial issues by the bank and non-bank financial institutions are addressed endogenously. However, this study, in line with the triple helix theory proposes a model that will encourage the issues to be handled exogenously – the interaction between the financial institutions and academia, representing the financial industry and institutions of research/universities.

On another note, governance shock relates to the significant improvement in the regulatory framework, management, and supervision of the financial sector. In other words, the financial sector policies should be proactive, current with the state-of-the-art security and officials, and the financial instruments should be well-managed to build trust in the financial system – to ensure an enabling environment for the smooth running of the financial system. This is

important because the introduction of ICT and digitalisation into the financial sector has led to a great deal of development in the financial sector. There are, however, digital threats and issues to be addressed that require competent and efficient regulators.

Governance development (government effectiveness in this case) generates a chain reaction that starts with the building of reliability (trust) in the economic system and, more specifically, the financial sector of an economy. The conducive environment being created encourages financial investment inflows from foreign economies to the domestic economy through foreign direct investment and foreign portfolio investment. This drives up the financial sector capital base which, in turn, has a direct impact on the financial sector access, financial size, financial stability, financial depth, financial activity and financial efficiency of an economy.

Governance development enables reliability in the use of technologies from ICT-innovation interaction, thereby supplementing the effect of ICT-innovation interaction on financial development in an economy. Reliability in the efficacy and efficiency of technologies is built: (i) when state-of-the-art security features are embedded in the technologies from ICT-innovation interaction and (ii) when, over time, the labour force observes the timely and successful investigation and prosecution of cyber-criminals, and issues with the parties involved are resolved amicably. This may help to ensure financial efficiency and reduce the impunity of the negative-minded labour market participants in the financial sector, ensuring financial development.

Revisiting the governance/regulatory framework of financial development in Africa is crucial as the financial and governance environment of an economy either significantly encourage or discourage international and multilateral organisations in offering development assistance and corporate social responsibility programmes. International organisations are expected to take the lead by having best practices in digitalisation and improve their international reputation.

Taking the lead could involve full compliance with state-of-the-art ICT and good governance. International and multilateral organisations, in turn, can significantly impact Africa's governance and financial development by emphasising the need for transparency in the

financial sector and governance as a whole, and by ensuring transparency in business operations. In so doing, these organisations can serve as role models of effective governance and financial development.

Conclusion

This study investigates the impact of governance and digitalisation shocks on financial development in Africa using the Bayesian Vector Auto-Regressive (BVAR) estimation technique. The study extends a study by Ejemeyovwi et al. (2021) by selecting five country representatives: Botswana, Democratic Republic of Congo (DRC), Nigeria, Rwanda and Tunisia to test out a version of the triple helix model to drive financial development. The study's empirical analysis of governance shocks in the selected countries finds that three of the five sample data sets showed a positive impact, whereas two countries – DRC and Tunisia – demonstrated negative effects.

With regard to the hypothesis on digitalisation shocks and their impact on financial development, the study finds that, with the exception of DRC, four of the five countries show a positive impact. The study provides possible explanations for these findings.

The study concludes that for Africa, governance (government effectiveness) shock positively explains significant variations in financial development, implying that the development of good governance is vital in ensuring better financial development amid digitalisation in Africa. This finding indicates that African countries have a chance of achieving SDG Goal 9 concerning industry, innovation and infrastructure development in 2030 through digitalisation and good governance. As a result, the study recommends that for countries with positive impacts, better governance (government effectiveness) and digitalisation should be used as effective tools to drive financial development. Therefore, government law enforcement responsibilities should be treated seriously to advance financial development. In addition, it is suggested that future studies conduct further research on auditing ICT deployment regulations and a robust legal framework in the financial industry.

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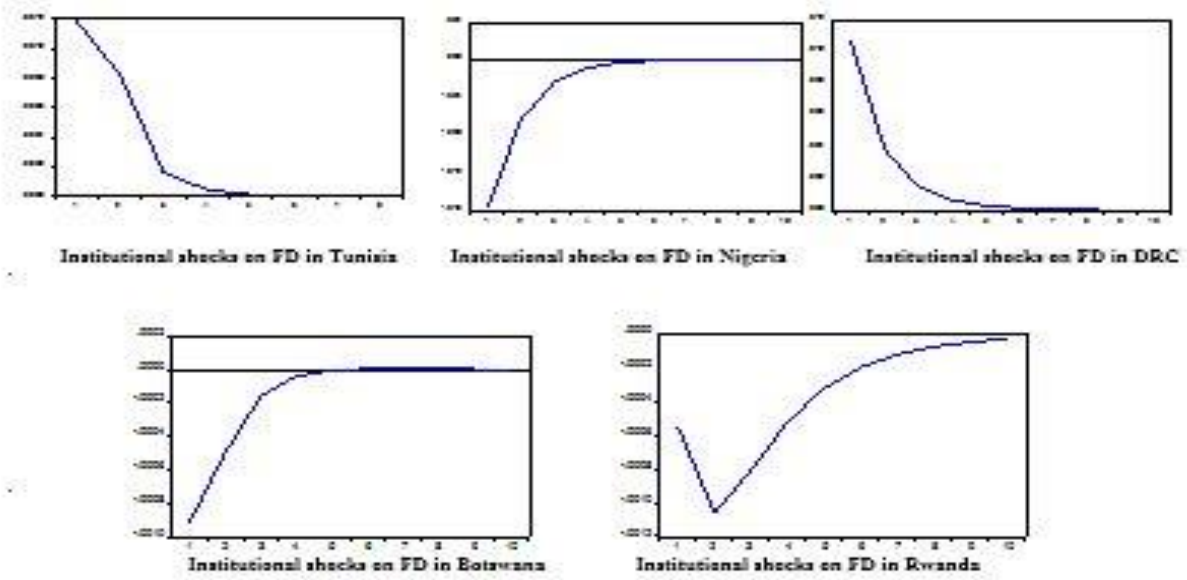
Appendices

Appendix A: Impulse response function (IRF) of governance shocks on financial development



Appendix B: Impulse Response Function (IRF) of digitalisation shocks on financial development

