DIGITAL FINANCE, FINANCIAL INCLUSION AND ECONOMIC GROWTH NEXUS IN COMESA: THE ROLE OF REGULATORY QUALITY, RULE OF LAW AND GOVERNMENT EFFECTIVENESS

[1]CHARLES O. MANASSEH, [2]OGOCHUKWU C. OKANYA, [3]CHINE SP LOGAN, [4]KENECHUKWU E. EDE, [5]EMEKA P. EJIM, [6]STELLA N. OZOR, [7]OGONNE ONUOHA & [8]EBELECHUKWU L. OKICHE

[1]Department of Banking & Finance, University of Nigeria Enugu, Enugu State

[2]Department of Banking & Finance, Institute of Management and Technology, Enugu

[3]Department of Public Policy, Helms School of Government, Liberty University, Lynchburg, VA 24502, US

[4]Department of Economics, University of Nigeria Enugu, Enugu State

[5]Department of Business Admin & Management, Institute of Management and Technology,

[6]Department of Banking & Finance, Institute of Management and Technology, Enugu

[7]School of Social Science & Humanities, Institute of Management and Technology, Enugu

[*8]Department of Jurisprudence & Legal Theory, University of Nigeria, Enugu Campus, Enugu, Nigeria

Corresponding Author: [*]Ebelechukwu Okiche (ebele.okiche@unn.edu.ng)

Abstract

This study examined the roles of digital finance and financial inclusion in the economic growth process of nineteen COMESA member states using annual time series data from 1997 to 2018. Using the panel ARDL framework, the study found that digital finance and financial inclusion are important drivers of growth in the region. Specifically, the results revealed that automated teller machine*, mobile purchase, point of sale and mobile banking, as well as number of deposit accounts with commercial banks per 1,000 adults, number of registered mobile money accounts per 1,000 adults, number of active mobile money agent outlets, digital card ownership and financial literacy are vital predictors of growth. We also found evidence of bidirectional causality between the index of digital finance, financial inclusion and economic growth, suggesting that policy initiatives targeted at promoting digital finance and financial inclusion may boost growth. By controlling for institutional environment and macroeconomic volatility, we found that weak legal environment and macroeconomic volatility can deter growth. The study, therefore, concludes that COMESA region should encourage policies that will promote digital finance and financial inclusion.*

Key words: *Digital Finance; Financial Inclusion; Panel ARDL; Economic Growth*

1. INTRODUCTION

The interconnection between digital finance, financial inclusion and economic growth has attracted the attention of researchers in recent times. Studies (e.g., Shen & Huang, 2016; Michelle, 2016; Ozili, 2018; Haider, 2018; Tabitha & Stella, 2019; Scott et al., 2017; Osafo-Kwaako et al., 2018) have established that digital finance and financial inclusion are relevant in promoting economic growth, and should be encouraged with viable policy support that could inspire the confidence of economic agents. The emergence of digital technologies such as mobile phones, personal computers, internet and automated teller machine (ATM) cards has tremendously improved growth in the financial system of Common Market for Eastern and Southern Africa (COMESA). Evidence has shown that digital finance and financial inclusion have several benefits to financial service users, providers, and governments. Such benefits include increasing easy access to financial services, reduction in cost of financial intermediation, flexibility in e-banking, promoting competition, job creation, reduction in the rate of money laundering and improvement in bank-customer relation, among others (Klapper, El-Zoghbi & Hess, 2016; Martin et al. 2016, Gomber et al. 2017 and Barbesino et al. 2005). This may have contributed to the economic growth of COMESA region due to increasing demand in e-financial services. Across many COMESA member states, evidence has shown that about 19.2% and 31.8% of adults (aged 16 years and above) had acquired bank account in 2011 and 2014, respectively. Mauritius

had the largest number of account at 82.2% while Burundi recorded the lowest with 7.1% of the population that had an account with financial institution, including mobile money (Global Findex, 2015). The improvement in the average number of account owners, functioning ATM machines, bank branches per 100,000 adults, registered mobile money accounts per 1,000 adults, and debit/credit card ownership, among others, has enhanced financial inclusion and digital transactions in COMESA region (World Bank, 2017).

Amidst the overwhelming benefits of digital finance and financial inclusion, it has been argued that digital finance and financial inclusion could impact differently on different groups or regions across the globe. Hence, Beck and Brown (2011) showed that digital finance favor urban households more than their rural counterparts due to their income and wealth differences. By implication, individuals with high income are motivated to participate in digital financial system more than those with low income due to transactions charges, which may not be of much concern to higher income earners, but substantial to low income earners in rural areas. To buttress the point, Ketterer (2017) indicated that digital finance and financial inclusion have not benefited individuals who do not use digital devices for financial transactions. Therefore, digital devices are most likely beneficial to the urban households with higher income than the rural households with low income. In other words, digital financial inclusion tools may have little or no monetary value to people with low income and thus, affect their desire to participate in digital transaction even when they are fully integrated in the digital financial system. On this note, Ketterer (2017) argued the viability of financial technology in poverty reduction, job creation and welfare improvement as corroborated by Kesuh et al. (2020), Raichoudhury (2019), Shofawati (2019), Jong-Hee (2016), Okoye et al. (2017), Nguling'wa (2019), Okafor et al. (2017) and Sharma (2016). These studies indicate that digital finance and financial inclusion promote growth, welfare and poverty reduction. Apart from low income, other challenges confronting digital finance and financial inclusion are cash-based economy, high level of financial illiteracy, and high degree of informal sector in COMESA region (Adam et al., 2010; Scheneider et al., 2010; Dell'Anno et al., 2018). These factors constrain the pace of digital finance and financial inclusion in the region despite the innovations in the financial system.

Despite the inherent challenges of digital financial services, it remains a veritable tool to drive financial development and growth globally. But the fact remains that efficient functioning of e-financial activities is dependent on the cost and quality of digital connectivity available to economic agents (Ketterer, 2017). In Africa, and COMESA region in particular, poor infrastructural development has affected not only quality and cost of accessing digital connectivity needed to ensure that everyone is connected to digital financial services irrespective of their income class, but also the economy in general due to the consequence of huge exposure to cost caused by digital financial services providers with superior technology that operate without rivals (Ketterer, 2017). However, considering the infrastructural and technological deficiencies including the aim to reduce transaction cost, foreign correspondent banking charges, cost of intra-regional trade and its consequences on consumers, there arose a call for economic integration which later resulted in the emergence of COMESA in 1994. One of the main objectives of this economic bloc is to create enabling environment for foreign cross-border and domestic investment in order to secure reliable payment system and infrastructure that can facilitate development of the market system in the region (Thakoor, 2012). For this reason, Regional Payment and Settlement System (REPSS) was introduced to permit member countries to transfer funds more easily within the region and other countries outside the region through their respective central banks with the main purpose of stimulating economic growth via an increased intra-regional trade (Thakoor, 2012). Consequently, evidence from African Development Bank's Socio Economic Database (1960-2021) indicate that COMESA has experience more growth in terms of real GDP and real per-capita GDP growth rate than Economic Community of West African States (ECOWAS) and Central African Economic and Monetary Community (CAEMC). It also revealed that many COMESA member states recorded more welfare values than other countries in West, North and Central Africa.

However, in spite of the important role that digital finance and financial inclusion could play in economic growth process of regions (Kesuh et al., 2020; Aker et al., 2011; Andrianaivo & Kpodar, 2011; Nguling'wa, 2019; Bruce et al. 2013; Hariharan & Marktanner, 2012), there are few studies on the subject in COMESA region. Hence, the contribution of this study to the literature stems from the observed empirical gap in COMESA region. Thus, this study broadly examines the nexus between digital finance, financial inclusion and economic growth for twenty COMESA countries. The study also examines the direction of causality between digital finance, financial inclusion and growth in the region. The interactive effects of regulatory quality, macroeconomic volatility and their long-run nexus were accounted for, which was also extended to individual countries that make up the panel. Specifically, the study tests four hypotheses: (i) digital finance has no significant and long-run relationship with economic growth; (ii) financial inclusion has no significant and long-run relationship with economic growth; (iii) digital finance and financial inclusion do not significantly granger cause economic growth; and (iv) the interactive effect of regulatory quality and macroeconomic volatility/environment has no significant impact on economic growth. The remainder of this paper is organized as follows: Section 2 discusses the literature review, while the method adopted for the study is presented in Section 3. In Section 4, we present the results; while Section 5 summarizes and concludes the study.

2. LITERATURE REVIEW

In this section, we reviewed literature on financial system, innovation and technology, but with particular emphasize on digital finance, financial inclusion and economic growth. Before the empirical studies, few related theories were reviewed. The theories include: (a) the public good theory of financial inclusion by Ozili (2020); (b) the systems theory of financial inclusion by Ozili (2020); (c) the theory of financial innovations by Silber (1983); and (d) the technology acceptance theory put forward by Davis (1986).

2.1 Review of Theories

As propounded by Ozili (2020), the public good theory of financial inclusion centers on two issues, namely: (i) the provision of financial services to the whole population, and (ii) to guarantee unrestricted access to finance. The theory further argues that financial services should be considered public goods and be made available to everyone. According to Ozili (2020), every individual is privileged to enjoy and access financial services without any form of restrictions, suggesting that access to financial services by one individual does not constrain its availability to others. According to the theory, individuals or businesses with bank account should be entitled to debit/credit card irrespective of their size. To buttress the point, the theory argued that account holders with debit/credit card reserve the right to perform transactions using ATM machines freely, without transaction charges. In order to achieve this, Ozili (2020) suggested government subsidy to financial institution, and offer of a lump-sum cash deposit by the government into individual account as a solution to cost related problems that may arise from free financial service delivery by the financial institution. Invariable, the theorist made provision for Beck and Brown (2011) and Ketterer (2017), which had earlier pointed out that digital finance and financial inclusion favor a group of individuals in urban areas. Hence, the public good theory of financial inclusion came to the conclusion that individuals who cannot pay for the transaction charges can leverage on government subsidy especially when digital financial inclusion is considered a public good.

In a related study on systems theory of financial inclusion, Ozili (2020) argued that achieving the purpose of financial inclusion is dependent on the economic, social and financial system (i.e. sub-system) of a country. He further argued that the stability and the growth of sub-system determine the benefits of financial inclusion. Hence, expectation of financial inclusion outcome may be significantly affected by the changes in sub-system. Thus, imposing regulations on economic agents and providers of financial services may consequently promote the quality of financial services to users, and protect them from unnecessary exploitation and exposure to price discrimination. Therefore, the instruments of e-financial service may be more beneficial to an economy if the

changes in sub-system are favourable and accessible to all the users, with the incorporation of the interest of the service provider.

In a theory of technology acceptance, Davis (1986) explained the perception or the rationale behind the need to engage technological knowledge as a driving factor. This theory further argued that the nature of consumers' perception on newly introduced technology may affect the level of confidence of the users. In support of this theory, Lule et al. (2012) opines that the understanding of the ease and usefulness of the newly introduced technology may determine decision of the users. Thus, perceiving technology as reliable and beneficial encourages its use and growth, and boosts the performance of the technology in the short and long-run (Mojtahed et al., 2011). According to the theory, if the invention of digital finance technology was not perceived as useful and reliable, its relevance in the financial system and economy will not be felt (Lim & Ting, 2012). Therefore, consumer's intention establishes their perception towards accepting technology and its function. Hence, the acceptability of a financial technology affects the financial system directly or indirectly. Similarly, the theory of financial innovation advanced by Silber (1983) argued that financial innovation drives financial system development. This theory sees financial innovation as a yardstick to measure economic competence which improves firms' competitive edge and earnings to the investors (Błach, 2011; Li & Zeng, 2010). Hence, financial innovation entails new ideas/discoveries, novelty, modernization, technological solutions and advancement of existing knowledge (Sekhar, 2013). Thus, innovative financial inclusion and digital finance can drive growth through their influence on the financial system, which in turn serves as a spine of every economy (Omwansa & Waema, 2014).

2.2 Empirical Review

Some studies found that digital finance and financial inclusion are positively related to economic growth, while others have contrary findings on the relationship. Studies (e.g., Raichoudhury, 2019; Tabitha & Stella, 2019; Shofawati, 2019; Ozurumba & Onyeiwu, 2019; Dai-Dai-Won et al., 2018; Kesul et al., 2020; Rasheed et al., 2016) found that digital finance and financial innovation are important determinants of economic growth. Many of these studies argued that digital finance and financial inclusion enhances savings mobilization, which in turn facilitates borrowing and economic activities. It also promotes efficiency through the minimization of intermediation cost and resource distortions often caused by financial frictions, as well as promoting access, penetration and usage of financial services. On the contrary, studies (e.g., Okafor et al., 2017; Michelle, 2016; Okoye et al., 2017; Williams et al., 2017; Koomson et al., 2020; Inoue, 2019) argued that digital finance and financial inclusion is negatively related to economic growth. The findings of these studies arise from the fact that many users of digital finance and financial inclusion instruments may not be well enlightened, which suggest high financial illiteracy rate common in most of the developing countries, especially in the COMESA region. The negative effects of digital finance and financial inclusion may also be attributed to financial service charges as earlier pointed by Ketterer (2017) and Beck and Brown (2011). Table 1 provides a summary of the empirical studies reviewed in the course of this study.

Table 1: Summary of the empirical literature

Author/Study	Period	Countries Studied	Model Used	Main Finding
Lapukeni (2015)	2004 – 2012	17 selected COMESA countries	Dynamic Panel Data Analysis and Gravity Model	Positive
Evans (2015)	2005–2014	Nigeria	Panel Dynamic Model	Inconclusive
Jong-Hee (2016)	1990M1–2018M12	Bangladesh, India, Pakistan, Nepal, Bhutan, and Srilanka.	Generalized Method of Moment (GMM)	Positive

Michelle (2016)	2016	Kenya	Correlation Method	Negative
Balach et al. (2016)	2005 - 2012	-	Fully Modified OLS and Dynamic OLS	Positive
Rasheed et al (2016)	2004 – 2012	Nigeria	Panel GMM	Positive
Bara & Mudzingiri (2016)	2008 – 2016	Zimbabwe	Panel ARDL model	Positive
Zins and Weill (2016)	2001 – 2016	37 African countries	Probit Estimation	Positive
Sharma (2016)	2004 - 2013	India	ARDL Model	Positive
Taiwo et al. (2016)	2013 – 2016	Nigeria	Descriptive Statistic	Positive
Yorulmaz (2016)	2011 – 2015	Selected European Member Countries	Panel ARDL	Positive
Odeleye and Olusoji (2016)	1996 – 2014	Nigeria	OLS Technique	Positive
Chowdhury (2016)	1996 – 2014	Sub-Saharan Africa	Dynamic Panel Estimation	Positive
Fromentin (2017)	2004 – 2016	Latin America & Caribbean Countries	Causality & non-Causality Test	Positive
Scott et al. (2017)	1977 – 2017	America and Europe	GMM	Positive
Okafor et al. (2017)	2009:Q1-2014:Q4	Nigeria	vector autoregressive Model (VAR)	Negative
Uddin et al. (2017)	2005 – 2014	Bangladesh	Generalized Method of Moment	Positive
Gomber et al (2017)		Europe	Survey Research Method	Positive
Adeola & Evans (2017)		Nigeria	Ordinary Least Square Method (OLS)	Inconclusive
Iqbal & Sami (2017)	2008 - 2016	India	ARDL Model	Positive
Omojolaibi (2017)	1980 – 2014	Nigeria	Generalized Method of Moment (GMM)	Positive
Lenka & Sharma (2017)	1980 – 2014	India	ARDL and ECM Model	Positive
Okoye et al. (2017)	1986 – 2015	Nigeria	Ordinary Least Squares (OLS)	Negative
Aro-Gordon (2017)	2008 -2016	Nigeria	Survey Research Method	Positive

Williams et al. (2017)	2006 – 2015	Kenya	OLS Method	Negative
Rewilak (2017)	2004 – 2015	10 selected African Countries	IV Model	Positive
Saab (2017)	-	MENA	VAR	Positive
Gourene and Mendy (2017)	2006 – 2015	West African Countries	Causality Test and OLS Technique	Positive
Abel et al. (2018)	2010 – 2018	Zimbabwe	Logit Model	Positive
Ozili (2018)	2016 – 2020	G-20 countries	Survey Research Method	Positive
Osafo-Kwaako, et al. (2018)	2006 – 2017	WAEMU countries	Generalized Method of Moment (GMM)	Positive
Koh et al. (2018)	2004 – 2018	South East Asia	ARDL model	Positive
Bhardwaj et al. (2018)	2004 – 2016	Asia	Feasible Generalized Least Square	Positive
Frame et al. (2018)	1990s – 2000s	World Determinants of Financial Inclusion	Survey Research Method	Positive
Dai-Won et al. (2018)	1990 – 2013	selected Organization of Islamic Countries (OIC)	Dynamic Panel Model and Panel VAR	Positive
Bist (2018)	1995 – 2014	16 African and Non-African Countries	Modified OLS & Dynamic OLS	Positive
Bigirimana & Hongyi (2018)	2004 – 2016	Rwanda	ARDL	Positive
Bakar & Sulong (2018)	2010 – 2018	Asia and Africa	Survey Research Method	Positive
Abimbola et al. (2018)	1992 -2016	Nigeria	OLS Techniques	Positive
Bayar and Gavriletea (2018)	1996 – 2014	Selected Central & Eastern European Union	Dumitrescu & Hurlin Causality Test	Positive
Mwaitete and George (2018)	2008 – 2015	Tanzania	OLS Technique	Positive
Wakdok (2018)	1990 -2014	Nigeria	ECM Technique	Positive
Otiwu et al. (2018)	1992 -2013	Nigeria	OLS & Johansen Cointgration Method	Positive
Zhong & Tinghui (2019)	1996 -2015	Selected Provinces in China	Global Malquist-Luenberger (GML)	Positive

			& Slacks based Measure (SBM)	
Raichoudhury (2019)	2005 – 2015	Japan, Korea, Turkey and Bulgaria	Panel Cointegration Model	Positive
Tabitha & Stella (2019)	2016-2019	G-20 Countries	ANOVA and Reliability Test	Positive
Shofawati (2019)	2000 – 2019	Indonesia	Descriptive Qualitative research method	Positive
Ozurumba et al. (2019)	2012 - 2018	Nigeria	Descriptive Research Design	Positive
Sha'ban et al. (2019)	2004 – 20015	95 selected global survey	Survey Research Method	Positive
Qamruzzaman & Wei (2019)	1990M1–2018M12	Bangladesh, India, Pakistan, Nepal, Bhutan, and Srilanka	GMM and ARDL	Positive
Nguling'wa (2019)	2009 – 2014	Selected sub-Saharan African Countries	Pooled Least Squares Fixed & Random Effects Methods	Positive
Jahan et al (2019)	2017 – 2019	Asian-Pacific Region	Survey Research Method	Positive
Inoue (2019)	1973 -2004	India	GMM Model	Negative
Thai-Ha et al. (2019)	2004 – 2016	selected Asian Countries	Feasible Generalized Least Squares (FGLS)	Inconclusive
Oyelami & Ogundipe (2019)	1990 – 2016	Sub-Saharan Africa	Panel ARDL	Positive
Iman (2020)	2012 – 2018	Selected African Countries	Survey Research Method	Positive
Kesul et al.(2020)	2011 – 2017	Selected sub-Sahara African Countries	Vector Error Correction Model	positive
Koomson et al. (2020)	2016 – 2017	Ghana	Multiple Correspondence Analysis	Negative

Source: Authors' concept.

Table 1 shows that some studies have been carried out on the nexus between digital finance and financial inclusion in relation to economic growth; however, studies for the COMESA region remain limited. Studies such as Iman (2020), Lapukeni (2015), and Zins and Weill (2016) focused on financial technology and intra-regional trade in COMESA, as well as the determinants of financial inclusion in Africa. While Iman (2020) adopted financial technology index as a measure of financial technology and traced its influence in an economy, Lapukeni (2015) studied financial inclusion, ICT and intra-regional trade in COMESA. In Lapukeni (2015), financial inclusion is measured with formal financial services, while mobile phone subscription is the proxy for ICT development. However, it is not clear how formal financial services were obtained, and using mobile phone subscription as a measure of ICT development may not be sufficient to capture the actual influence on financial inclusion that was

alleged to have promoted intra-regional trade in COMESA region. Zins and Weill (2016) studied the determinants of financial inclusion using primary data and probit model. The findings show that rich and highly educated people favour financial inclusion than poor and less educated people. This study differs from Iman (2020) and Lapukeni (2015) by estimating the nexus between different measures of digital finance, financial inclusion and economic growth in COMESA. Furthermore, since African countries were poorly rated in the World Bank ease of doing business, we also controlled for the influence of regulatory quality and macroeconomic environment on digital finance and financial inclusion. Since North (1990) argued that viable legal system is a key factor for new investment success and growth-enhancing business environment, understanding the roles of regulatory system and stable macroeconomic environment become paramount to ensure the actualization of innovation in the financial system and its impact on economic growth in COMESA.

digital finance also benefits governments by providing a platform to facilitate increase in aggregate expenditure which subsequently generates higher tax revenue arising from increase in the volume of financial transactions (Manyika et al, 20

3. DATA AND METHODOLOGY

3.1 The Data

Our data consist of 19 annual observations from 1997 to 2018 on measures of digital finance, financial inclusion, economic growth and other control variables. The choice of this period is due to data availability and to ensure that recent developments in COMESA region were captured. Data on digital finance and financial inclusion were generated from IMF global financial development database (GFD, 2019), while the data on the measures of regulatory quality were obtained from World Bank governance indicators (WGI. 2019). Data for other variables, such as real GDP, per-capita GDP and financial deepening, were generated from the World Bank Development indicator (WDI, 2019). Following Greenwood-Nimmo and Shin (2013) and Ogbuabor, Orji, Aneke and Manasseh (2018), the entire dataset were logged prior to estimation. The log transformation was performed to enhance the robustness of the estimates, and to ensure that the results possess economic interpretations. Table 2 provides the descriptive statistics of the data. The observed minimum and maximum values are not too far away from the respective mean values, indicating the absence of outliers in the data.

Table 2: Descriptive statistics of the variables

Variables	Acronyms	Mean	Max.	Min.	Std Dev
Real Gross Domestic Product	RGDP	-0.29	1.67	-2.23	1.01
Automated Teller Machine per 100,000 Adults	ATM	3.91	10.71	0.00	3.01
Point of Sale	POS	0.03	7.00	-2.24	1.53
Mobile Banking	MB	-0.21	2.00	-1.85	1.01
Mobile Purchase	MP	-0.19	1.89	-1.82	1.04
Mobile Money	MM	0.94	1.99	0.00	0.54
Number of Deposit Accounts with Commercial Bank per 1,000 Adults	NDA	0.56	1.49	-0.27	0.54
Financial Literacy	FIL	3.70	11.57	-0.13	3.17
Number of Registered Mobile Money Accounts Per 1,000 Adults	NRMA	-0.21	1.67	-2.23	1.01

Number of Active Mobile Money Agent Outlets	NAMO	0.47	1.96	0.00	0.49
Digital Card Ownership	DCO	0.40	1.49	-0.27	0.50
Financial Deepening	FD	0.59	2.39	-1.59	0.67
Macroeconomic Volatility	MEV	0.41	1.84	0.00	0.38
Rule of Law	ROL	-0.20	1.99	-1.85	1.00
Regulatory Quality	REQ	-0.23	1.67	-2.23	1.02
Government Effectiveness	GEF	3.50	13.29	0.00	3.34

Source: Authors. **Note:** Max and Min denote maximum and minimum values, respectively, while Std Dev denote standard errors.

3.2. Methodology

The theoretical framework for this study is based on the theory of financial innovations by Silber (1983), which stated that financial innovation spurs financial development and economic growth through improvement in firms' competitive edge and earnings to the investors. Hence, this suggests that increase in financial innovation (same as digital finance & financial inclusion) instruments such as automated teller machine (ATM), point of sale (POS), mobile banking (MB), mobile account (NRMA) and mobile money agent (NAMO), among others, promote financial development and economic growth. Therefore, to investigate the relationship between digital finance, financial inclusion and economic growth in COMESA, the study adopted panel autoregressive distributed lag model (PARDL). The rationale for PARDL model is based on its superiority over other cointegration estimation techniques (Pesaran et al. 2001). In addition, Odhiambo (2009), Al-Malkawi et al. (2012) and Manasseh et al. (2017) who had earlier adopted ARDL approach in their various studies pointed its conventional and reliability in estimating long-run relationship compared to Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990) and Gregory and Hansen (1996). In like manner, Choong et al. (2005) and, Rahman and Salahuddin (2012) buttressed the advantage of ARDL given the preference for the bounds testing approach as compared to the traditional bivariate cointegration techniques. Other benefits of the model include; simultaneous estimation of long-run and short-run parameters of the model, and the dynamic ECM derivable from ARDL by way of simple linear transformation (Manasseh et al. 2017), which also integrates short-run adjustments with long-run equilibrium without loss of long-run information (Pesaran and Shin, 1999). With the appropriate lag lengths, both serial correlation and the endogeneity problem are corrected using ARDL approach (Pesaran et al. 2001). Thus, the generalized ARDL (p, q) model following Adeleye et al. (2017) is specified as:

$$Y_{i,t} = \varphi_i + \sum_{j=1}^{p} \delta_i Y_{i,t-j} + \sum_{j=0}^{q} \beta'_{i,j} X_{i,t-j} + \mu_{i,t} \quad (1)$$

Where $Y_{i,t}$ represent real GDP or per-capita GDP, and the variables in ($X_{i,t}$) such as measures of digital finance and financial inclusion are allowed to be purely integrated at I(0) or I(1). $\mu_{i,t}$; is the error term or the unobserved zero mean white noise vector process. $\delta_{i,t}$; is the coefficient of the lagged dependent variable, while $\beta_{i,t}$ are $k \times 1$ coefficient vectors; φ_i is the constant or unit-specific fixed effect. $i = 1, \dots, 1; t = 1, 2, .., T; and\ p, q$, are the optimal lag orders.

The long-run relationships between digital finance, financial inclusion and economic growth and its short-run dynamic using a log level PARDL (p, q) error correction technique is established with the specified model shown as:

$$\Delta lnRGDP_{i,t} = \varphi_i - \gamma_i\left(lnRGDP_{t-j} - \vartheta X_{i,t}\right) + \sum_{i=1}^{p-1} \emptyset_i \Delta lnRGDP_{t-j} + \sum_{i=0}^{q-1} \beta_i \Delta X_{i-j} + \in_{1i,t} \quad (2)$$

$$\Delta lnGDPpc_{i,t} = \varphi_i - \gamma_i\left(lnGDPpc_{t-j} - \vartheta X_{i,t}\right) + \sum_{i=1}^{p-1} \emptyset_i \Delta lnGDPpc_{t-j} + \sum_{i=0}^{q-1} \beta_i \Delta X_{i-j} + \in_{2i,t} \text{- - - - - - (3)}$$

where: Δ is the different operator, and $\gamma_i = 1 - \sum_{j=i}^{p} \delta_i$ is the coefficient of speed of adjustment. $\vartheta = \frac{\sum_{j=i}^{q} \beta_j}{\varphi_i}$ is the long-run coefficient.

Equations [2] and [3] state that Δ*lnRGDP* and Δ$lnGDPpc$ depend on their lags, the differenced explanatory variables and the equilibrium error term. While equation [2] is the main model for the long-run relationship and short-run dynamic estimation, equation [3] is used to perform a robustness check. Hence, we expect γ to be negative and the absolute value explain the degree of response to equilibrium or how quickly equilibrium is reinstated. In addition, the causality test will be performed with the aid of equation [2] to determine the direction of causation between measures of digital finance, financial inclusion and economic growth, which was further ascertained using the value of error correction term. If the error correction term is significant and negative, it implies that the explanatory variables granger causes the dependent variable.

4. RESULTS AND DISCUSSIONS

This section presents and discusses the regression results. First, the variables were subjected to diagnostic tests following Pesaran et al. (2001) assumptions to avoid spurious results. To ascertain if the variables have unit roots, Levine, Lin and Chun (LLC) and Im, Pesaran and Shin (IPS) stationarity tests were performed (see table 3 below). LLC and IPS tests were chosen because; LLC allows for heterogeneity of individual deterministic effects and assume homogeneous autoregressive for the variables in the model, while IPS allows for residual serial correlation and heterogeneity of the dynamics and error variances across groups as well as reflects the mean of ADF statistics computed for each cross-section unit in the panel. Pedroni and Kao cointegration tests were performed to examine the long run relationships, while Hausman test was also carried out to ascertain the most suitable procedure for estimating panel ARDL model. Other post-estimation diagnostic checks include cross-sectional dependence test, normality test, serial correlation test, Ramsey reset test, and Heteroskedasticity test.

4.1. Unit Root Test Results

The results of the Levine, Lin and Chu (LLC) unit root tests presented in Table 3 revealed that all the variables are integrated of order I(0) and I(I). The results of the LLC tests are consistent with the results of the Im, Pesaran and Shin (IPS) unit root tests. These results are in conformity with ARDL assumption, which requires all the variables to be integrated of I(0) or I(1).

Table 3: LLC and IPS unit root test results

Variables	LLC	Order of Integration		Estimation Process	IPS	Order of Integration		Estimation Process
		Level	Diff			Level	Diff	
RGDP	-4.02284***	I(0)	-	None	-12.8355***	-	I(1)	Intercept & Trends
ATM	-3.29458***	I(0)	-	None	-11.947****	-	I(1)	Intercept
POS	-6.50682***	-	I(1)	None	6.07049***	I(0)	-	Intercept
MB	13.8156***	-	I(1)	Intercept	-9.22445***	-	I(1)	Intercept & Trends
MP	-6.54999***	I(0)	-	Intercept	-5.23816***	I(0)	-	Intercept & Trends
MM	-5.61488***	I(0)	-	Intercept	-4.67446***	I(0)	-	Intercept & Trends
NDA	-2.80868***	I(0)	-	Intercept	-2.05344**	I(0)	-	Intercept

LnFIL	-9.68074***	-	I(1)	Intercept & Trends	-3.92353***	I(0)	-	Intercept
NRMA	-4.10362***	I(0)	-	Intercept	-15.3858***	-	I(1)	Intercept & Trends
NAMO	-3.91607***	I(0)	-	None	-3.04349***	I(0)	-	Intercept
DCO	-3.88788***	I(0)	-	Intercept	-2.56197***	I(0)	-	Intercept
ROL	-18.0079***	-	I(1)	None	-9.77502***	-	I(1)	Intercept & Trends
REQ	-7.46146***	-	I(1)	Intercept & Trends	-5.78525***	I(0)	-	Intercept
GEF	-13.3260***	I(0)		Intercept & Trends	-8.61574***	I(0)	-	Intercept
FD	-3.40260***	I(0)	-	Intercept	-5.58671***	I(0)	-	Intercept
MEV	-6.91651***	-	I(1)	Intercept &Trends	-2.52900***	I(0)	-	Intercept

Source: Authors. ***, ** & * represent 1%, 5% & 10% level of significance, respectively.

4.2 Cross Sectional Dependence Test

Cross sectional dependence test was performed using Breusch-Pagan LM test, Pesaran scaled LM test, Bias-corrected scaled LM test and Pesaran CD test to check if the panel model show presence of cross-sectional dependence in the errors due to the existence of common shocks (Robertson and Symons, 2000; Pesaran, 2004). The results presented in Table 4 show that all the variables are statistically significant at 1%, 5% and 10% levels of significance, suggesting the rejection of null hypothesis of no cross sectional dependence.

Table 4: Summary Cross Section Dependence Test Results

Variables	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
RGDP	1873.575***	86.36555***	85.91101***	-0.686997*
GDPpc	656.5825***	23.93518***	23.48063***	10.92776***
ATM	484.2376***	15.09407***	14.63952***	6.360754***
POS	2884.745***	138.2375***	137.7829***	52.15863***
MB	1965.322***	91.07208***	90.61753***	3.001664***
MP	2055.377***	95.69184***	95.23730***	0.143056*
MM	506.2327***	16.22239***	15.76785***	1.562388*
NDA	499.0180***	15.85229***	15.39775***	-1.247571*
FIL	398.7560***	10.70896***	10.25441***	3.448383***
NRMA	2409.332***	113.8493***	113.3948***	-0.415578*
NAMO	509.5808***	16.39415***	15.93961***	-1.272728*
DCO	483.2500***	15.04341***	14.58886***	-1.985067*
ROL	2239.052***	105.1141***	104.6596***	4.338777***
REQ	2058.470***	95.85048***	95.39594***	0.451917*
GEF	346.1459***	8.010118***	7.555573***	0.538373*
FD	248.9712***	3.025161***	2.570615**	0.821856*
MEV	439.7129***	12.81000***	12.35546***	-0.690843*

Source: Authors. ***, ** & * represents 1%, 5% & 10% level of significance, respectively.

4.3 Cointegration Tests

We performed Pedroni (1999; 2004), and Kao (1999) cointegration test to examine the existence of long run relationship in the series. The outcome of this test further strengthens the evidence provided

by the unit root test outcome. Pedroni test produces two results - within dimension and between dimensions. Within dimension produced Panel-v statistic, Panel rho-statistic, Panel PP-statistic and Panel ADF-statistic results, while between dimension tests yield Group rho-statistic, Group PP-statistic and Group ADF-statistic results, respectively. These results show that the series are cointegrated, suggesting the existence of a long-run relationship within the series as well as between the groups. This outcome was further investigated using Kao Cointegration Test. Performing the ADF - Statistics of Kao residual Cointegration tests, we found a consistent outcome which supported the evidence from Pedroni residual Cointegration test. The result from Kao residual Cointegration tests is significant at 1% level across models (1 - 4). Hence, the null hypothesis ($H0$) of no Cointegration is rejected at 1% level of significance.

Table 4: Panel Pedroni and Kao Cointegration Results

Model	1		2		3		4	
	Stat	**W-Stat**	**Stat**	**W-Stat**	**Stat**	**W-Stat**	**Stat**	**W-Stat**
Within – Dimension								
Panel-V Statistic	-0.6757	-1.1956	-1.9547	-2.0909	-3.2037	-2.9834	-2.3195	-2.8775
Panel-rho Statistic	-0.40701	-0.2230	1.8430	1.5375	2.2026	1.9577	1.8517	1.9575
Panel PP-Statistic	-4.0974***	-3.7616***	-4.8398***	-6.0217***	-3.745***	-5.0943***	-5.477***	-6.2185***
Panel ADF-Stat	-3.9016***	-3.5324***	7.5524***	6.9843***	-3.2820***	-4.6086***	6.1694***	4.9237***
Between – Dimension								
Group rho-Stat	0.887533		3.095107		3.378756***		3.329509***	
Group PP-Statistic	-5.515564***		-5.992384***		-5.607754***		-7.172055***	
Group PP-Statistic	-5.084273***		8.633826***		-4.282126***		6.414467***	
Robust Check: Kao Cointegration Test								
ADF-Stat	4.298348		4.583660		3.320510		3.376993	
Prob.	0.0000		0.0000		0.0004		0.0004	

Source: Authors. ***, ** & * represent 1%, 5% and 10% level of significance, respectively

4.4. ARDL and ECM Estimation Results

Using panel ARDL approach, we first presented and discuss the long-run relationship between digital finance and economic growth in COMESA member states, which is followed by the error correction or the short-run dynamics. The obtained results from Hausman tests indicated fixed effects (FE) estimation technique as most suitable for the study. The p-values obtained from Hausman tests were found to be less than the conventional 5%. The results of panel ARDL regression based on the fixed effects technique are presented in Table 5. Hence, since digital finance is supported with electronic device which enables customers to perform financial transactions like cash withdrawals, deposits, and funds transfers, among others, without direct contact with the financial institution, automated teller machine (ATM), Mobile Purchase (MP), Mobile Money (MM), Point of sale (POS) and Mobile Banking (MB) were considered important measures of digital finance. Also, to account for the performance of these indicators, we generated their index and estimate its influence on economic growth. This enhances the opportunity to investigate the individual influence of the measures of digital finance on economic growth, and understand each of the measures that accounted most on

economic growth. Thus, it also enables us account for the general performance of digital finance measures on economic growth. In like manner, economic growth is proxied by real gross domestic product (RGDP), while per-capita gross domestic product (GDPpc) is used in the robustness check estimation.

Evidence from column 1 revealed that in the long-run, automated teller machine (ATM) and Mobile Purchase (MP) are positively and significantly related to economic growth (RGDP growth), while Point of sale (POS) and Mobile Banking (MB) are negatively and significantly related to RGDP growth. These results show that ATM, MP, POS and MB are strong predictors of economic growth in COMESA except Mobile Money (MM) observed to be positive but insignificantly related to economic growth. Also, we observed that macroeconomic volatility (MEV) is negatively and significantly related to RGDP in the long-run. This suggests that MEV is a strong predictor of RGDP. Hence, increase in the volatility of macroeconomic environment will deter economic growth in COMESA region. These results are consistent with the robustness checks as shown in column 4 of Table 5. From the results, automated teller machine (ATM) and Point of sale (POS) are positively and significantly related to per-capita gross domestic product (GDPpc), while Mobile Purchase (MP) is negatively and significantly related to GDPpc in the long-run. The robustness check also confirmed automated teller machine (ATM) and Point of sale (POS) to be key determinants of economic growth. MM and MB were positively and negatively related to GDPpc respectively, but their effects were not significant.

Table 5: Panel ARDL Long-run Estimation of Digital Finance and Economic Growth

	Dependent Variable (RGDP)			**Robustness Check Dependent Variable (GDPpc)**		
Variable	**1**	**2**	**3**	**4**	**5**	**6**
ATM	0.010517***			0.485284***		
	(0.004682)			(0.116324)		
MP	1.120340***			-4.314182***		
	(0.031055)			(1.614363)		
MM	-0.001111			0.251466		
	(0.024183)			(2.153462)		
D(POS)	-0.243727***			8.109082***		
	(0.034579)			(2.318607)		
D(MB)	-0.236368**			-8.525501		
	(0.113229)			(8.099043)		
DFINDEX		0.437535***	0.796273		3.671571***	1.811221***
		(0.161951)	(0.480193)		(1.218148)	(6.920976)

FD		-0.070736*** (0.029451)	6.378872** (3.044735)		5.478891*** (1.061346)	1.428194*** (4.696006)
D(MEV)	-0.512716*** (0.180673)		13.62078** (6.089457)	-11.42167*** (2.078346)		1.534702*** (0.601930)
GEF		0.036015*** (0.005836)			6.966595*** (1.747978)	
D(ROL)		0.612664*** (0.099181)			8.417305*** (3.253826)	
D(REQ)		0.318535 (0.052829)			2.988903* (2.024616)	
D(MEV)*DFINDEX			-4.309263*** (1.415392)			-3.1062741*** (0.974123)
D(ROL)* DFINDEX			-0.670553*** (0.113583)			-1.110573*** (0.168146)
GEF* DFINDEX			-1.492744*** (0.411789)			-1.561776*** (0.2015624)
D(REQ)* DFINDEX			-2.715134 (0.596374)			-0.917338*** (0.261431)
Hausman Test	8.724238*** (0.2731)	7.518219*** (0.31681)	5.524137*** (0.21642)	9.818249*** (0.2780)	13.766438*** (0.423513)	10.25481*** (0.31821)
Serial Correlation Test	5.297203 (0.1153)	0.279537 (0.7563)	4.951131 (0.513426)	0.369648 (0.071263)	2. 775261 (0.12871)	1.976525 (0.1398)
Heteroscedasticity Test	1.990567 (0.3109)	1.397459 (0.1866)	1.225662 (0.211731)	1.4914731 (0.175541)	3.482101 (0.5304)	4.832131 (0.63134)

Source: Authors. Numbers in parentheses are the standard error. The estimation is based on White heteroscedasticity-consistent standard errors. ***, ** & * represent 1%, 5% and 10% level of significance respectively

The reported results in column 2 show the long-run relationship between digital finance index (FINDEX) and economic growth (RGDP). It is observed that the performance of digital finance indicators proxied with FINDEX is positive and significantly related to economic growth (RGDP). We also observe consistent result in column 4, where RGDP is replaced with per-capita gross domestic product (GDPpc). Thus, the performance of digital finance indicators is a strong determinant of economic growth. However, effort should be ensured to improve on the services of financial institutions to promote the performance of digital finance instruments. Furthermore, we also account for the influence of regulatory environment by controlling for the lung-run relationship between government effectiveness (GEF), rule of law (ROL), regulatory quality (REQ) and economic growth (RGDP). The evidence in column 2 of Table 5 revealed that government effectiveness (GEF) and rule of law (ROL) is a strong predictor of RGDP, while the robustness check in column 5 was found to be consistent with the results, suggesting that GEF, ROL and REQ are positive and significantly related to RGDP and per-capita gross domestic product (GDPpc). In addition, interacting macroeconomic volatility, and regulatory environment indicators (GEF, ROL & REQ) with the digital finance index (FINDEX), we observed that stable macroeconomic and quality regulatory environment promotes economic growth. Hence, the results suggest that the interactive effects is negatively related to both real gross domestic product (RGDP) and per-capita gross domestic product (see Columns 3 and 6 in Table 5). In view of these findings, digital finance is strong predictor or determinant of economic growth in the long-run as earlier revealed by Kesul et al. (2020), Lapukeni (2015), Raichoudhury (2019), Tabitha and Stella (2019), Shofawati (2019), Ozurumba and Onyeiwu (2019), Safo-Kwaako et al. (2018), Koh et al. (2018), Bhardwaj et al. (2018), Dai-Won et al. (2018), Uddin et al. (2017), and Rasheed et al. (2016).

Table 6: Panel ARDL Short-run Estimation of Digital Finance and Economic Growth

Variable	Dependent Variable (RGDP)			Robustness Check Dependent Variable (GDPpc)		
	1	2	3	4	5	6
ECT	-0.467065** (0.232048)	-0.055520** (0.017938)	-0.584370** (0.094001)	-0.226790*** (0.048691)	-0.426120** (0.1311026)	-0.5046140** (0.116124)
Δ(ATM)	0.019241 (0.050588)			0.576487 (0.836298)		
Δ(MP)	0.034817 (0.175413)			0.397325 (5.234677)		
Δ(MM)	-0.002733 (0.044856)			4.344967 (3.083013)		
Δ(POS)	0.134737*** (0.042897)			0.027791 (1.033283)		
Δ(MB)	-0.236368** (0.113229)			6.255503 (4.882692)		
Δ(FINDEX)		-0.214370** (0.094001)	-0.053600 (0.043406)		-0.114540** (0.0283112)	0.712110** (0.143721)
Δ(FD)	0.014147 (0.069208)	0.201153** (0.0531612)	4.733821**	-3.188815 (1.245025)	2.748313** (0.513106)	1.214072** (0.365216)

			(1.021465)			
Δ(MEV)	0.703129 (0.919234)		1.130789 (6.148374)	-7.732022 (21.25201)		1.4326031*** (0.3162701)
Δ(GEF)		-0.028865 (0.027049)			0. 610132** (0.213521)	
Δ(ROL)		0.025262 (0.099181)			4.203214*** (1.143961)	
Δ(REQ)		-0.318535 (0.026525)			2.766812* (0.912456)	

Source: Authors. Numbers in parentheses are the standard error. The estimation is based on White heteroscedasticity-consistent standard errors. ***, ** & * represent 1%, 5% and 10% level of significance respectively.

The results in Column 1 of Table 6 show the short-run dynamic. The table revealed error correction term (ECT) to be negative and statistically significant (-0.467065), which indicates the speed of adjustment. The negative and significant ECT shows the speed at which the variables return to equilibrium. The results shows that 46.7 percent of disequilibrium due to past year's shocks are adjusted to the long-run equilibrium in the current year, *cetris paribus*. However, the evidence from the robustness check in column 4 (of Table 6) shows a relatively low speed of adjustment to equilibrium. The results shows that about 22.7 percent of disequilibrium due shocks are corrected to the long-run equilibrium in the current year. Hence, we observed slight disparity in the error correction term (ECT) in column 2 and 3, as well as column 5 and 6 compared to results obtained in column 1 and 4. When controlled for the regulatory environment, macroeconomic environment as well as the financial deepening (FD) - proxied with M2/GDP, we observed that 55.5% and 58.4% (column 2 & 3) of disequilibrium due shocks are corrected to the long-run equilibrium in the current year, while 42.6% and 50.5% of disequilibrium due shocks are corrected to the long-run equilibrium in the current year, *cetris paribus*. It also indicates that the ECT converges to long-run stable state rapidly (Narayan and Smyth 2005). The significant ECT indicates that economic growth adjusts faster to its realization between the long-term and short-term within the period. Furthermore, in the short-run, measures of digital finance are insignificantly related to economic growth (RGDP) except POS and MB in column 1. While POS is positively related to RGDP, MB exert negative relationship with economic growth (RGDP) in the short-run.

Table 7: Panel ARDL Long-run Estimation of Financial Inclusion and Economic Growth

Variable	**Dependent Variable (RGDP)**			**Robustness Check Dependent Variable (GDPpc)**		
	1	**2**	**3**	**4**	**5**	**6**
NDA	0.421691*** (0.046134)			2.530526*** (0.540412)		
NRMA	0.190348*** (0.066611)			0.010547** (0.002105)		
NAMO	-0.680137*** (0.107962)			0.031296***		

				(0.008562)		
DCO	-0.577185*** (0.174760)			0.049232** (0.021077)		
D(FIL)	0.021670** (0.004271)	1.071170** (0.21162)	0.137162** (0.021473)	0.080791** (0.010451 3)	0.001170** (0.000212)	0.045672** (0.001103)
FININDEX		1.021334*** (0.241536)	9.231182** (4.086224)		0.006634*** (0.002424)	1.806657** (0.835863)
FD		-0.639609*** (0.062815)	19.67697** (9.226543)		2.02714*** (0.23612)	4.240944*** (0.926945)
D(MEV)	-1.534702*** (0.601930)		-4.510617** (0.51431)	-0.06662*** (0.009505)		-23.96040*** (6.715779)
GEF		0.461436** (0.126181)			0.076592*** (0.011302)	
D(ROL)		0.786378*** (0.276401)			1.316214*** (0.100214)	
D(REQ)		0.310034* (0.167881)			1.870432** (0.429047 1)	
D(MEV)*FININDEX			-36.9531*** (14.95147)			-29.94292*** (8.119861)
D(ROL)*FININDEX			-19.67697** (9.226543)			9.250103*** (3.655369)
GEF*FININDEX			9.231182** (4.086224)			-1.995505*** (0.781630)
D(REQ)*FININDEX			-2. 1741*** (0.35281)			-9.285277*** (3.988721)

Hausman Test	7.149814 (0.4134)	4.289748 (0.8301)	5.862092 (0.3199)	4.083374 (0.5375)	3.071374 (0.465127)	7.124332 (0.2116)
Serial Correlation Test	0.751060 (0.4725)	1.567905 (0.2097)	0.754331 (0.4710)	0.878853 (0.4160)	0.787641 (0.31520)	1.211464 (0.2988)
Heteroskedasticity Test	2.429555 (0.4513)	1.556180 (0.6327)	2.924689 (0.2392)	3.879876 (0.2801)	2.642736 (0.41531)	3.842525 (0.7461)

Source: Author's Conception. Numbers in parentheses are the standard error. The estimation is based on White heteroscedasticity-consistent standard errors. ***, ** & * represent 1%, 5% and 10% level of significance respectively

The results in table 7 above are the estimated output of the investigation on the nexus between financial inclusion and economic growth using fixed effects (FE) estimation technique as suggested by Hausman tests. Financial inclusion is the access to financial products and services for the purpose of financial transactions, and indicators such as number of deposit accounts with commercial banks per 1,000 adults (NDA), number of registered mobile money accounts per 1,000 adults (NRMA), number of active mobile money agent outlets (NAMO), digital card ownership (DCO) and financial literacy (FIL) were considered key measures. Hence, the influence of the performance of the selected indicators on economic growth was accounted for using their index (FININDEX). In addition, economic growth is captured by real gross domestic product (RGDP) and per-capita gross domestic product (GDPpc) used as a robustness check. The findings in column 1 suggest that in the long-run, financial inclusion measures are significantly related to real gross domestic product (RGDP). Thus, NRMA and FIL were observed to be positively related to RGDP, while NAMO and DCO are negatively related to RGDP. The robustness check results (in column 4) were found to be consistent with the findings, though with a slight difference in their magnitude. These results show that financial inclusion measures are strong and significant predictors of real gross domestic product in COMESA. Overall, these results lend support to previous studies such as Kesuh et al. (2020), Lapukeni (2015), Tabitha and Stella (2019), Shofawati (2019), Safo-Kwaako et al. (2018), Koh et al. (2018), Bhardwaj et al. (2018), Dai-Won et al. (2018), Uddin et al. (2017) and Rasheed et al. (2016). It is also supported by Silber (1983) hypothesis, which perceived financial innovation as drivers of financial development and economic growth through improvement in firms' competitive edge and investors' earnings.

As earlier seen in Table 5, we also observed that increase in macroeconomic volatility (MEV) is negatively and significantly related to economic growth in COMESA region in the long-run *cetris paribus* (see columns 1, 3, 4 and 6 of Table 7). In addition, the results have shown that the performance of financial inclusion promotes real gross domestic product (RGDP). This is evident in the existing relationship between FININDEX and economic growth measures (see columns 2 and 5). Based on these results, financial service providers in COMESA region should moderate their service charges to promote the use of financial inclusion instruments. In addition, government effectiveness (GEF), rule of law (ROL) and regulatory quality (REQ) were all found to be strong predictors of RGDP and per-capita GDP (see columns 2 and 5 of Table 7) and thus, suggest the relevance of regulatory environment in promoting economic growth. Hence, improved regulatory environment such as freedom of expression, property right protection, proper enforcement of law and human right observation, may spur growth in COMESA, *cetris paribus*. Interacting macroeconomic volatility, regulatory environment indicators with financial inclusion index (FININDEX), we observed that unstable macroeconomic and poor regulatory environment may deter financial inclusion and economic growth, *cetris paribus* (see columns 3 and 6 in Table 7). Thus, given the above results, financial inclusion is a key and significant determinant of economic growth in COMESA region.

Table 8: Panel ARDL Short-run Estimation of Financial Inclusion and Economic Growth

Variable	Dependent Variable (RGDP)			Robustness Check Dependent Variable (GDPpc)		
	1	2	3	4	5	6
ECT	-0.119423** (0.051166)	-0.203845** (0.091184)	-0.00456*** (0.003516)	-0.165347** (0.072534)	-0.318581*** (0.054515)	-0.646116*** (0.126942)
Δ(NDA)	0.991223** (0.486277)			2.639537*** (0.15276)		
Δ(NRMA)	-0.019312 (0.040261)			1.479391** (0.25713)		
Δ(NAMO)	0.798509 (1.423474)			5.90993*** (0.31614)		
Δ(DCO)	1.529750** (0.761154)			4.23487** (1.02162)		
Δ(FIL)	-0.030970 (0.016134)	0.875959* (0.469300)	0.030634 (0.036223)	0.626931*** (0.240149)	0.017799* (0.010969)	0.014603 (0.011279)
Δ(FD)		0.013744 (0.072290)	0.426893*** (0.076036)		0.078095 (0.056110)	0.475084*** (0.021145)
Δ(FININDEX)		0.039940** (0.019293)			0.288022*** (0.021516)	0.194009 (0.160161)
Δ(MEV)	-0.491197** (0.051311)		-0.03366*** (0.003341)	-24.76702** (10.79434)		-1.713808 (1.356086)
Δ(GEF)		0.033440* (0.021008)			0.032423*** (0.0036184)	
Δ(ROL)		0.066157 (0.071847)			0.023120*** (0.003671)	
Δ(REQ)		0.124543* (0.084172)			0.307859* (0.185365)	

Source: Author's Conception. Numbers in parentheses are the standard error. The estimation is based on White Heteroskedasticity-consistent standard errors. ***, ** & * represent 1%, 5% and 10% level of significance respectively.

Table 8 above revealed that the error correction term (ECT) is negative and statistically significant (11.9 percent) and it indicates the speed of adjustment to restore equilibrium in the long-run (see column 1). This implies that 11.9 percent of disequilibrium due to shocks from past year are adjusted to the long-run equilibrium in the current year, *cetris paribus*. However, we found consistence evidence in the robustness check (see column 4). The results show that about 16.5 percent of disequilibrium is adjusted to long-run equilibrium in the current year. In addition, we also observed that 20.4% and 0.5% (columns 2 and 3) of disequilibrium, while 31.9% and 64.6% of disequilibrium (columns 5 and 6) due to shocks are corrected to the long-run equilibrium in the current year, *cetris paribus*. Hence, the speed of adjustment to equilibrium were observed to be faster when regulatory environment is accounted for, and this may suggest the need for a viable regulatory environment in an economy. In the short-run, financial inclusion measures are significantly related to economic

growth measures (RGDP & GDPpc) except NRMA, NAMO and FIL in column 1. This means that financial inclusion is an important determinant of economic growth. In like manner, regulatory and macroeconomic environments as well as financial deepening (FD) (proxied with M2/GDP) were also observed to be significant predictors of economic growth in the short-run.

4.5 Granger Causality

In order to ascertain the direction of causality between digital finance, financial inclusion and economic growth, granger causality test was conducted on digital finance index (FINDEX), financial inclusion index (FININDEX) and economic growth measures (RGDP & GDPpc). The empirical results are presented in Table 9.

Table 9: Granger Causality Test Results

Variable			F-Statistic	Probability	Status
LnFINDEX	⟷	LnRGDP	4.80112	0.0004	Bidirectional Causality
LnRGDP		LnFINDEX	6.70024	0.0000	
LnFININDEX	⟷	LnRGDP	4.88645	0.0009	Bidirectional Causality
LnRGDP		LnFININDEX	3.11011	0.0058	
LnFINDEX	⟷	LnGDPpc	5.94841	0.0002	Bidirectional Causality
LnGDPpc		LnFINDEX	8.57017	0.0000	
LnFININDEX	⟷	LnGDPpc	2.64373	0.0281	Bidirectional Causality
LnGDPpc		LnFININDEX	9.02502	0.0000	

Sources: Author's Conception. Decision was made based on 5% level of significance, Ln represent the log of the variables

This study investigated the nature of causal relationship between digital finance, financial inclusion and economic growth. Hence, digital finance index (FINDEX) and financial inclusion index (FININDEX) were used instead of their individual measures to estimate the causal relationship. The results as shown in Table 9 revealed bidirectional causality between the digital finance, financial inclusion and economic growth. This outcome shows that the probability value is less than 5% level of significance, indicating that digital finance, financial inclusion and economic growth ganger causes each other. Thus, policies targeted at driving digital finance and financial inclusion will as well promote economic growth in COMESA region. These results prove and support the claim of Silber (1983) hypothesis, which viewed financial innovation as a sure way of promoting economic growth by encouraging competition among firms which may likely spur investors' profits. In like manner, it also provides additional evidence on the significant long-run relationship existing between digital finance, financial inclusion and economic growth measures, which were also proven by the ECT observed to be negative and statistically significant in the short-run. Hence, from this result, we therefore suggest that the government of COMESA member states should endeavor to embrace policies that will create more awareness on the usefulness of digital finance and financial inclusion, as well as making it affordable for the rural dweller who seem to be left out due to high cost of charges from the service providers.

4.6. ARDL Bound Test for Cointegration across Countries

The study further extended its investigation to the long-run cointegration in the 19 countries that make up the panel as shown in Table 10. The purpose of this estimation is to know if the existing long-run relation between digital finance, financial inclusion and economic growth is extended to individual member countries using ARDL bound test for cointegration following Pesera et al (2001). Also, we examined if the error correction term or the short-run dynamic differ across the COMESA member countries.

Table 10: ARDL Bound Test and Short-run Dynamics Results for Countries in the Panel

Dependent Variable: Log RGDP									
			1%		5%		10%		
Countries	F-Stat	T-Stat	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	ECT
Burundi	5.501266	-4.760070	3.51	4.03	2.69	3.83	2.38	3.45	-0.53373***
Comoros	9.508847	-6.515016	3.54	4.91	1.97	3.18	1.7	2.83	-0.70844***
D.R. Congo	7.521363	-5.774796	2.24	3.41	1.83	3.11	1.9	2.88	-0.65539***
Djibouti	17.71017	-9.144727	2.58	4.88	1.95	4.23	1.62	3.9	-0.28088***
Egypt	16.64834	-4.275073	2.44	3.01	2.22	2.89	1.03	2.83	-0.19745**
Eritrea	8.226301	-4.842160	3.59	4.88	2.49	3.91	2.35	3.72	-0.110155**
Ethiopia	11.15378	-5.602866	2.45	4.34	1.11	3.98	1.04	3.42	-0.27904***
Kenya	12.76559	-4.999481	1.99	3.92	1.56	3.22	1.34	2.93	-0.752452**
Libya	11.93788	-10.41979	2.01	4.58	1.40	4.10	1.29	3.85	-0.62034***
Madagascar	20.16369	-7.007504	2.33	4.61	1.32	4.41	1.22	3.67	-0.18603***
Malawi	33.34269	-10.48897	2.18	4.48	1.94	3.29	1.66	3.01	-0.262568*
Mauritius	4.314777	-3.982399	2.89	4.75	2.33	3.71	1.98	3.28	-0.96272***
Rwanda	22.07278	-8.998470	3.17	4.94	2.67	3.21	2.01	3.01	-0.260583*
Seychelles	8.923361	-4.580747	1.91	4.02	1.92	3.23	1.11	3.17	-0.43876***
Somalia	53.38986	-11.71038	2.34	3.86	1.04	3.02	1.01	2.86	-0.982475*
S. Sudan	9.689754	5.018179	2.68	4.51	2.17	4.23	1.88	3.91	-0.10143***
Swaziland	14.71609	-8.302150	2.19	3.89	2.52	3.82	2.30	3.53	-0.86425***
Zambia	41.84464	-9.508386	5.11	7.57	1.77	3.21	1.46	2.96	-0.77610***
Zimbabwe	5.563819	-4.616852	3.16	4.98	2.31	4.03	2.09	3.99	-0.239411*

Source: Authors' Conception. ***, ** and * represent 1%, 5% and 10% level of significance respectively.

The results in Table 10 show that the values of F-statistic are greater than the upper I(1) and lower I(0) bound critical values at 1%, 5% and 10% for all the countries, indicating an evidence of long-run relationship between the measures of digital finance, financial inclusion and economic growth. Hence, the null hypothesis (Ho) of no cointegration is rejected, suggesting the existence of long-run relationship between digital finance, financial inclusion and economic growth in the individual member countries. In addition, since the bound test shows that the series are cointegrated in the long-run, we estimated the short-run dynamic/the error correction term (ECT) across the COMESA member countries. The ECT results are observed to be negative and statistically significant across

the countries, indicating the speed of adjustment to equilibrium due to shocks from past years, *cetris paribus*. Hence, while Somalia, Mauritius, Swaziland, Zambia, Kenya, D.R. Congo and Comoros adjust to equilibrium faster, countries like Sudan, Egypt, Eritrea, Madagascar and Rwanda were found to be slow in their adjustment to equilibrium. The differences in the speed of adjustment to equilibrium may be linked to differences in policy mix by the individual countries.

5. CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

This study examined the nexus between digital finance, financial inclusion and economic growth in selected COMESA member countries using annual time series data that covered the period 1997-2018. Adopting the panel ARDL framework as proposed by Pesera et al. (2001), the study discovered that a significant and positive long-run relationship exists between digital finance, financial inclusion and economic growth in COMESA. Even when subjected to various robustness checks, this finding remained consistent. This suggests that digital finance and financial inclusion are key determinants of economic growth in COMESA, *cetris paribus*. The result reveals that automated teller machine (ATM), Mobile Purchase (MP), Point of sale (POS) and Mobile Banking (MB), as well as number of deposit accounts with commercial banks per 1,000 adults (NDA), number of registered mobile money accounts per 1,000 adults (NRMA), number of active mobile money agent outlets (NAMO), digital card ownership (DCO) and financial literacy (FIL) are vital in the region's economic growth process. This shows the importance of initiating policies that may further promote the need for every household's members to embrace digital finance and financial inclusion.

Using the index of digital finance and financial inclusion respectively, we found consistent evidence on the long-run relationship between digital finance, financial inclusion and economic growth. These results are generally in agreement with empirical evidence on the relationship between digital finance, financial inclusion and economic growth as seen in the works of Kesuh et al. (2020), Lapukeni (2015), Tabitha and Stella (2019), Shofawati (2019), Safo-Kwaako et al. (2018), Koh et al. (2018), Bhardwaj et al. (2018), Dai-Won et al. (2018), Uddin et al. (2017) and Rasheed et al. (2016) among others. It also supported the postulates of theory of financial innovation developed by Silber (1983), which sees financial innovation as key drivers of financial development and economic growth. Further investigation also revealed bidirectional causality between the index of digital finance, financial inclusion and economic growth, suggesting that policy initiative targeted on promoting digital finance and financial inclusion may result to economic growth. While controlling for the influence of institutional quality and macroeconomic volatility, we found that government effectiveness (GEF), regulatory quality (REQ), rule of law (ROL) and macroeconomic volatility (MEV) are strong predictors of economic growth. This evidence suggests that weak institution or legal environment and unstable macroeconomic environment may deter economic growth. Hence, the interactive effect of institutional quality and macroeconomic volatility on the index of digital finance and financial inclusion respectively is negatively related to economic growth of COMESA region.

Based on these findings, we urged the governments in COMESA region to create schemes that support digital finance and financial inclusion in the region. For instance, they could promote financial literacy across the region with emphasizes on the rural areas. This will help to increase access to digital financial services and enhance economic activities in COMESA region since more than 70% of their population is dependent on agriculture. Governments in the region could ensure that every bank operating within the region should adopt agency banking. This will ease the stress of economic agents travelling from rural to urban areas for financial transactions and the inherent risks. It will also enhance the habits of digital transaction by increasing the use of automated teller machine (ATM), point of sale (POS), internet banking (INB), mobile purchase (MP) and mobile banking (MB), as well as promotes number of registered mobile money accounts (NRMA), number of active mobile money agent outlets (NAMO) and digital card ownership (DCO). Besides, the introduction of finger prints and face scanning devices in all ATM stations in addition to passwords may likely reduce theft of debit/credit card information as well as instill more confidence in economic actors in the region. This may enhance e-financial activities and facilitate the smooth functioning of the real economy across the member states. Viable internet security should be initiated to protect economic agents

who see internet banking and mobile purchase as a means of performing their daily economic activities in the COMESA region. Monetary authorities in the region should initiate policies that may encourage the creation of central servers that may automatically generate the IP address of every device used in e-financial activities, and automatically blocks or denies all hidden IP addresses access to e-finance. This will reduce the rate of account hacking and internet related fraudulent activities. Finally, COMESA member countries should reduce service charges on e-financial transactions to encourage the use of digital finance and financial inclusion devices.

REFERENCE

[1] *Abel, S, Mutandwa, L & Roux, L. (2018): A Review of Determinants of Financial Inclusion; International Journal of Economics and Financial Issues, 8(3), 1-8.*

[2] *Abimbola, A., Olokoya, F. O., Babalola, O & Farouk, E. (2018). Financial Inclusion as a catalyst for poverty reduction in Nigeria. International Journal of Scientific Research and Management, Vol. 06, Issue 06, Pp.481-490*

[3] *Adam, C. S, Kessy, P., Nyella, J. J. & O'Connell, S. A. (2010). The Demand for Money in Tanzania. LSE Research Online*

[4] *Adeleye, N., Evans, O., Ebenezer, B., Oluwatoyin, M and Emmanuel, O (2017). Financial reforms and credit growth in Nigeria: Empirical insights from ARDL and ECM techniques, MPRA Paper No. 85351*

[5] *Adeola, O. and Evans, O (2017). Financial inclusion, financial development, and economic diversification in Nigeria. The Journal of Developing Areas, 51: 1-15.*

[6] *Aker, J. C., Boumnijel, R., McClelland, A. & Tierney, N. (2011). Zap It to Me: The Short-Term Impacts of a Mobile Cash Transfer Program. Center for Global Development, WP 268*

[7] *Al-Malkawi, H. N., H. A. Marashdeh and N. Abdullah (2012), 'Financial Development and Economic Growth in the UAE: Empirical Assessment Using ARDL Approach to Co-integration', International Journal of Economics and Finance, Vol. 4, No. 5.*

[8] *Andrianaivo, M., & Kpodar, K. (2011). ICT, Financial Inclusion and Growth: Evidence from African Countries. IMF WP/11/73.*

[9] *Aro-Gordon, S (2017). Implementation of Financial Inclusion Strategy in Nigeria, SDMIMD Journal of Management, Karnataka, Vol 8 | Issue 2*

[10] *Bakar, H. O and Sulong, Z. D (2018). The Role of Financial Sector on Economic Growth: Theoretical and Empirical Literature Reviews Analysis. Journal of Global Economics DOI: 10.4172/2375-4389.1000309*

[11] *Bara A. & Mudzingiri, C. (2016): Financial innovation and economic growth in the SADC: Evidence from Zimbabwe Investment Management and Financial Innovations, Research Southern Africa 1: 1-23.*

[12] *Barbesino, P., Camerani, R. & Gaudino, A. (2005). Digital finance in Europe: Competitive dynamics and online behaviour. Journal of Financial Services Marketing, 9(4), pp..329-343.*

[13] *Bayar, Y & Gavriletea, M. D (2018). Financial Inclusion and Economic Growth: Evidence from Transition Economies of European Union, JIFE, Volume 18, November 2.*

[14] *Bigiriman. M and Hogyi, X (2018). Research on Relationship between Financial Inclusion and Economic Growth of Rwanda: Evidence from Commercial Banks with ARDL; International Journal of Innovation and Economic Development, vol. 4, issue 1, 7-18*

[15] *Bist, J. P (2018). Financial Development and Economic Growth: Evidence from a Panel of 16 African and non-African Low-Income Countries. Cogent Economics & Finance, 6, https://doi.org/10.1080/23322039.2018.1449780*

[16] *Bruce, L., Gine, X., Goldberg, J. & Yang, D. (2013). Commitments to Save: A Field Experiment in Rural Malawi. World Bank eLibrary*

[17] *Choong, C. K., Z. Yusop, S. H. Law and V. K. S. Liew (2005), 'Financial Development and Economic Growth in Malaysia: The Perspective of Stock Market', Investment management and Financial Innovations, Business Perspectives, Ukraine, Vol. 2, No. 4, pp. 105-15.*

[18] *Chowdhury, M. (2016). Financial development, remittances and economic growth: Evidence using dynamic panel estimation. Margin: the Journal of Applied Economic Research, 10(1), 35-54. Doi: 10.1177/0973801015612666*

[19] *Dai-Won, K., Jung-Suk, Y & Hassan, M. K (2018). Financial inclusion and economic growth in OIC countries. Research in International Business and Finance, Elsevier, vol. 43(C), pages 1-14.*

[20] *Dell'Anno, R., Davidescu, A. A.& Balele, N. P. (2018). Estimating Shadow Economy in Tanzania: An Analysis with the MIMIC Approach. Journal of Economic Studies, 45(1), 100-113.*

[21] *Engle, R. F. and C. W. J. Granger (1987), 'Cointegration and Error Correction Representation: Estimation and Testing', Econometrica, Vol. 55, pp. 251-76.*

[22] Evans, O. (2015). The Effects of Economic and Financial Development on Financial Inclusion in Africa. Review of Economics and Development Studies 1, pp.17-25.
[23] Frame, W.S., Wall, L & White, L. J (2018). Technological Change and Financial Innovation in Banking: Some Implications for Fintech; Federal Reserve Bank of Atlanta Working Paper 2018-11
[24] Fromentin, V. (2017). The long-run and short-run impacts of remittances on financial development in developing countries. The quarterly Review of Economics and Finance, 66, pp.192-201. doi:10.1016/j.qref.2017.02.006
[25] Gomber, P., Koch, J. A. & Siering, M. (2017). Digital Finance and Fintech: current research and future research directions. Journal of Business Economics, 67(5), pp.537-580
[26] Gourene, G. A .Z & Mendy, P. (2017). Financial Inclusion and Econo m i c G r o w t h i n W A E M U : A M u l t i - s c a l e Heterogeneity Panel Causality Approach, https://mpra.ub.uni-muenchen.de/82251/1/MPRA_paper_82251.pdf (15.01.2018)
[27] Greenwood-Nimmo M, Shin Y (2013) Taxation and the asymmetric adjustment of selected retail energy prices in the UK. Econ Lett 121:411-416
[28] Gregory, A. W. and B. E. Hansen (1996), 'Tests for Cointegration in Models with Regime and Trend Shifts', Oxford Bulletin of Economics and Statistics, Vol. 58, No. 3, pp. 555-60.
[29] Haider, H. (2018). Innovative financial technologies to support livelihoods and economic outcomes. Helpdesk Report
[30] Hariharan, G., & Marktanner, M. (2012). The Growth Potential from Financial Inclusion. Draft submitted for Atlanta Fed/GSU International Development Economics.
[31] Iman, N (2020). The rise and rise of financial technology: The good, the bad, and the verdict. Journal Cogent Business & Management Volume 7, 2020 - Issue 1
[32] Inoue, T. (2019), "Financial inclusion and poverty reduction in India", Journal of Financial Economic Policy, Vol. 11 No. 1, pp. 21-33, https://doi.org/10.1108/JFEP-01-2018-0012
[33] Iqbal, B. A & Sami, S. (2017): Role of banks in financial inclusion, Contaduría y Administration 62 (2017) 644-656, http://dx.doi.org/10.1016/j.cya.2017.01.007
[34] Jahan, S., Jayendu, D., Jamaludin, F., Sodsriwiboon, P & Sullivan, C (2019). The Financial Inclusion Landscape in the Asia-Pacific Region: A Dozen Key Findings. IMF Working Papers, WP/19/79
[35] Johansen, S. (1988), 'Statistical Analysis of Cointegrating Vectors', Journal of Economics and Dynamic Control, Vol. 12, pp. 231-54.
[36] Johansen, S. and K. Juselius (1990), 'Maximum Likelihood Estimation and Inference on Cointegration: With Applications to the Demand for Money', Oxford Bulletin of Economics and Statistics, Vol. 52, pp. 169-210.
[37] Jong-Hee, K. (2016). A study on the effect of financial inclusion on the relationship between income inequality and economic growth. Emerging Markets Finance and Trade 52: 498-512.
[38] Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. Journal of Econometrics 90, pp.1-44.
[39] Ketterer, J. A. (2017). Digital Finance: New Times, New Challenges, New Opportunities. Inter-American Development Bank. March: https://publications.iadb.org/handle/11319/8199
[40] Klapper, L., El-Zoghbi, M. & Hess, J. (2016). Achieving the Sustainable Development Goals: The Role of Financial Inclusion. CGAP.
[41] Koh, F., Phoon, F. & Ha, C. D. (2018). Digital financial inclusion in South East Asia. Handbook of Blockchain, Digital Finance, and Inclusion, 2. doi:10.1016/B978-0-12-812282-2.00015-2
[42] Koomson, I., Villano, R.A. & Hadley, D. (2020). Effect of Financial Inclusion on Poverty and Vulnerability to Poverty: Evidence Using a Multidimensional Measure of Financial Inclusion. Soc Indic Res 149, pp.613-639. https://doi.org/10.1007/s11205-019-02263-0
[43] Lapukeni, A. F. (2015). Financial Inclusion, ICT and Intra Regional Trade in COMESA. Paper presented at the COMESA Research Forum, in Entebbe, MPRA Paper No. 75631
[44] Lenka, S. K., Sharma, R. (2017): Does Financial Inclusion Spur Economic Growth in India? Journal of Developing Areas, 51(3), doi: 215-228. DOI:10.1353/jda.2017.0069
[45] Li, X. & Zeng, S. (2010). Finance Innovation Model Literature Review. Beijing University of Technology, http://www.seidatacollection.com/upload/product/201005/2010qyjjhy01a4.pdf
[46] Lim, W. M. & Ting, D. H. (2012). E-shopping: An Analysis of the Technology Acceptance Model. Modern Applied Science, 6(4), 49 -62
[47] Lule, I., Omwansa, T. K. &Waema, T. M. (2012). Application of Technology Acceptance Model (TAM) in M-Banking Adoption in Kenya. International Journal of Computing and ICT Research, 6(1), 31-43.
[48] Manasseh, O. C., Mathew, T. E and Ogbuabor, J. E. (2017). Investigating the Nexus between Institutional Quality and Stock Market Development in Nigeria: An Autoregressive Distributed Lag (ARDL) Approach. African Development Review, Vol. 29, No. 2, pp. 272-292

[49] Martin, C., Harihareswara, N., Diebold, E., Kodali, H. & Averch, C. (2016). Guide to the Use of Digital Financial Services in Agriculture. USAID's Mobile Solutions Technical Assistance and Research. https://www.raflearning.org/post/usaid-mstars-guide-use-digital-finance-services-agriculture

[50] Mojtahed, R., Nunes, J. M. B. & Peng, G. C. (2011). The Role of the Technology Acceptance Model in Information Systems Research. In Proceedings of the International Workshop on Information Systems Research Trends, Approaches and Methodologies Rome, Italy.

[51] Mwaitete, C. P & George, L .A. (2018). Financial Inclusion and Economic Growth: A Regression Analysis. Imperial Journal of Interdisciplinary Research, 4(1), pp.265-288.

[52] Narayan, P. K.and Smyth, R. (2005). "What Determines Migration Flows from Low-Income to High-Income Countries? An Empirical Investigation of Fiji-U.S. Migration 1972 -2001. Contemporary Economic Policy 24 (2): 332-342.

[53] Nguling'wa, P. B (2019). The Impact of Financial Inclusion on Economic Growth in Sub-saharan Africa. Journal of Applied Economics and Business, vol. 7, issue 4, Pp. 51-68

[54] Odeleye, A. T & Olusoji, M. O (2016). Financial Inclusion and Inclusive Growth In Nigeria; A Conference paper titled: Attaining Inclusive growth in Nigeria: challenges and prospects"., at Abuja, Nigeria

[55] Odhiambo, N. M. (2009), 'Stock Market Development and Economic Growth in South Africa: An ARDL-Bounds Testing Approach', available at: www.wbiconpro.com/2.Nicholas.pdf

[56] Ogbuabor, J. E., Orji, A., Aneke, G. C and Manasseh, C. O (2018). Did the global financial crisis alter the oil–gasoline price relationship?, Empirical Economics, 57, 1171–1200. https://doi.org/10.1007/s00181-018-1490-z

[57] Okafor, I. G., Ezeaku, H. C. & Anyalechi, K. C. (2017). Does financial innovation drive growth? Empirical analysis of the Nigerian case.British Journal of Economics, Management & Trade, 16(3), 1-10.http://www.journalrepository. Org/media/journals/BJEMT_20/2017/Mar/Chijindu1632016BJEMT30809.pdf

[58] Okoye, L. U., Adetiloye, K. A., Erin, O & Modebe, N. J. (2017). Financial Inclusion as a Strategy for enhanced Economic Growth and Development, journal of internet banking and commerce, Vol. 22, No. S8

[59] Omojolaibi, J. (2017): Financial Inclusion, Governance and Economic Progress in Nigeria: What Happens to the Welfare of the Poor? Arabian Journal of Business and Management Review (Oman Chapter) Vol. 6, No. 7

[60] Osafo-Kwaako, P., Singer, M., White, O., & Zouaoui, Y. (2018). Mobile money in emerging markets: The business case for financial inclusion. McKinsey Global Institute, March. https://www. mckinsey. Com/~/media/McKinsey/Industries/Financial%20Services/our% 20Insights/Mobile, 20.

[61] Otiwu, K C., Okere, P. A., Uzowuru, L. N & Ozuzu, P (2018). Financial Inclusion and Economic Growth of Nigeria. International Journal for Innovation Education and Research, Vol. 6 No. 2

[62] Oyelami, L. O. & Ogundipe, A. A. (2019): An empirical investigation of remittances and financial inclusion nexus in Sub-Saharan Africa, Journal of Congent Business Management Volume 7, 2020 – Issue 1

[63] Ozili, P. K (2018). Impact of Digital Finance on Financial Inclusion and Stability Rasheed, Balach, Siong-Hook Law, Lee Chin, and Muzafar Shah Habibullah. 2016. The role of financial inclusion in financial development: International evidence. Abasyn University Journal of Social Sciences 9: 330–48.

[64] Ozurumba, C. O. & Onyeiwu, C (2019). The Impact of Financial Innovation on Economic Growth in Nigeria. International Journal of Economics, Commerce and Management, Vol. VII, Issue 8.

[65] Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and Statistics 61: 653–70.

[66] Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory 20: 597–625.

[67] Pesaran, M. (2004). Pesaran, M. Hashem 2004. General Diagnostic Tests for Cross Section Dependence in Panel. CESifo Working Paper Series 1229.

[68] Pesaran, M. H, Shin, Y & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American Statistical Association 94: 621–34.

[69] Pesaran, M. Hashem, Shin, Y & Smith, R, P. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16: 289–326.

[70] Qamruzzaman, M. and Wei, J(2019). Do financial inclusion, stock market development attract foreign capital flows in developing economy: a panel data investigation. Quantitative Finance and Economics, Volume 3, Issue 1, 88–108. DOI: 10.3934/QFE.2019.1.88

[71] Rahman, M. M. and M. Salahuddin (2012), 'The Determinants of Economic Growth in Pakistan: Does Stock Market Development Play a Major Role?', Economic Issues, Vol. 15, No. 2, pp. 69-86.

[72] Raichoudhury, A. (2019): Financial Inclusion and Economic Growth Utilizing Panel Co-Integration. International Journal of Recent Technology and Engineering (IJRTE) Volume 8, Issue 4

[73] Rasheed, B., Siong-Hook, L., Chin, L & Habibullah, M. S. (2016). The Role of Financial Inclusion in Financial Development: International Evidence, Abasyn University Journal of Social Sciences, Volume 9, Special Issue

[74] Rewilak, J (2017). The role of financial development in poverty reduction, Review of Development Finance 7, 169-176

[75] Saab, G. (2017). Financial Inclusion and Growth. Business and Management Review, 8(4), 434-441.

[76] Scheneider, F., Buenhn, A. & Motenegro, E. C. (2010). Shadow economies all over the world: New economies for 162 countries from 1999 to 2007. Policy research working paper, 53-56.

[77] Scott, S. V., Van Reenen, J., &Zachariadis, M. (2017). The long-term effect of digital innovation on bank performance: an empirical study of SWIFT adoption in financial services. Research Policy, 46(5), 984-1004.

[78] Sekhar, S & Gudimetla, V. (2013). Theorems and Theories of Financial Innovation: Models and Mechanism Perspective. Financial and Quantitative Analysis 1: 26.

[79] Sha'ban, M., Girardone, C & Sarkisyan, A. (2020). Cross-country variation in financial nclusion: a global perspective, The European Journal of Finance, 26:4-5, 319-340, DOI: 10.1080/1351847X.2019.1686709

[80] Sharma, D. (2016). Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy. Journal of Financial Economic Policy 8: 13-36.

[81] Shen, Y. & Huang, Y. (2016). Introduction to the special issue: Internet finance in China. China Economic journal, Volume 9, Issue 3, Pages 221-224

[82] Shofawati, A. (2019). The Role of Digital Finance to Strengthen Financial Inclusion and the Growth of SME in Indonesia; 2nd ICIEBP the 2nd International Conference on Islamic Economics, Business, and Philanthropy (ICIEBP) Theme: "Sustainability and Socio Economic Growth" Volume 2019

[83] Silber, W. L. (1983). The process of financial innovation. American Economic Review, (73).

[84] Tabitha, D & Stella, G. (2019). Digital Finance and Its Impact on Financial Inclusion, Journal of Emerging Technologies and Innovative Research, Vol.6, Issue 1, page no.122-127

[85] Taiwo, J. N., Kehinde, A. O., Afieroho, E. O. & Agwu, M. E. (2016). Appraisal of Cashless Policy on the Nigerian Financial System, West African Journal of Industrial and Academic Research. 10(1), 96-108

[86] Thai-Ha, L., Chuc, A. T & Taghizadeh-Hesary, F (2019 Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia, Borsa Istanbul Review, Volume 19, Issue 4, Pages 310-322

[87] The Global Findex Database. (2019): http://www.worldbank.org/en/programs/globalfindex. [Last accessed on 2017 Feb 15].

[88] Uddin, A., Chowdhury, M. A. F & Islam, M (2017). Determinants Of Financial Inclusion In Bangladesh: Dynamic Gmm & Quantile Regression Approach. The Journal of Developing Areas, 51(2), 221-237. https://doi. org/10.1353/jda.2017.0041

[89] Wakdok, S. S (2018). The Impact of Financial Inclusion on Economic Growth in Nigeria: International Journal of Innovation and Research in Educational Sciences Volume 5, Issue 2

[90] Williams, H. T., Adegoke, A. J & Dare, A. (2017). Role of Financial Inclusion in Economic Growth and Poverty Reduction in a Developing Economy. Internal Journal of Research in Economics and Social Sciences, Vol. 7 Issue 5, pp. 265-271

[91] Yorulmaz, R. (2016). Construction of a Financial Inclusion Index for the Member and Candidate Countries of the European Union. Sayıştay Dergisi, No.102

[92] Zhong, J and Tingui, L (2019): Impact of Financial Development and Its Spatial Spillover Effect on Green Total Factor Productivity: Evidence from 30 Provinces in China; Mathematical Problems in Engineering, Volume 2020, 11 pages, https://doi.org/10.1155/2020/5741387

[93] *Zins, A and Weill L. (2016): The determinants of financial inclusion in Africa Review of Development Finance, 6 (1) (2016), pp. 46-57*