THE GROWTH EFFECTS OF ELECTRONIC BANKING: EVIDENCE FROM EASTERN AFRICA

Mudasiru Kyewaalabye , **John Bbale Mayanja** , **John Bosco Nnyanzi** [*]
Makerere University, School of Economics, P.O BOX 7062, Kampala Uganda
E-mail: jbnnyanzi@yahoo.com

Abstract
Innovations in the financial sector are theoretically imbued with potential to impact economic growth. However, studies that have sought to investigate this linkage in Eastern Africa have produced mixed results. Moreover, barely a few existing empirics have attempted to examine the possible mediating role of investment and savings on the latter nexus if any. With focus on the period from 2004 through 2018, this study investigates the extent to which electronic banking affects economic performance in the region. Furthermore, the moderating effects of investment on the one hand and savings on the other were examined in the innovations-growth nexus to capture any conditional effects. To achieve our objective, panel data was analyzed using the autoregressive distributed lag (ARDL) approach well-known for its efficiency and unbiasedness, as it takes care of endogeneity and serial correlation but which is also relatively more robust in small and finite sample data size. The results reveal the presence of the short and long-run relationship between electronic banking and economic growth. It is important note here that the impact is significantly stronger for the longrun relative to the shortrun. Interestingly, our findings confirmed the significant role played by capital formation in the latter relationship. On the other hand, the analysis provides no evidence that gross domestic savings are important in this linkage. However, we observe a direct critical role of investment, savings, inflation, foreign direct investment as well as labor in influencing output growth in the long run. Policies that are geared towards promoting electronic banking and investment while simultaneously minimizing the risks to the financial sector instability should be a priority in Eastern Africa

Research paper

Reference to this paper should be made as follows: Kyewaalabye, M., Mayanja, J. B., & Nnyanzi, J. B. (2022). The Growth Effects of Electronic Banking: Evidence from Eastern Africa. *Journal of Entrepreneurship, Business and Economics*, *10*(1), 294–325.

Introduction

Financial innovation can be defined as the process of creating new financial or investment products, services, or processes. These modifications can include efficient technology, risk management, risk transfer, credit and equity generation, as well as many other innovations in the financial industry. Some of recent innovations in the financial industry include crowd funding, mobile banking technology, ATMs concentration, electronic funds transfer, credit and debit card usage and remittance technology. While these are theoretically assumed to be a catalyst to the financial sector development, with potential to correct business models of traditional banking system, structure, risks, and financial operations process, the extent to which they contribute to economic growth is characterized by a mixture of evidence in the empirical arena. Nevertheless, several authors have provided evidence on the linkages that exist between these financial innovations and other macroeconomic factors, with the majority focusing on money demand (e.g. Nnyanzi, 2018). The latter study in particular avers that financial innovations have not only contributed significantly to increased employment opportunities, household savings, ease of exchange of goods and services, in countries where thay have been fully embraced, but also orchestrated the availability of credit, reduction in the cost of capital, as well as encouraging technological progress and greater efficiency. Additionally, the role of financial innovations in enhancing consumption smoothing and investment decisions for households and corporations is attributed to the dynamics of financial innovations in Bara, Mugano & Le Roux (2016).

On account of the above aforementioned benefits attributed to financial innovations, it is not illogical to argue that there is a theoretical connection between financial innovations and economic growth. In fact, it is avered that the exclusion of the financial innovations in the growth model would potentially result in misspecification of the model, particularly for countries that have witnessed a surge in these innovations (Nnyanzi, 2018). Eastern Africa is one such region where countries have in the recent decades experienced enormous dynamism in financial technology. For example, according to the report by the African Development Bank (2019), about 80% of the Kenyan population use mobile financial services followed by Rwanda and Tanzania with 60%, Uganda (56%), Ethiopia (31%), Malawi (30.2%), Burundi (21%), Zambia (12.11%), Madagascar (12.1%), and DRC (9.2%), inter alia. The adopted economic liberalization and structural transformation policies initiated in the 1990s in Eastern Africa appear to have inevitably heightened the technology of the financial system (Yakubu et al., 2022). However, the question still perturbing economists and policy makers alike has to do with the role of financial innovations in economic growth.

For Africa, the existing studies regarding the aforementioned linkage are seemingly scanty, while those at a wider global level appear inconclusive and mixed. For example, while the likes of Qamruzzaman and Jianguo (2018), reveal a positive relationship between financial innovations and economic growth, it is not uncommon to find others documenting a negative relationship (e.g. Adusei, 2013; Bara, Mugano & Le Roux, 2016). Regarding the latter, the intrinsic argument is that finacial innovations can adversely impact GDP through excessive increases in liquidity outside of the banking system, triggering inflationary pressures due to low productivity and relatively

higher imports. At the same time, it is not uncommon to locate studies that report no significant relationship between financial technology and output growth (e.g. Ulgen, 2014; Okereke, 2016; Nsor-Ambala & Amewu, 2022). Moreover, the likes of Adu-Asare & Aboagye (2014) and Okereke (2016) support the two contrasting outcomes: an inverse link in the long-run but positive relation in the short-run. Perhaps the observed divergencies in findings could be attributed to differences in data, methodologies and the nature of the sample in the analysis, as well as the proxies used for financial innovation. For example, there is a likelihood that country-specific studies produce different outcomes compared to regional studies due to differences in the sample characteristics. As argued in Nnyanzi (2018), it is important that focus is limited to individual proxies of financial innovation rather than ramping all innovations in one index. Such an approach would probably benefit policy direction in a more effective way. A critical review of the existing literature also appears to suggest differential outcomes depending on whether time-series, cross-sectional or panel analysis is used. Nevertheless, it should be pointed out that panel data contains more information, more variability, and more efficiency than pure time series data or cross-sectional data. Despite the well-known superiority of panel data to detect and measure statistical effects that pure time series or cross-sectional data can't, a sizable amount of empirics employ the latter two data techniques, perhaps due to panel data unavailability.

In light of the above, the current paper contributes to the ongoing debate by examing the effect of electronic banking on economic growth in Eastern Africa in a panel framework. The use of the latter data type, well-known for allowing a larger number of observations, in addition to accounting for

individual-specific heterogeneity, is targeted for its additional advantage of studying more complex behavior among variables such as in the present case. Our focus on Eastern Africa is because the region has experienced aggressive digital innovations in the financial system, making them take the lead in Africa. According to the African Union report of 2021 (AU, 2021) that makes the latter observation, the hypothesis is that if policymakers and regulators take the risk to invest in innovation, this would make the financial sector more inclusive and could be a catalyst for growth. Incidentally, the Eastern Africa has been highlighted as the best performing region in Sub-Saharan Africa in terms of economic growth. For example, regional GDP has increased from 5.8% between 2004 and 2013 to 6.7% between 2013 and 2017. Could financial innovations have had a role in the observed growth trends? And if so, to what extent would other macroeconomic factors play in this linkage?

These are certainly still empirical questions. In other words, particularly for the Eastern Africa, the empirical linkage between the observed surge in financial innovations to economic growth is not well-ascertained. Theoretically too, one would on one hand envisage a positive relationship between the financial technology and growth, given the power of financial innovations to influence financial sector development by kindling the supply of money in the financial system, which in turn boosts economic growth. However, the possibility of having little if any impact on growth may not be dismissable either, especially if financial innovations contribute minimally to the financial sector development or if the regulatory framework in the financial sector is weak. For, as Beck et al. (2016) argue, too much or inefficient innovation may have serious consequences for the overall economy. Moreover, it is also

not far-fetched to contend that financial innovations which favour consumption over investment are likely to have a negative effect on the economy (Dana et al., 2022 a,b,c; Soleimani et al., 2022). Given these contrasting theoretical as well as the empirical underpinnings earlier pointed out, it is important to ascertain the extent to which financial innovations affect economic growth for Easetern Africa.

Solans (2003) argues that the effects of financial innovation on growth depend on either decreased risks or improved service that satisfy the particular needs of players in the financial system. Similarly, according to Almsafir and Morzuki (2015) financial innovations could lead to a higher level of savings and capital accumulation, which in turn orchestrate economic growth in the long run. The current study therefore, takes these conditionality arguments into consideration by additionally investigating the indirect role of financial innovation on growth, specifically via investment and savings. The choice of the latter two factors is based partially on the enumerable efforts during the last decades in the East African region to improve the investment climate as well as implementing pro-savings strategies to reduce the relatively high marginal propensity to consume characterizing member countries. Particularly on investment, the region for example boasts of several Investment Promotion Agencies (IPAs) such as Burundi Investment Promotion Authority (API), Kenya Investment Authority (KenInvest), Rwanda Development Board (RDB), South Sudan Investment Authority (SSIA), Tanzania Investment Centre (TIC), Uganda Investment Authority (UIA), and, Zanzibar Investment Promotion Agency (ZIPA) *inter alia*. As a result of these and similar efforts, the region has witnessed increasing investments, both foreign and domestic. Bernier & Plouffe (2019) argues that financial innovation could theoretically

be related to economic growth through gross capital formation. This implies that the potential impact of innovations on the economy might be missed if the investment behaviours in an economy are compromised. Therefore, the possibility of investment playing a role in the innovations-growth nexus may not be dismissable. We investigate the latter hypothesis from an empirical perspective. Moreover, given that the savings banks appear to have been responsible for a whole set of innovations, it is considered appropriate in the current study but also in line with Bonga-Bonga and Guma (2017) to ascertain the moderating role of savings in the same linkage, if any.

In sum, our paper paper addresses two policy objectives: First, the study investigates the effect of electronic banking (proxied by ATM concetration) on economic growth in Eastern Africa. The justification for our choice of this innovation proxy hinges not only on data availability, but essentially because the ATM measure has been consistently employed in developing countries, given its popularity amongst retail customers (Ekpu, 2015). Secondly, the paper analyzes the indirect effect of financial innovations on economic growth via investment and savings. While the direct role of either of these variables on economic growth is unquestionably well-researched, the extent to which either factor affects the relationship between financial innovations and economic growth is less explored in literature. To our knowledge, only a few studies such as Laeven et al. (2015) considered similar interactions *albeit* suggesting financial institution and technological entrepreneurs as the moderator factors (Dana et al., 2021; Dana et al., 2022 d). In the present case, the behaviour of financial innovations in driving or curtailing economic growth amidst changes in domestic investment or domestic savings is the point of focus.

Apart from contributing to the existing literature on the subject under analysis, the study would go a long way to reshape policy, particularly those geared towards promoting electronic banking and investment while simultaneously minimizing the risks to the financial sector instability should be a priority in Eastern Africa. As the region becomes more integrated, ascertaining the direct and indirect role of financial innovations in the region's economic growth would be handy in providing direction for the financial sector development as well as realigning financial innovations with economic growth.

The main finding is that for Eastern Africa, there is a short and long-run relationship between electronic banking and economic growth. However, the impact is observed significantly stronger in the longrun relative to the shortrun. Interestingly, our findings confirmed the significant role played by capital formation in the latter relationship. On the other hand, we fail to find evidence that gross domestic savings are important as moderators. Nevertheless, we observe a direct critical role of investment, savings, inflation, foreign direct investment as well as labor in influencing output growth in the long run.

The rest of the paper is organized as follows. Section two offers both theoretical and empirical literature while Section three presents the methodology used. The empirical findings and conclusion are presented in Sections four and five, respectively.

Overview of literature

At the theoretical level, several schools of thought exist postulating the link between innovations and economic growth. For example, the "financial innovation-led growth" theory assumes the presence of a "supply-leading" association between financial innovation and economic growth. It is reasoned that the presence of financial innovation as a powerful financial instrument in allocating inadequate financial resources from surplus units to deficit units offers an efficient allotment of resources leading other economic sectors in their growth process (Beck, 2010; Salamzadeh & Markovic, 2018). By implication, a well-developed financial system enhances technological innovation and economic growth through the provision of financial services and resources to entrepreneurs (Salamzadeh et al., 2021). At the same time, well-working financial intermediaries improve efficiency in the allocation of capital resources, encourage savings and lead to more capital formation and economic growth.

On the other hand, in the "demand-following" theory, as reported Bara, Mugano & Le Roux (2016), high economic growth generates demand for financial products. By implication, financial innovations are effectively responsive to the demand changes. Therefore, increasing demand for financial services deepens the financial sector as the economy progresses. In sum, the gist of the hypothesis is that the expansion of economic activities, real sector development, and increased domestic as well as international trade exert pressure on financial systems not only to improve payment mechanisms, but also to make financial institutions more efficient and diversify financial assets for purposes of reducing investment risks.

The 'feedback' theory propagated by the likes of Bara and Mudzingiri (2016) further strengthened the causality view albeit arguing for bi-directional causality between financial development and economic growth. The latter theory assumes that a country with a robust financial system promotes high economic growth through technological changes, product and services innovation hence creating a high demand for financial products and services. As such, the banking sector commendably responds to these demands. The model assumes that both financial innovations and economic growth are positively interdependent and their association leads to feedback causality.

In their critique of the aforementioned theories however, the likes of Doepke & Zilibotti (2014) argue that in an endogenous model framework, there is no way the causality view would hold. Acording to the the endogenous growth theory, economic growth is predominantly a consequence of internal forces, instead of external forces. Therefore, productivity improvements can be tied directly to rapid innovations and investments in human capital from the public and private sectors. By implication, the theory avers that investment in human capital, innovations, and knowledge are important drivers of economic growth. In such cases, economic growth depends on policy measures such as research and development, as well as education.

At the empirical front, a dearth of literature *albeit* characterized by a mixture of evidence, focus on the aforementioned linkage between financial innovaions and economic growth. For Africa in particular, scanty evidence exists and is equally mixed, with some reporting a positive effect while others document an adverse linkage, as well as those which provide mixed and inconclusive evidence.

For example, employing the ARDL technique on data collected in the Southern African Development Community, and estimated particularly by pooled mean group and dynamic fixed-effects techniques, Bara, Mugano & Le Roux (2016) reveal that financial innovation has a positive long-run relationship with economic growth. These findings were in support of a previous study by Pece et al. (2015) based on a panel of three Central and Eastern European Countries using multiple regression models, as well as those from Qamruzzaman and Jianguo (2017) who focused on data from Bangladesh for the period 1991 to 2015, after employing the Cointegration test. A later study by Chukwunulu (2019), using applying the GMM technique on data from Nigeria during the period 2008 to 2017, finds that automated teller machines, mobile banking, as well as point of sale terminals had a significant positive effect on economic growth.

In another study by Bara and Mudzingiri (2016) on Zimbabwe, for the period 1980-2013, the results based on the ARDL bounds test reveal that financial innovation has a relationship to economic growth that varies depending on the variable used to measure financial innovation. Specifically, the authors note that while the ratio of broad to narrow money had a significant positive effect on economic growth in the long run, albeit negative in the shortrun, growth in banking sector credit to private sector was found insignificant both in the shortrun and longrun. Similarly, Qamruzzaman and Jianguo (2018), with focus on Asian countries between 1974Q1 and 2016Q4, use ARDL bounds testing, provide further evidence of the long-run cointegration. However, once the author employ the nonlinear ARDL approach, they confirm the presence of an asymmetric relationship between financial innovation, banking sector development, and economic growth. Still, the findings are

confirmed even when the authors focus on Bangladesh, and particularly for the period 1980 to 2016.

In a study by Adusei (2013), that employs various techniques including cointegration, Fully-Modified Ordinary Least Squares, Error Correction as well as Generalized Method of Moments technique, the focus is on Ghana for the period 1971-2010. The results therefrom show that financial innovations proxied by domestic credit as a share of GDP, domestic credit to private sector as a share of GDP and broad money supply as a share of GDP, are negatively related to economic growth.

Okereke (2016) on the other hand, used ordinary least square to investigate the effect of various maeasures of financial technology on economic growth of Nigeria. While it was found that only point of sales terminal was significant to economic growth, data provided no proof that automated teller machine, mobile banking, Internet banking were related significantly to economic growth. Similar findings are recorded in a recent study by Nsor-Ambala & Amewu (2022), which focuses on Ghana during the period 1960-2019. The results here obtained from a non-linear autoregressive distributed lag (ARDL) time series econometric model reveal no evidence that financial innovations significantly impact economic growth.

On their part, Adu-Asare and Aboagye (2014), focus on Ghana for the period 1990 to 2009 using quarterly data analyzed using the ARDL cointegration procedures to show show that while in the long run, bank competition is positively related to economic growth, financial innovation is negatively related to economic growth. In contrast, the short run results demonstrate that bank competition is negatively related to economic growth whereas financial innovation is positively related to economic growth.

At a panel level, an earlier study by Ajide (2016) looked at 8 West African countries from 2000 to 2013. By employing the ratio of M3 to M1 to proxy financial innovation, the findings confirmed that an increase in banking efficiency driven by competition and financial innovation improves economic growth and development. A much more related study by Worku (2016) that focused on East Africa from 1975 to 2014, using the FMOLS technique, however, provides support for the supply-leading and demand-following hypotheses, implying that financial sector development accelerates economic growth in East Africa. Previously, Valverde et al. (2007) analyzed 17 administrative regions of Spain from 1986 to 2001, using the GMM methodology, to conclude that there is a positive and significant relationship between bank financial deepening and economic growth.

A recent study by Domeher, Konadu-Yiadom & Aawaar (2022), analyzing data from 26 selected SSA countries over the period 2004 to 2017 using the GMM estimation technique found out that financial inclusion fully mediates the relationship between innovation and economic growth. On the other hand, Bernier and Plouffe (2019), employing a panel of 23 countries over the period of 1996–2014, demonstrate that financial innovation is positively related to economic growth through gross capital formation. Additionally, the authors find little robust evidence of macroprudential policy influencing the relationship between financial innovation and economic growth.

Overall, the above-mentioned studies present no consensus regarding the influence of financial innovations on economic growth. Realistically, the findings documented appear inconclusive and mixed. While the majority of the studies conducted on Eastern Africa have focused on the direct role of financial innovations on economic growth and are basically at a country level

analysis, all reviewed works on Eastern Africa generally ignore the indirect effects of financial innovations on economic growth. This paper closes the knowledge gap for Eastern Africa by examining the role played by financial innovation in influencing economic growth, both directly and indirectly via investment and savings. Ascertaining the latter moderating role would go a long way in improving policy.

Empirical strategy

Model spectification

The empirical model for this study is given below;

$$Y_{it} = \beta_0 + \beta_1 FI_{it} + \beta_2 X_{it} + \varepsilon_{it}$$

(3.7)

Where Y is economic growth, FI is financial innovations, X is a set of control variables specified by the growth theory. The subscripts i and t present country specific and time specific components respectively. β_0 is intercept while β_1 to β_2 are coefficients of the explanatory variables and ε is the error term. Therefore, the general financial innovation-economic growth relationship can be specified as follows;

$$GDP_{it} = \beta_0 + \beta_1 EB_{it} + \beta_2 GCF_{it} + \beta_3 LFPR_{it} + \beta_4 INFL_{it} + \beta_5 FDI_{it} + \beta_6 GDS_{it} + \varepsilon_{it}$$

(3.8)

Here, GDP is growth of gross domestic product (same as Y in equation 3.7); EB is electronic banking (proxy for financial innovation); GCF is gross fixed capital formation (proxy for domestic investment); LFPR is labour

force participation rate (proxy for labor); INFL is inflation; FDI is foreign direct investment; GDS is gross domestic savings. We include investment and savings in the same model because traditionally the major growth enhancing factors are savings and investment and the norm is that not every saving is invested as it is assumed and that each variable is independent.

The effect of financial innovations on economic growth could be through policy variables especially investment and savings. The fact that investment is a component of aggregate demand and that increase in investment enhances economic growth, we include interaction terms to examine the indirect effect of financial innovations on economic growth via investment following Bernier and Plouffe (2019). Hence our model for interactions will be presented below;

$$GDP_{it} = \alpha_0 + \alpha_1 EB_{it} + \alpha_2 GCF_{it} + \alpha_3 LFPR_{it} + \alpha_4 FDI_{it} + \alpha_5 GDS_{it} +$$
$$\alpha_6(GCF_{it}^* EB_{it}) + \varepsilon_{it}$$

(3.9)

Furthermore, we interact savings with financial innovation to evaluate the indirect role of financial innovations on economic growth via savings, following Bonga-Bonga and Guma (2017). Thus our model for interaction is specified as follows;

$$GDP_{it} = \gamma_0 + \gamma_1 EB_{it} + \gamma_2 GCF_{it} + \gamma_3 LFPR_{it} + \gamma_4 INFL_{it} + \gamma_5 GDS_{it} +$$
$$\gamma_6(GDS_{it}^* EB_{it}) + \varepsilon_{it}$$

(3.10)

Variable description, measurement and data

In the estimated model, the dependent variable is the annual growth rate of GDP, with data sourced from the World Bank Database (WDI). The growth of labour force participation rate is included to proxy for labor. We expect the this variable to be positively related to economic growth. Similarly, capital is here proxied by gross fixed capital formation as percentage of GDP. On financial innovations, as explained earlier, the current study adopts ATMs concentration to measure financial innovation and is expected to a positive impact on economic growth. Data unavailability limited the use of alternative measures such as mobile banking, agent banking, electronic funds transfer, internet banking, debit and credit card usage. Nevertheless, our choice has basis in empirical literature as above reviewed. The expected relationship with economic growth is positive. This is because such technology is likely to improve accessibility and financial inclusion, which would consequently be a catalyst for ease in doing business.

Again from reviewed literature, we include savings, here proxied by gross domestic savings as a percentage of GDP. A positive relationship with economic growth is expected. The other control variable we include is inflation, here to measure the macroeconomic stability. The proxy adopted is annual percentage rate of consumer price index, with a negative sign expected. Finally, we include foreign direct investment, here measured by net inflows as a percentage of GDP. This is because, Eastern Africa has for the last decade witnessed enormous growth in foreign investment, which several authors have empirically related to growth (e.g. Mutenyo, Nnyanzi and Makika, 2022). It is expected that this variable is positively related to economic

growth. Table 1 below presents a summary of the variable description and data source.

Table 1. Variable Description, Data Sources and their Expected Signs

Variable	Variable Description	Source	Expected Sign
GDP Growth (Annual percentage)	Gross Domestic Product measured in annual percentage	World Development Indicators (WDI)	
EB	Electronic banking proxied by ATMs Concentration	World Development Indicators (WDI)	Positive
GCF	Investment proxied by Gross Fixed Capital Formation as a percentage of GDP	World Development Indicators (WDI)	Positive
LFPR	Labor force Participation rate measured as a percentage of total population.	World Development Indicators (WDI)	Positive
GDS	Gross Domestic Saving as a percentage of GDP	World Development Indicators (WDI)	Positive
INFL	Inflation rate measured by consumer price index	World Development Indicators (WDI)	Negative
FDI	Foreign Direct Investment, net inflows (% GDP)	World Development Indicators (WDI)	Positive

Source: Author's Compilation

Data Analysis

It should be noted that the current study employs panel data on fourteen (14) Eastern African countries. As presented in Table 2, the summary statistics were computed for fourteen Eastern African countries for the period of fifteen (15) years resulting into a total number of two hundred and ten observations. This signifies that the panel is strongly balanced. The minimum and maximum values of each of the variables have also been computed of

which, overall, there are no outliers since the minimum and the maximum values of each of the variables is moderately near their mean.

Table 2. Summary Statistics

VARIABLES	(1) N	(2) Mean	(3) sd	(4) Min	(5) max
GDP	210	5.495	2.970	-4.014	13.57
EB	210	8.401	14.00	0.0194	82.55
GDS	210	10.19	9.804	-13.78	36.03
INFL	210	8.604	6.776	-4.295	44.36
GCF	210	22.73	7.325	9.358	43.05
FDI	210	4.686	6.528	-6.321	41.81
LFPR	210	74.00	11.51	41.79	89.05

Source: Author's compilation

In any economic analysis, it is important to test for the presence of multicollinearity problem in the regression model using the pairwise correlation analysis.From the Table 3, it is evident that there is no multicollinearity problem since none of the variables has a value which is above 0.8 threshold (Studenmund, 2001; Rahman et al., 2022 a,b). Thus, we conclude that our model is free from the multicollinearity problem.

Table 3. Pairwise Correlation

Variables	EB	GDS	INFL	GCF	FDI	LFPR
EB	1.000					
GDS	0.351*	1.000				
INFL	-0.148*	-0.071	1.000			
GCF	0.248*	0.639*	-0.090	1.000		
FDI	-0.189*	-0.056	-0.020	0.289*	1.000	
LFPR	-0.022	0.194*	0.254*	0.209*	0.113	1.000

Source: Author's compilation

Estimation techniques

Models 3.9 and 3.10 were estimated using the auto-regressive distributed lag (ARDL) technique, proposed by Pesaran et al. (1999), which does

not require that all variables must be integrated of the same order but instead, it can be realistically applied when variables are of order zero, order one or for mutually integrated data. Furthermore, panel ARDL model is relatively more robust in small and finite sample dataset containing say 30 to 80 observations. By using this technique, we are able to truck both the shortrun and longrun effects. Note that we needed to make a choice between two estimators of panel ARDL: the Mean Group or Pooled Mean Group models. Under the Hausman test, the null hypothesis is that of the slope homogeneity whereby we fail to reject the null hypothesis and conclude that the Pooled Mean Group model is the preferred model in explaining the long run cointegration among the variables and that the long run equilibrium relationship amongst the variable is homogenous across countries under study. Since the probability value from the Hausman h-statistic was found greater than the 5% level of significance, the PMG model was chosen.

In addition, we present first the unit root tests to make sure that our model variables are integrated either of order zero, I(0) or one, I(1), and not I(2) or above. This is an important condition for the efficient application of the ARDL technique that this study adopts. From Table 3, the results from LLC unit root test indicate that all variables are stationary in levels. On the other hand, results from Pesaran (2003) test reveal that investment and Inflation are stationary in levels while GDP, electronic banking, labour force participation rate, savings and foreign direct investment. This is justified by their probability values which suggest rejection of null hypothesis and in turn articulates that all panels contain a unit root in favour of alternative hypothesis. The latter states that some panels are stationary. Going by the Pesaran test, which is designed specifically for panel unit roots in the dynamic panels, but

also with additional benefits of taking care of cross-sectional dependence and serially correlated errors, and therefore superior to LLC test, we conclude that the panel unit root tests show that variables meet the criteria for estimating Panel ARDL Technique.

Table 4. Panel Unit root Test results

	LLC Test	PESARAN (2003)Test	LLC Test	PE-SARAN (2003)Test	Order of Integration
Variables	**Level**		**First Difference**		
Gross Domestic Product	-8.2314*** (0.0000)	-0.963 (0.168)	-16.3883*** (0.0000)	-2.934*** (0.002)	I(1)
Electronic Banking	-4.5894*** (0.0071)	2.968 (0.999)	-5.8472 (0.5476)	0.356 (0.639)	I(1)
Gross Fixed Capital Formation	-7.0475*** (0.0028)	-1.452** (0.073)			I(0)
Labour Force Participation Rate	-10.5213*** (0.0000)	-0.471 (0.319)	-6.0895 (0.9412)	-0.529 (0.298)	I(1)
Gross Domestic Saving	-6.0562** (0.0159)	-0.236 (0.407)	-13.9102*** (0.0000)	-1.790** (0.037)	I(0)
Inflation Rate	-10.5094*** (0.0000)	-1.520** (0.064)			I(0)
Foreign Direct Investment	-7.8184*** (0.0005)	-0.516 (0.303)	-11.6796*** (0.0000)	-2.699*** (0.003)	I(1)
Note: Probability values in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$					

Source: Author's compilation

Results

Direct effect of financial innovation on economic growth

Table 5 provides the results on the direct relationship between financial innovations and economic growth estimated. It can be observed that the relevant coefficient on the error correction term is negative (-0.758) and statistically significant at 1% level, an indication that a deviation in the previous period is corrected at 75.8% to restore the equilibrium back to the steady state.

From the Table 5 still, financial innovations displayed a positive and statistically significant long run relationship with economic growth as reported in Table 5. Specifically by holding other explanatory variables constant, a one unit increase in financial innovations increases economic growth by about 0.0245. Similarly, financial innovation is reported to possess a positive and statistically significant relationship with economic growth in the short run. Here, a one unit rise in financial innovations results into a 0.224 unit increase in economic growth, *ceteris paribus*. This can largely be due to increased use of payment cards among people and businesses and the increased focus on the use of digital platforms in Eastern Africa. One important note here is that the impact is significantly stronger for the longrun relative to the shortrun. The long run positive and statistically significant impact of financial innovation on economic growth obtains strong support from the supply leading hypothesis suggested by McKinnon and Shaw (1973) which maintains that financial innovations enhances economic growth by apportioning scarce resources from small savers to large investors. These finding are consistent with what is documented in Bara, Mugano & Le Roux (2016), and, Chukwunulu (2019).

Table 5. Effect of financial Innovations on Economic Growth

VARIABLES	MG	PMG
Error Correction Term	-0.177	-0.758***
	(1.290)	(0.145)
Short Run Results		
D.Electronic Banking	2.985	0.224*
	(2.073)	(0.123)
D.Gross Fixed Capital Formation (% GDP)	0.0745	0.0103
	(0.475)	(0.0790)
D.Labour Force Participation Rate	34.95*	0.879
	(20.52)	(2.881)
D.Inflation rate (Annual %)	-0.483**	0.00444
	(0.238)	(0.0341)
D.Foreign Direct Investment (% GDP)	-0.117	-0.0268
	(0.417)	(0.0778)
D.Gross Domestic Saving (% GDP)	-0.393	0.0674
	(0.380)	(0.0614)
Long Run Results		
L.Electonic Banking	3.158	0.0245***
	(2.594)	(0.00821)
L.Gross Fixed Capital Formation (% GDP)	-0.0561	-0.189***
	(0.154)	(0.0139)
L.Labour Force Participation Rate	-19.52	-0.106***
	(13.14)	(0.0132)
L.Inflation rate (Annual %)	0.0435	-0.116***
	(0.122)	(0.00950)
L.Foreign Direct Investment (% GDP)	0.270	-0.104***
	(0.433)	(0.0285)
L.Gross Domestic Saving (% GDP)	0.331	-0.0602***
	(0.234)	(0.0130)
Constant	-1,574	14.61***
	(1,668)	(3.345)
Observations	196	196
Hausman h-Statistic	0.00	
(P-Values)	(1.0000)	
Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1		

Source: Authors' computations

Additional findings

As reported in Table 5, investment has a negative and statistically significant long run relationship with economic growth. Precisely by keeping other explanatory variables constant, a one unit increase in investment results into 0.189 decline in economic growth. Perhaps this is due to the continuing flows and profit repatriation by foreign owned companies operating within Eastern Africa which has made savings to become strongly and consistently negative. Nevertheless, the finding is consistent with what Haque et al. (2019) document.

Additionally, labour force participation rate is reported to possess a negative and statistically significant effect on economic growth in the long run. Specifically, a one unit increase in labour force participation rate decreases economic growth by 0.106 while keeping other explanatory variables constant. This could largely be explained by the fact that economic growth fluctuates in response to wages and unemployment in the economy. A previous study by Olanrewaju et al. (2021) records similar findings.

Inflation rate is reported to have a negative and statistically significant long run relationship with economic growth. Specifically holding other independent variables constant, a one unit rise in inflation on average decreases economic growth by about 0.116. For Eastern Africa, this can be largely attributed to the ever increasing appetite of the central government to increase government expenditure through printing more money. Nonetheless, since inflation reduces both capital accumulation and total factor productivity, its detrimental effect on economic expansion may not be a surprise. Moreover, the finding is consistent with the previous work by Nyongesa, Lubega & Odhiambo (2017).

Similarly, foreign direct investment possesses a negative and statistically significant relationship with economic growth in the long run. Specifically keeping other explanatory variables constant, if we there is an increase of one unit in foreign direct investments, economic growth would reduce by about 0.104. For Eastern Africa, several factors could be behind this observation. Among these is perhaps poor investment climate which scares away potential investors. However, it is also possible that foreign investors exert much of their efforts in unproductive activities such as mining which don't contribute significantly to growth. It is also possible that the Eastern African economies have over the years experienced a lowering of their balance of payments due to repatriated profits, lack of positive linkage with local enterprises, as well as negative environmental impact and crowding out domestic investment. According to OECD (2002), such an experience would result into FDI inflows hurting host countries. Nevertheless, the findings are consistent in the recent work by Mutenyo et al. (2022) that focused on Sub-saharan Africa.

Savings possessed a negative and statistically significant long run relationship with economic growth. Precisely holding other independent variables constant, a one unit rise in savings results into 0.062 decrease in economic growth. This could be attributed to the high marginal propensity to consume and low marginal propensity to save in Eastern Africa. A rapid population growth observed in Eastern Africa could equally have contributed to the harmful nature of savings to growth. A previous study by Valverde et al. (2007) reports a similar finding.

Indirect role of financial innovations on Economic Growth via investment and savings

Table 6 provides the results on the interactive effect of financial innovations on economic growth through investment and savings. The results reveal the interaction term with investment is positive though weakly significant at 10% statistical level. This means that a one percentage rise in financial innovations via investment increases economic growth by 0.494% while keeping other explanatory variables constant. By implication, the moderating role of investment in the financial innovations – growth linkage is evident in data for Eastern Africa, signifying that countries with financial innovations tend to grow faster than countries with less developed financial innovations because financial innovations amidst significant growing gross capital formation would most likely be on the right path to economic economic growth. The finding is consistent with what is recorded in Bernier & Plouffe (2019).

Table 6. Interactive role of financial innovations on Economic Growth via investment and savings

VARIABLES	MODEL 1: INTERACTION WITH INVESTMENT		MODEL 2: INTERACTION WITH SAVINGS	
	MG	PMG	MG	PMG
Error Correction Term	-6.520	-0.872***	1.575	-0.850***
	(4.296)	(0.133)	(4.684)	(0.116)
SHORT RUN RESULTS				
D.Electronic Banking	-91.90	0.152	-36.39	0.483*
	(85.31)	(0.636)	(41.48)	(0.293)
D.Gross Fixed Capital Formation (% GDP)	-38.63	0.242	3.390	-0.0466
	(45.77)	(0.244)	(2.128)	(0.0769)
D.Labour Force Participation Rate	-236.7	2.638	15.42	0.592
	(244.2)	(2.567)	(14.37)	(2.608)
D.Inflation rate (Annual %)			-1.634	0.0305
			(2.288)	(0.0705)
D.Foreign Direct Investment (% GDP)	2.627	-0.0660		
	(3.839)	(0.102)		
D.Gross Domestic Saving (% GDP)	4.264	0.0103	2.833	0.199
	(4.174)	(0.0469)	(2.028)	(0.169)
D.GCFEB	4.941	-0.00717		
	(5.101)	(0.0317)		
D.GDSEB			-0.576	-0.0352
			(0.630)	(0.0403)
LONG RUN RESULTS				
L.Electronic Banking	4.417	-0.178**	-3.694	0.0227
	(7.970)	(0.0888)	(11.13)	(0.0579)
L.Gross Fixed Capital Formation (% GDP)	-3.974	-0.0628**	0.783*	-0.152***
	(4.085)	(0.0267)	(0.400)	(0.0223)
L.Labour Force Participation Rate	-22.32	-0.146**	-26.78	-0.0964***
	(29.92)	(0.0610)	(16.47)	(0.0263)
L.Inflation rate (Annual %)			-0.456	-0.112***
			(1.026)	(0.0157)
L.Foreign Direct Investment (% GDP)	-0.174	-0.110***		
	(0.944)	(0.0366)		
L.Gross Domestic Saving (% GDP)	0.214	-0.0725***	-7.637	-0.0512**
	(0.517)	(0.0166)	(7.543)	(0.0253)
L.GCFEB	(0.201)	0.00494*		
	19,237	(0.00277)		
L.GDSEB			0.372	-5.11e-06
			(1.112)	(0.00191)
Constant	19,237	17.09***	-15,619	14.67***
	(21,233)	(3.014)	(14,191)	(2.511)
Hausman h-Statistic	0.00		0.00	
(P-Values)	(1.0000)		(1.0000)	
Observations	196	196	196	196
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1				

Source: Authors' computations

Conclusion

The study aimed at providing the empirical evidence on the direct and indirect relationship between financial innovations and economic growth in Eastern Africa over the period 2004 till 2018. In order to achieve the long run relationship, the panel ARDL model was employed while controlling for the possible effect of other macroeconomic variables. Prior to the execution of Panel ARDL framework, the study employed two panel unit root tests that is; Levin, Lin and Chu Unit Root Test and Pesaran (2003) Test to check for the stationarity properties of panel variables. The study found it suitable to estimate the model using Panel ARDL Approach since the panels were found to be integrated of order zero and order one. Specifically, the Hausman test favored the Pooled Mean Group model instead of the mean group estimator.

The results confirmed the presence of the long run relationship between financial innovations and economic growth in Eastern Africa. Specifically, the empirical estimations carried out in this study indicate that electronic banking generally has a positive and statistically significant long run effect on economic growth in Eastern Africa. These findings support the supply leading hypothesis which affirms that financial innovations promote economic growth by appropriating scarce resources from small savers to the bigger investors (McKinnon and Shaw, 1973). As a nuance, the study unveils the importance of gross ficapital formation in the innovation-growth linkage. Therefore, in addition to policies that support electronic banking, countries in Eastern Africa would optimally gain from financial technology if they engage at the same time in creating a favourable environment for investment. Additionally, there is evidence to suggest that investment, savings, inflation, foreign direct investment and and labor have a direct long run relationship with

economic growth. We aver that macroeconomic policies tailored towards stabilizing the general price levels as well as improving the labour market should be at the heart of policy makers.

Our findings should however be interpreted with knowledge that only one form of financial innovation was considered due to data insufficiency pertaining to other forms of financial innovation proxies such as mobile money usage. Perhaps once panel data on the latter forms is ascertained, future studies would re-visit the topic for further scrutiny of the growth effects of financial innovations. Nevertheless, our findings provide sufficient basis for policy direction.

References

1. Adu-Asare, A.I., & Aboagye, Q.Q. (2014). Bank competition, financial innovations and economic growth in Ghana. African Journal of Economic and Management Studies, 5(1), 30–51.
2. Adusei, M. (2013). Financial Development and Economic Growth: Evidence from Ghana. The International Journal of Business and Finance Research, 7(5), 61-76.
3. Ajide, F. M. (2016). Financial innovation and sustainable development in selected countries in West Africa. Journal of Entrepreneurship, Management and Innovation, 12(3), 85-112.
4. Almsafir, M. K. & Morzuki, Z.M. (2015). The relationship between investment and economic growth in Malaysia. Journal of Empirical Economics, 4(2),116-126.
5. AU. (2021). Africa's Development Dynamics. African Union.
6. Bara, A. & Mudzingiri, C. (2016). Financial innovation and economic growth: evidence from Zimbabwe. Investment management and financial innovations, 13(2): 65-75.
7. Bara, A., Mugano, G. & le Roux, P. (2016). Financial innovation and economic growth in the SADC. African Journal of Science Technology Innovation and Development 8(5):1-13.
8. Beck T. (2010) Financial Development and Economic Growth: Stock Markets versus Banks? Africa's Financial Markets: A Real Development Tool. Tilburg University, 3
9. Beck, T., Chen, T., Lin, C. & Song, F.M. (2016). Financial innovation: The bright and the dark sides. Journal of Banking & Finance, 72(2016): 28-51. Doi:10.1016/j.jbankfin.2016.06.012.
10. Bernier, M. & Plouffe, M. (2019). Financial innovation, economic growth, and the consequences of macroprudential policies. Research in Economics, 73(2): 162-173.

11.   Bonga-Bonga, L. & Guma, N. (2017). The relationship between savings and economic growth at the disaggregated level. Economia Internazionale / International Economics, 70(1):1-24.

12.   Chukwunulu, J.I. (2019). Effect of Financial Innovation on the Nigerian Economy. World Journal of Innovative Research, 6(5):15-21.

13.   Dana, L. P., Tajpour, M., Salamzadeh, A., Hosseini, E., & Zolfaghari, M. (2021). The impact of entrepreneurial education on technology-based enterprises development: The mediating role of motivation. Administrative Sciences, 11(4), 105.

14.   Dana, L. P., Salamzadeh, A., Hadizadeh, M., Heydari, G., & Shamsoddin, S. (2022 a). Urban Entrepreneurship and Sustainable Businesses in Smart Cities: Exploring the Role of Digital Technologies. Sustainable Technology and Entrepreneurship, 100016.

15.   Dana, L. P., Salamzadeh, A., Mortazavi, S., & Hadizadeh, M. (2022 b). Investigating the impact of international markets and new digital technologies on business innovation in emerging markets. Sustainability, 14(2), 983.

16.   Dana, L. P., Salamzadeh, A., Mortazavi, S., Hadizadeh, M., & Zolfaghari, M. (2022 c). Strategic futures studies and entrepreneurial resiliency: a focus on digital technology trends and emerging markets. Tec Empresarial, 16(1), 87-100.

17.   Dana, L. P., Salamzadeh, A., Ramadani, V., & Palalić, R. (2022 d). The New Economy with Aspects of the Bazaar. In Understanding Contexts of Business in Western Asia: Land of Bazaars and High-Tech Booms (pp. 521-534).

18.   Doepke & Zilibotti (2014) Culture, Entrepreneurship, and Growth. In: Aghion, P & Durlauf, S.N. (Eds.), Handbook of economic growth. Elsevier B.V., Edition 1, Volume 2, Chapter 1, pp.1-48.

19.   Domeher, D., Konadu-Yiadom, E. & Aawaar, G. (2022). Financial innovations and economic growth: Does financial inclusion play a mediating role?, Cogent Bus.& Mgmt, 9(1): 1-21.

20.   Ekpu, V.U. (2015). Determinants of Bank Involvement with SMEs: A Survey of Demand-Side and Supply-Side Factors. SpringerBriefs in Finance.

21.   Haque, A.U., Kibria, G., Selim, M.I. & Smrity, D.Y. (2019). Labor force participation rate and economic growth: Observations for Bangladesh. Inter. J. of Econ. and Fin. Res., 5(9): 209-213.

22.   Laeven, L., Levine, R. & Michalopoulos, S. (2015). Financial innovation and endogenous growth. Journal of Financial Intermediation, 24(1): 1-24.

23.   Levin, A., Lin, C. F. & Chu, C. S. (2003). Unit root tests in panel data: asymptotic and finite-sample properties. Journal of econometrics, 108(1): 1-24.

24.   McKinnon, R. & Shaw (1973). Money and Capital in Economic Development. Brooking Institution.Washington, DC, USA.

25. Mutenyo, J., Nnyanzi, J.B. & Makika, M.D. (2022). Foreign direct investment, private domestic investment and economic growth in Africa: Theory and evidence. Int. J. Soc. Sc. and Econ. Res.7(88):1278-1300. DOI: https://doi.org/10.46609/IJSSER.2022.v07i05.009

26. Mwega, F. (2011). The competitiveness and efficiency of the financial services sector in Africa: A case study of Kenya. African Development Review, 23(1): 44-59.

27. Nnyanzi, J. B. (2018). The interaction effect of financial innovation and the transmission channels on money demand in Uganda. International Journal of Economics and Finance, 10(12): 1-18.

28. Nsor-Ambala, R. & Amewu, G. (2022). Linear and non-linear ARDL estimation of financial innovation and economic growth in Ghana. Journal of Business and Socio-economic Development, https://www.emerald.com/insight/content/doi/10.1108/JBSED-09-2021-0128/full/pdf

29. Nyongesa, D.N., Lubega, E.A. & Odhiambo, S. (2017). The Relationship between inflation and economic growth in East African Community countries. Noble International Journal of Economics and Financial Research, 2(12):152-162.

30. OECD. (2002). Foreign direct investment for development: Maximising benefits, minimising costs. Paris. https:// www.oecd.org/investment/investmentfordevelop ment/1959815.pdf

31. Okereke, J. U. (2016). Cashless banking transactions and economic growth of Nigeria. Middle-East Journal of Scientific Research, 24(11), 3576–3581.

32. Pece, A.M., Simona, A.C. & Salisteanu, F. (2015). Innovation and Economic Growth: An Empirical Analysis for CEE Countries . Precedia Economics and Finance, 26(2015): 461-467.

33. Pesaran, M. H. (2003). A Simple Panel Unit Root Test in the Presence of Cross Section Dependence. mimeo, Cambridge University. .

34. Pesaran, M. H., Shin, Y. & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. Journal of the American statistical Association, 94(446): 621-634.

35. Qamruzzaman, M. & Jianguo, W. (2017). Financial innovation and economic growth in Bangladesh. Financial Innovation, 3(1):1-24. https://doi.org/10.1186/s40854-017-0070-0

36. Qamruzzaman, M. & Jianguo, W. (2018). Financial Innovation, Stock Market Development, and Economic Growth: An Application of ARDL Model. International Journal of Financial Studies, MDPI, vol. 6(3):1-30.

37. Rahman, M. M., Salamzadeh, A., & Tabash, M. I. (2022 a). Antecedents of entrepreneurial intentions of female undergraduate students in Bangladesh: a covariance-based structural equation modeling approach. Journal of Women's Entrepreneurship and Education, (1-2), 137-153.

38. Rahman, M. M., Tabash, M. I., Salamzadeh, A., Abduli, S., & Rahaman, M. S. (2022 b). Sampling Techniques (Probability) for Quantitative Social Science Researchers: A Conceptual Guidelines with Examples. Seeu Review, 17(1), 42-51.

39. Robinson, J. (1952). The model of an expanding economy. The Economic Journal, 62(245): 42-53.

40. Salamzadeh, A., & Markovic, M. R. (2018). Shortening the learning curve of media start-ups in accelerators: Case of a developing country. In Evaluating media richness in organizational learning (pp. 36-48). IGI Global.

41. Salamzadeh, A., Ebrahimi, P., Soleimani, M., & Fekete-Farkas, M. (2021). An AHP approach to identify the barriers of sustainable geotourism development in Iran: an economic view. Geoheritage, 13(3), 1-11.

42. Schumpeter, J. A. (1911). The Theory of Economic Development, An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Cambridge MA, Harvard University Press.

43. Solans, E. D. (2003). Financial Innovation and Monetary Policy: Speech Delivered at the 38th SEACEN Governors conference and 22nd Meeting of the SEACEN Board of Governors on Structural Change and Growth Prospects in Asia-Challenges to Central Banking, Manila.

44. Soleimani, M., Dana, L. P., Salamzadeh, A., Bouzari, P., & Ebrahimi, P. (2022). The effect of internal branding on organisational financial performance and brand loyalty: mediating role of psychological empowerment. Journal of Asian Business and Economic Studies.

45. Studenmund, A. H. (2001). Using Econometrics: A Practical Guide. Addison Wesley Longman. Inc., New York.

46. Valverde, S.C., del Paso, R.L. & Fernández, F.R. (2007). Financial innovations in banking: Impact on regional growth. Regional Studies, 41 (3), pp. 311-326.

47. Worku, V. N. (2016). The Contribution of Financial Sector Development for Economic Growth in East Africa. Applied Economics and Finance, 3(2): 201-214.

48. World Bank. (2019). World Development Indicators. World Bank.

49. Yakubu, B. N., Salamzadeh, A., Bouzari, P., Ebrahimi, P., & Fekete-Farkas, M. (2022). Identifying the key factors of sustainable entrepreneurship in the Nigerian food industry: The role of media availability. Entrepreneurial Business and Economics Review, 10(2), 147-162.

John Bosco Nnyanzi is a lecturer of Economics at Makerere University after receiving his Doctorate in Economics from Johannes Kepler University of Linz. He was also a visiting scholar at the University of Rwanda and a member of the American Economic Association, where he has attended international conferences on teaching economics and research. He was Trade Specialist for the Northern Corridor Integration Projects, 2017. His research interests include Applied Macroeconomics and Microeconomics, Development economics, Risk-Sharing, Integration, and, Remittances. He is also a peer reviewer of, inter alia, the African Journal of Economic and Management Sciences, African Development Review, Annals of Public and Cooperative Economics, and, Journal of Economic Integration.

John Bbale Mayanja is a Senior Lecturer of Economics at Makerere University. He received his Doctorate from Austria, from Johannes Kepler University. He is a member of Uganda Economics Association. His research interests include foreign direct investment, financial economics, growth and development, innovation and applied microeconomics, inter alia.

Mudasiru Kyewalabye holds a Master of Arts in Economics from Makerere University and is now self-employed. His research interests include growth and development, financial innovations, as well as applied macroeconomics.