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Digital Financial Services Regulations: Their Evolution and Impact on Financial Inclusion in East Africa

Ronald Ochen and Enock Will Nsubuga Bulime

Abstract

Digital Financial Services such as mobile money provides immeasurable benefits for financial inclusion and intermediation in East Africa. In this paper, we use a Fixed Effects panel model and annual data collected from 2007 to 2021 to examine the evolution of Digital Financial Services regulatory frameworks and their effects on conventional banking and Financial Inclusion in East African countries – Kenya, Tanzania, and Uganda. Results indicate that digital financial services regulations positively and significantly affect conventional banking services and mobile money (financial inclusion). Also, during the COVID19 pandemic period when the different governments instituted COVID19 policy response measures in the digital payments space to circumvent the use of cash and physical contact, positively affected digital financial services, thereby enhancing financial inclusion in the region. Also, an increase in lending rates and the consumer price index causes mobile money to decline. Therefore, digital financial services regulations are pivotal in advancing financial inclusion and intermediation through mobile money and conventional banking services in East Africa. Also, Central Banks should be concerned with mobile money in the economy because it forms part of the loanable funds by banks thus, stabilizing lending rates and prices in the economy is crucial for financial inclusion.

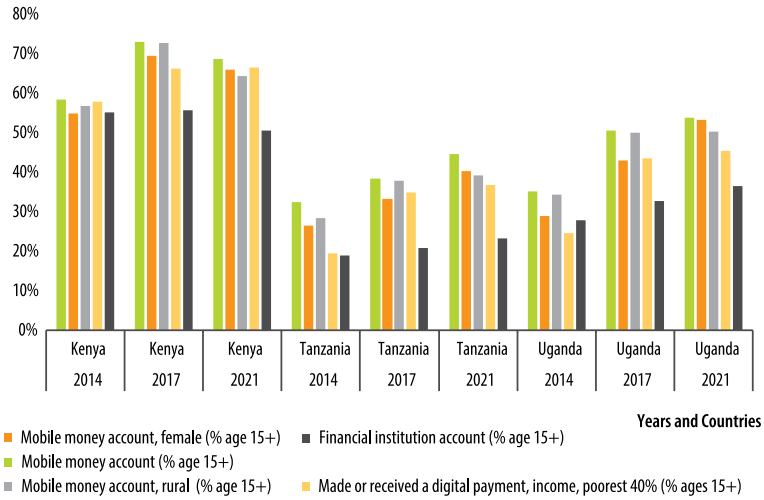
1.0 Introduction

Digital Financial Services (DFS), such as mobile money, are critical for financial inclusion, gender equality, and inclusive growth in Africa (Hedricks 2019; World Bank 2020). They are also critical in lowering conventional banks' cost-to-income ratios and enhancing their profitability (Ochen & Bulime 2021). DFS play a crucial role in making banking services accessible, promoting savings and investment, driving economic activity, and increasing access to financial services (Ndung'u 2022). Relatedly, the evolution of DFS provided a means of managing bank accounts at minimal cost, thus enabling commercial banks to reach more customers and grow deposits (Ndung'u 2022). However, they also disrupt traditional financial services and challenge incumbent service providers (Disrupt Africa 2021).

First launched in 2007 as M-PESA by Safaricom in Kenya, mobile money quickly spread across all East African Community (EAC) countries, especially Kenya, Uganda, and Tanzania, though at different levels. This is explained by the growth in digital platforms, technological advancements and the improved access and utilization of mobile phones. To meet the growing demand for DFS, Mobile Network Operators (MNOs) are intensifying efforts to diversify their digital products and services through public and private partnerships (Shapshak 2020). Moreover, during the coronavirus pandemic period, the use of DFS further enhanced financial inclusion by enabling digital payments and credit creation (ECA 2020), they also smoothened household consumption needs (Suri & Jack 2016). For example, we observe an increase in some financial inclusion indicators in Tanzania and Uganda during the pandemic albeit in Kenya, the change was negligible (**Figure 1**).

Conversely, although numerous factors influence DFS, regulation plays a more prominent role in the uptake and use of DFS (Evans & Pirchio 2015). Several studies have examined the role of regulation on DFS and financial inclusion; however,

Figure 1: Selected financial inclusion indicators in East Africa (2014 – 2021)



Source: Authors' construction using Global Findex data (2014, 2017 and 2021)

these studies do not provide quantitative analysis. Further, these studies only review the literature on the regulations in the different countries. For instance, some studies (Ondiege 2015; Gibson et al. 2015; Mhella 2019; Castri 2013; Maina 2018; Pazarbasioglu et al. 2020; Muthiora 2015; Ndung'u 2017; 2019; and International Telecommunication Union 2016) found that regulatory frameworks and an enabling environment backstop DFS and financial inclusion but they neither explain the magnitude of the effect nor do they provide an in-depth empirical analysis.

To the best of our knowledge, only two studies (Klapper et al. 2021 and Bahia et al. 2020) attempted to measure the effect of regulation on DFS and financial inclusion. They found a positive and robust relationship between mobile money account ownership (and usage) and the GSMA Mobile Money Regulation Index in developing countries. These studies, however, focus on mobile money account ownership as a proxy for financial inclusion. In this study, we go beyond owning a mobile money account and use mobile money transactions or balances as an indicator of digital financial inclusion.

Previous studies demonstrate that mobile money transactions or balances facilitate financial inclusion and intermediation (Nampewo et al. 2016; Levin

2005). Besides, none of the aforementioned studies analyses the effects of conventional banking services and the COVID-19 period on DFS and financial inclusion, which presents a novelty in our study. Our study builds on the existing empirical evidence on regulation by examining the effect of digital financial inclusion on regulation and conventional banking services on financial inclusion in the EAC.

Using panel data analysis techniques, we examine the evolution of digital financial services regulatory frameworks and their effect on conventional banking services and financial inclusion in EAC. Relatedly, we seek to answer the following research questions; What is the effect of DFS regulations on financial inclusion and conventional banking services? What is the effect of the COVID-19 pandemic on DFS and financial inclusion? Out of the seven EAC countries, our study focuses on Kenya, Tanzania, and Uganda because they are the main DFS hubs, pivotal in the evolution of digital financial services (mobile money) and digital services regulatory frameworks such as the National Payment Systems Acts in the region. Also, data for undertaking the analysis is readily available for these countries. Notably, the study's findings provide policy insights on the importance of DFS regulations for financial inclusion in the EAC.

In the follow-up sections, we present the evolution of DFS regulations in East African countries in section 2, a review of literature in section 3, methodology and data are presented in section 4, empirical results and discussions in section 5, and the conclusion and recommendations in section 6.

2.0 Evolution of digital financial services regulations in East Africa

Digital financial services regulations evolved at different rates across Kenya, Uganda and Tanzania. This could partly explain the differences in the uptake and utilization of DFS and financial inclusion (See **Box 1** for details). As a regional leader in DFS, other EAC countries have closely monitored and mirrored the Kenyan experience, albeit at different adoption rates. Notably, all three countries adopted an adaptive regulatory approach that aims to balance enabling financial inclusion and ensuring financial stability and consumer protection.

Box 1: Summary of the of the evolution of digital financial services regulations in East Africa

Kenya:

- The Central of Bank (CBK) supervised the National Payment Structure implemented in 2003.
- In 2011, the National Payment Systems (NPS) Act was enacted by the Parliament of Kenya.
- In 2014, NPS regulations are implemented by the Central Bank of Kenya.
- In 2015, Safaricom partnered with CBA to provide Bank to mobile Wallet services.
- In April 2018, implementing of the Mobile Money Interoperability services across MNOs launched by the Central Bank of Kenya.
- In March 2019, Call for Fintech start-ups by the Capital Markets Authority of Kenya.
- In April 2022, Implementing the Merchant Interoperability amongst MNOs like Airtel Networks Kenya Limited, Safaricom PLC, and Telekom Kenya by the CBK.

Tanzania:

- In 2012, a draft of Mobile Money regulations was created in the National Payment Systems Draft by the Bank of Tanzania (BOT).

- In September 2014, Mobile Money Interoperability was created resulting into Bilateral agreements within MNOs Tigo, Airtel, Zantel and Vodacom birthed A2A interoperability.
- In 2015, the National Payment Systems Draft regulations led to the enactment of the Electronic Money Payments Systems Act, also known as the NPS Act, by the Parliament of Tanzania and implemented by the BOT.

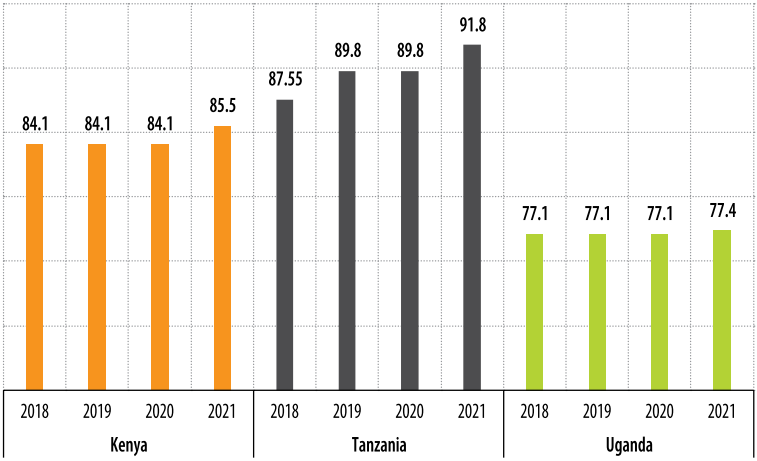
Uganda:

- In 2013, the Bank of Uganda and Uganda Communications Commission launched Mobile Money guidelines including, Uganda Communications Commission (UCC) regulated the MNOs and the Bank of Uganda supervised the MNOs.
- In 2018, Mobile Interoperability was launched amongst Mobile Money Account 2 Account across Mobile Network Operators.
- In September 2020, after drafting of Mobile Money regulations with stakeholders, the Parliament of Uganda enacted the NPS Bill, which was accented to by the President.
- In 2021, the Bank of Uganda gazetted and implemented the NPS Act as law.
- In May 2021, the Bank of Uganda established the regulatory Sandbox by the Capital Markets Authority of Uganda and Bank of Uganda. Also, launched a call for testing of the Fintech start-ups and digital payment space.

However, though Kenya has taken the lead in developing and implementing DFS regulations, a recent mobile money regulatory index (MMRI) report by Groupe Speciale Mobile Association (2022) suggests that Tanzania is doing better than Kenya and Uganda in terms of providing an enabling environment for DFS such as mobile money (**Figure 2**). The MMRI is a tool that measures the extent to which a country's regulations provide an enabling framework for sustainable mobile money services. It comprises 26 indicators clustered in six dimensions: Authorization, Consumer Protection, Transaction Limits, Know Your Customer (KYC), Agent Networks, and Investment and Infrastructure. The details of the performance of the countries across the six dimensions of the MMRI are provided in the Annex (**Table A1**).

All the countries experienced improvements in their performance between 2020 and 2021 amidst the COVID-19 pandemic. This is mainly because of the increased cooperation among the regulators and the mobile money providers and the changes in the different regulations to facilitate mobile money use since mobile money played a critical role in supporting livelihoods. In all the countries, the regulators issued and implemented COVID-19-induced measures, which are likely to be adopted permanently.

Figure 2: The overall mobile money regulatory index for select EAC countries



Source: Author's construct based on data from Groupe Speciale Mobile Association (2022)

Despite the opportunities above, the pandemic is also associated with financial stability and cyber security risks that have become prominent due to the increase in the uptake of DFS. Therefore, these might require more changes and/or reforms in the DFS regulations in the post-COVID-19 period. Furthermore, the competition in the mobile money market is likely to boost further financial inclusion, especially with the emergence of new operators. Therefore, governments have a more significant role in ensuring healthy competition in mobile money markets. Ochen & Bulime (2021) argued that Uganda's National Payment Systems Act (2020) is likely to limit competition unless some of the guidelines regarding the minimum capital (reserve) requirements are relaxed to allow smaller players into the mobile financial services space.

3.0 Literature Review

We review thematic literature linking DFS to financial inclusion, conventional banking services, monetary aggregates, regulation, and the COVID-19 pandemic.

3.1 Digital Financial Services and Financial Inclusion and Conventional Banking Services

DFS aids financial inclusion; thus, an increase (decrease) in DFS implies financial inclusion (exclusion). Several studies, such as Lyimo & Mbesigwe (2022), Gujral and Kumar (2021) and Peterson (2018), show that DFS has a positive relationship with financial inclusion. Regarding conventional banking services and DFS, most MNOs hold accounts with the banking system where they deposit their outstanding mobile money balances (Shirono et al. 2021). Nampewo et al. (2016) argued that commercial banks facilitate financial intermediation through mobilizing deposits from economic agents and reallocating them as credit.

Indeed, MNOs and other DFS service providers established and strengthened their partnerships with traditional banks, giving rise to several innovations and business models. These partnerships include MNOs leveraging the banks' experience in complying with regulations and navigating the regulatory environment, while traditional banks are tapping into the MNO's network and innovations to get more customers. Therefore, despite the increasing competition between traditional banking services and DFS, there seems to be stronger complementarity between the two services.

Furthermore, Jenkins (2008) argues that mobile money promotes financial inclusion and the long-term impact of enabling excluded populations to save and borrow. Weil et al. (2014) argue that mobile money complements the banking sector because it stimulates demand and access to products such as credit. While Jack et al. (2013) strongly associate mobile money with a disproportionate credit expansion through the credit creation hypothesis. Empirical evidence from studies

(Nampewo et al. 2016; Mawejje & Lakuma 2019; and Wiafe et al. 2022) substantiated this; they found a positive and significant relationship between private sector credit from banks with mobile money in Uganda and Ghana, respectively.

Conversely, Agufa (2016) found no association between financial inclusion and Kenya's banking sector. The study argued that banks implement DFS to lower operational costs associated with opening and operating branches to increase their profitability and financial efficiency. Finally, the literature here motivated the research question on how conventional banking services affect DFS and financial inclusion.

3.2 Digital Financial Services and Monetary Aggregates

The channel through which DFS, like mobile money, influences inflation is explored by Simpassa and Gurara (2012) who argue that mobile money could prove to be inflationary if it affects the velocity of money circulation. However, Aron et al. (2015) found that mobile money improves productivity and economic efficiency, leading to lower transaction costs, higher output, and consequently a lower or non-existent effect on inflation. On the other hand, mobile money could affect interest rates through its effect on money demand and the supply of private-sector credit. If mobile money increases money demand and inflation, then monetary authorities might respond by pursuing tight monetary policies leading to high-interest rates (Mawejje & Lakuma 2019). The relationship between mobile money on inflation and interest lending rates has been examined by Nampewo et al. (2016), Mawejje and Lakuma (2019), Waife et al. (2022) and Adam and Walker (2015).

Nampewo et al. (2016) found a negative and significant effect of the consumer price index on mobile money in the short and long run but insignificant in the long run, while lending rates of interest were found to have a negative and insignificant effect in the short run and a positive and significant effect in the long run. On the contrary, Mawejje & Lakuma (2019) found positive moderate effects of consumer price index and a decline in mobile money balances with a positive shock in interest rates. Likewise, the findings of studies (Waife et al. 2022 and Adam & Walker 2015) support those of Mawejje & Lakuma (2019). They found that shock in mobile money raises inflation in the short run but declines in the long run while interest rates decline in the short horizon, then the impact evens out in the long run.

3.3 Digital Financial Services and Regulation

The rapid development of DFS greatly depends on a robust and flexible regulatory framework and sound financial literacy, as witnessed in Kenya and South Africa (Ochen & Bulime 2021). As highlighted in Chapter 2, DFS regulations evolved at different rates across Kenya, Uganda and Tanzania. These regulations cover authorisation, consumer protection, transaction limits, and know your customer and agent networks, among others.

One of the most significant risks with mobile money usage is the loss of customer funds, which can arise due to insufficient liquidity or insolvency of the MNOs. This concern is more pronounced for MNO-led mobile money services as these are operated by non-banks, which lie outside the scope of banking regulations (Shirono et al. 2021). Countries adopted mobile money-specific regulations to mitigate these risks, and the National Payment Systems (NPS) Regulations have evolved.

The NPS regulations covered several regulatory practices, including safeguarding customer funds, licensing, and AML/CFT (Shirono et al. 2021; Pelletier et al., 2019). Mobile money is held in bank accounts as deposits. Depending on a country's legal system, this type of account may be called a trust, escrow, fiduciary or custodial account (Kerse & Staschen 2018). This is because most regulations require MNO-led mobile money services to hold their mobile money liabilities as deposits at regulated financial institutions (Shirono et al. 2021). Most empirical evidence has found that regulations and an enabling environment enhanced mobile money usage (Castri 2013; Gibson et al. 2015; Mhella 2019; Maina 2018; Pazarbasioglu et al. 2020; Muthiora 2015; Ndung'u 2017, 2019; and International Telecommunication Union 2016).

Furthermore, Pazarbasioglu et al. (2020) find that regulations facilitated the development of mobile financial services in Kenya and Tanzania. For instance, in Tanzania, they attributed the rapid growth of mobile money to having a sound and highly competitive and collaborative market (with industry-led interoperability arrangements) and the regulatory flexibility of the Bank of Tanzania. For Kenya, the authors highlight the existence of a private-sector-led model (a partnership between Safaricom and the Commercial Bank of Africa), the regulatory flexibility of the Central Bank of Kenya and the adoption of simplified customer due diligence.

However, evidence on the effect or magnitude of mobile money-specific regulations on DFS and financial inclusion is still scanty. To the best of our knowledge, the available studies (Klapper e,t al. 2021; Bahia et al. 2020) attempted to measure the effect of mobile money-specific regulations on mobile money usage and ownership. They found a positive and strong correlation between mobile money account ownership (and usage) and GSMA Mobile Money Regulation Index in developing countries, respectively. As such, this also motivated our research question on the effect of digital financial services regulations (National Payment System Acts) on digital financial services (mobile money) and financial inclusion.

3.4 Digital Financial Services during the COVID-19 Pandemic

The COVID-19 pandemic forced radical changes in customer behaviour, moving significant portions of the economy online and increasing customers' willingness to engage digitally (Deloitte, 2021). Further, before the COVID-19 pandemic, the uptake of DFS such as payment for utilities, Bank to Wallet, Wallet to Bank, insurance, and credit extension was

low, but with the advent of the COVID-19 pandemic and its containment measures, traditional approaches to banking in Brick & Mortar Financial Institutions were constrained (Groupe Speciale Mobile Association 2021; and Machasio 2020; ECA 2020; Ochen & Bulime 2021).

Due to the constraints and incentives by Mobile Money Service Providers (MMSPs) such as reduced services costs, there was an increase in the uptake in DFS (Ssonko & Kawooya 2020). For example, in Uganda, the use of digital payment products picked up further in the year to June 2020, partly driven by actions taken by financial institutions to promote the use of cashless transactions to reduce the risk of COVID-19 transmission (Ssonko & Kawooya 2020). Bazarbash et al. (2020) conducted a descriptive analysis on mobile money and the COVID-19 pandemic. They found that mobile money usage increased in low and middle-income economies during the pandemic. Likewise, Mugume & Bulime (2022) found a significant and positive effect of DFS usage during the COVID-19 pandemic in Kenya and Uganda.

In addition to incentives by the MMSPs, government responses also boosted the uptake of DFS. Some of these measures are highlighted in Table B2 in the annex. Regulatory authorities are responsible for ensuring effective competition in the evolving mobile money market, especially with the emergence of new players because of the pandemic. This will enable the consumers to access and utilize a range of high-quality products and services.

4.0 Methodology and Data

4.1 Theoretical underpinnings

The increase in the use of mobile money reduces the amount of money in circulation. It also increases deposits within the banking system because outstanding mobile money balances with the mobile money service providers, in most cases, are transferred as deposits with conventional banks (Shirono et al. 2021). For example, Kipkemboi and Bahia (2019) found that the use of cash declined while bank deposits increased in the use of mobile money in Uganda and Kenya. As such, since mobile money is part of the deposits held up in conventional banks, we leverage the quantity theory of money advanced by Irving Fisher to develop a theoretical framework for mobile money demand. Using Fisher's model $MV = PT$, where MV denotes the demand for mobile money, PT denotes the total value of mobile money transactions, and PT/V is the average value of mobile transactions, which is also the dependent variable of our study. Thus, the average value of money in circulation held as mobile money transactions is $M=PT/V$.

Deducing from economic theory, the demand for money has often been modelled with indicators such as interest rates, inflation, income and exchange rates that stance an opportunity cost for holding money. Notwithstanding, several studies (Nampewo et al. 2016; Mawejje & Lakuma 2019; Wiafe et al. 2022), modelled mobile money transactions using the aforementioned indicators/variables. For example, Nampewo et al. (2016) found a negative and significant relationship between mobile money and the consumer price index and a positive but insignificant link with lending rates on loans. Conversely, Mawejje and Lakuma (2019) found a moderately positive link between mobile money and consumer price index and negative interest rates.

Nonetheless, mobile money is a financial innovation that expands the depth and breadth of financial intermediation (Levine, 2005). Commercial banks facilitate

financial intermediation through mobilizing deposits from economic agents and reallocating them as a credit (Nampewo et al. 2016). For example, mobile money deposits from households with bank accounts consist of a portion of the loanable funds that banks use to extend credit in the economy. Empirical evidence has shown a positive and significant relationship between mobile money and private sector credit (Nampewo et al. 2016; Mawejje and Lakuma 2019).

Shirono et al. (2021) argue that mobile money poses inherent risks of loss of customer funds, which can arise due to insufficient liquidity or insolvency of the MNOs. Thus, mobile money-specific regulations are deemed necessary to mitigate these risks. The mobile money-specific regulations, the National Payment Systems (NPS) Regulations adopted by countries and MNOs cover several regulatory practices, including safeguarding customer funds, licensing, and AML/CFT (Shirono et al. 2021; Pelletier et al. 2019). Notwithstanding, enabling policy and regulatory frameworks create an open and level playing field for banks and nonbank providers to foster competition and innovation and promote customer adoption (Castri 2013).

4.2 Econometric model and empirical approach

We employed panel data analysis techniques to examine the effects of digital financial services on conventional banking and regulatory frameworks and their influence on enhancing financial inclusion and innovations in East Africa. We adopted a panel data analysis technique because of its merits. One, they do not require a very large sample size for macro panels, i.e. T>N. Henceforth this technique suits the scope of our study and 3 East African countries were chosen from the other 7 countries in the region due to scarcity of data. Two, it has enormous potential for addressing complex interactions amongst variables (Biørn 2016). Three, they allow analyzing data using variables from many countries simultaneously in a series (Petersen, 2004). Four, panel data analysis provides accurate inferences of model parameter estimates (Uthman et al. 2021). We employed linear static panels because they popularly assume the effects of the observed explanatory variables are identical across cross-sectional units and time while the omitted variables can be decomposed into individual specific effects and time-specific effects (Hsiao, 2003). Our general linear static panel equation is expressed as follows.

$$\text{Mobile Money}_{it}=\beta_0+\beta_1\ \text{Private Sector Credit}_{it}+\beta_2\ \text{Lending Rates}_{it} + \beta_3\text{Consumer Price Index}_{it}+\beta_4\ \text{NPSAct}_{it}+\beta_5\,\text{COVID-19}_{it}+v_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where; i is the entity (in this case countries, Kenya, Tanzania and Uganda), t is the period from 2007 to 2021, β_0 is the constant or intercept term, and β_1 to β_2 are coefficients for the independent variables (private sector credit, lending rates, consumer price index, NPS Act and COVID-19) while Mobile Money_{it} is the dependent variable and v_i is the error term.

We then decomposed the error term v_i in equation (1) into a cross-sectional unit-specific error term and an idiosyncratic error μ_i as shown below:

$$v_i = \alpha_i + \mu_i \quad \text{..... (2)}$$

From equation 2, the cross-sectional unit-specific error term does not change over time while the idiosyncratic error term varies over the cross-sectional units and time (Greene, 2003; Gujarati, 2003; Wooldridge, 2006). After incorporating equation 2 into 1 we obtain a Fixed Effects equation as follows:

$$\text{Mobile Money}_{it} = \beta_0 + \beta_1 \text{ Private Sector Credit}_{it} + \text{Lending Rates}_{it} + \text{Consumer Price Index}_{it} + \text{NPSAct}_{it} + \text{COVID-19}_{it} + \alpha_i + \mu_{it} \quad \text{..... (3)}$$

Where α_i is the estimated fixed parameter of the model. In the event of the Random Effects panel model, μ_{it} becomes ε_{it} from the random drawing from a probability distribution the model would be estimated as follows:

$$\text{Mobile Money}_{it} = \beta_0 + \beta_1 \text{Private Sector Credit}_{it} + \beta_2 \text{ Lending Rates}_{it} + \beta_3 \text{ Consumer Price Index}_{it} + \beta_4 \text{ NPSAct}_{it} + \beta_5 \text{ COVID-19}_{it} + \alpha_i + \varepsilon_{it} \quad \text{..... (4)}$$

However, using the Hausman test criteria shown in **Table 5**, we reject the Random Effect model and adopt the Fixed model in equation 3 for our study. Furthermore, the expected economic apriori for our study variables $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$ and $\beta_5 > 0$ are guided by the works from studies (Nampewo et al. 2016; Mawejje & Lakuma, 2019; Ssonko & Kawooya 2020; Bazarbash et al. 2020).

4.3. Data

Our analysis used annual data from 2007 to 2021 for Kenya, Tanzania and Uganda. The study's scope is important for three reasons; (1) it captures the period when mobile money was introduced in the three East African countries, with Kenya as the pioneer in 2007, and (2) the data covers the COVID-19 period between 2020 and 2021 when the different governments instituted COVID-19 response measures in the financial sector to avert the spread of the virus by facilitating the

use and access to digital financial services (**Annex: Table B1)** and lastly, it covered the different timelines when the national regulatory frameworks for digital financial services were implemented.

Relatedly, the variables used in the study were informed by empirical literature, which guided the construction of our theoretical framework (see Nampewo et al. 2016; Mawejje & Lakuma 2019; Waife et al. 2022). Our study variables are mobile money transactions, private sector credit, lending rates, consumer price index, and two dummies; the National Payment Systems Act (NPS Act) and COVID-19 (Annex: **Table B3** for more details). Notably, the discrepancies in the local currency values of mobile money transactions and private sector credit were standardized into constant US dollar values using a constant base year of 2015.

Also, note that mobile money is the proxy for digital financial services hence digital financial inclusion. At the same time, private sector credit was used a proxy for conventional banking services since these loans were from the banking sector.

The dependent variable of our study, mobile money, was transformed into natural logarithms. In contrast, the independent variables included: private sector credit also transformed into natural logarithms, lending rates (%), consumer price index transformed into natural logarithms and two dummy variables (National Payment Systems Act [NPS Act] and COVID-19). More so, the data used in the study is illustrated graphically in Annex **Figure B1**.

4.3.1 Descriptive statistics and exploratory data analysis

From the summary statistics in Table 1, we observe that the mean of mobile money transactions for the three countries from 2007 to 2021 is 11.17 per cent, private sector credit is about 9 per cent, lending rates are about 18 per cent, and the consumer price index is about 5 per cent. There is a wide variation between mobile money transactions and independent variables, while the dispersion between private sector credit and lending rates is small compared to the consumer price index; this is shown by the standard deviation.

Table 1: Descriptive summary statistics of the variables used in the study

Variables	Obs.	Mean	Std. Dev.	Min	Max
Mobile Money	41	11.17718	8.450915	.6931472	24.40137
Private Sector Credit	42	8.714531	3.53815	2.890372	12.75619
Lending Rates	42	17.52381	3.637462	12	26
Consumer Price Index	42	4.94157	0.2765364	4.248495	5.356586

Table 2: Pair-wise Correlation matrix of the study variables

	Mobile Money	Private Sector Credit	Consumer Price Index	Lending Rates
Mobile Money	1.0000			
Private Sector Credit	-0.9600*	1.0000		
Consumer Price Index	0.2043	0.0102	1.0000	
Lending Rates	0.8718*	-0.8760*	0.0900	1.0000

Note: * denotes P-Value at 5 % (0.05) level of significance

From **Table 2** in the pairwise correlation matrix, we notice that the off-diagonal elements of the variables are unitary as expected. The relationship between mobile money and private sector credit is high and significant, the relationship is in tandem with lending rates but positive unlike with private sector credit. While, the relationship between mobile money and consumer price is positive, it is insignificant and weak.

4.3.2 Unit Root Test

We used the Fisher test for panel unit root using the Augmented Dickey-Fuller Test with zero lags to determine stationarity and order of integration of the variables. From **Table 3**, we observe that mobile money transactions, private sector credit and consumer price index are stationarity in levels. However, lending rates are non-stationary in levels but first difference and integrated of order one, we can therefore proceed with our analysis with linear static panel model since most the variables are stationary in levels.

Table 3: Unit root panel model test using the Fisher-type tests

P-values	H_0: All panels contain a unit root			
	Levels		Differences	
Variables	Chi2	Prob>Chi2	Chi2	Prob>Chi2
Mobile Money	204.8782	0.0000**	46.1726	0.0000**
Private Sector Credit	47.5074	0.0000**	31.6131	0.0000**
Lending Rates	5.4731	0.4847	41.8292	0.0000**
Consumer Price Index	32.1992	0.0000**	38.6381	0.0000**

Note. *** p<0.01, ** p<0.05, * p<0.1

5.0 Empirical Results and Discussions

To answer the research questions of our study, we estimated a Fixed Effect (FE) Panel model shown in Table 4, this model was determined using the Hausman test shown in Table 5.

First, we explore the important statistics in the estimated model. We observe an overall high within period R-squared, about 88 per cent variation in the outcome variable mobile money is explained by the predictor variables (private sector credit, lending rates, consumer price index, COVID-19, and the National Payment Systems Act). The probability of the F-test is significant at the 5 per cent level, implying that the model is good thus, we can draw inferences from it while the coefficients are significantly different from zero. The Rho implies that about 99 per cent of the variance in the model is due to differences across panels, while the correlation between the error term and the predictor variables expressed as Corr (u_i, Xb) = 0.8839, indicates that errors are correlated with the predictor variables in the FE model.

Table 4: Results from the Fixed Effects Model of Mobile Money

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Private Sector Credit	0.6710	0.3014	2.23	0.033**
Lending Rates	-0.2335	0.0771	-3.03	0.005**
Consumer Price Index	-8.3476	0.7495	-11.14	0.000**
COVID-19	0.1350	0.4067	0.33	0.742
NPS Act	0.9741	0.4520	2.16	0.039**
Constant	28.0226	4.2504	6.59	0.000**

Variables	Coefficient	Std. Error	t-Statistic	Prob.
R-squared:		Corr (u_i, Xb)		0.8839
Within	0.8708	(F(5,33)		44.47
Between	0.9993	Prob > F		0.0000
Overall	0.9208	Sigma_u		5.9524
Rho	0.9842	Sigma_e		0.7521

Source: Authors' construction using model output estimates

Note. *** p<0.01, ** p<0.05, * p<0.1

Our results indicate that private sector credit from banks has a positive and significant effect (5 per cent) on mobile money. This implies that a one per cent increase in private sector credit from banks leads to about 68 per cent increase in mobile money transactions, ceteris paribus. This outcome corroborates the findings of Nampewo et al. (2016 and Mawejje and Lakuma (2019).

The National Payment Systems Act (NPS Act) regulations also have a positive and significant effect (at 5 per cent) on mobile money. The findings suggest that mobile money grew during the enactment and implementation of the NPS Act. This could imply that the enactment and implementation of the NPS Acts boosted customer confidence in using mobile money since they address consumer protection issues and provide redress mechanisms for fraud of MNO clients and customers. Castri (2013) argues that mobile money-specific regulations and NPS Acts promote the adoption of mobile money services.

The COVID-19 policy responses instituted by the Central Banks to avert the pandemic's adverse effects on the financial sector had a positive effect on mobile money, as witnessed by an increase in mobile money transactions. Mobile money transactions increased during the COVID-19 pandemic period as a result of the policy responses. This is consistent with the findings of previous studies (Ssonko & Kawooya 2020; Groupe Speciale Mobile Association 2021; Deloitte 2021; Bazarbash et al. 2020; and Mugume & Bulime 2022).

Elsewhere, we also found that the opportunity cost variables of mobile money, including lending rates and consumer price index, as supported by theoretical and empirical literature, have a negative and significant effect on mobile money at a 5 per cent level of significance. In other words, a one per cent increase in the consumer price index resulted in an 8.3 per cent reduction in mobile money, ceteris paribus. This is corroborated by the findings of Nampewo et al. (2016) and Wiafe et al. (2022). However, this is contrary to Mawejje and Lakuma

(2019), who found a positive relationship between the consumer price index and mobile money. Lastly, a one per cent increase in lending rates resulted in a 23 per cent reduction in mobile money transactions, ceteris paribus. This finding is supported by studies (Nampewo et al. 2016; Wiafe et al. 2022; Mawejje & Lakuma 2019).

5.1. Diagnostic checks

In Table 6 below, we present the diagnostic checks to test the validity and strength of our Fixed Effects model estimates. The tests include the Hausman model selection test, the Cross-sectional dependence test using the Breusch-Pagan LM test and the Pesaran CD test, the Heteroscedasticity test, serial correlation test**,** the Breusch and Pagan Lagrangian multiplier test for random effect and normality test using the Jarque-Bera test.

The Hausman test indicates that we reject the null hypothesis of Random Effects model selection at a 5 per cent significance level and conclude that the Fixed Effects model was appropriate for our study. The Breusch and Pagan Lagrangian multiplier test for random effects confirm the rejection of the Random Effects model selection for our study. The Cross-sectional dependence test using the LM test checked whether the residuals are correlated across entities, thus, there is no cross-sectional dependence at a 5 per cent level of significance.

Also, using the Pesaran CD test, there is no cross-sectional dependence at a 5 per cent significance level. The Jarque-Bera test shows the normality of residuals, and it confirms the normality of the residuals at 5 per cent of significance. The test for heteroscedasticity indicates that we fail to reject the null hypothesis of constant variance (Homoscedasticity). While the serial correlation test was investigated using the Wooldridge Auto-correlation test, which failed to reject the null hypothesis of no first-order auto-correlation at a 1 per cent significance level.

Table 5: Results from the diagnostic tests of the Fixed Effects model

Tests	P-values
Hausman test: Ho: The model is Random Effects.	0.0011**
Breusch and Pagan Lagrangian multiplier test for Random Effect.	1.0000**
Breusch-Pagan LM test of independence. (Ho: The residual across entities is not correlated.)	0.5916**
Pesaran CD test of cross-sectional independence. Ho: The residuals are correlated.	0.8405**
Jarque-Bera normality test. Ho: Normality.	0.0921**
Heteroscedasticity Test. Ho: Homoscedasticity.	0.4985**
Serial Correlation. Ho: No first-order autocorrelation.	0.0418***

Note. *** p<0.01, ** p<0.05, * p<0.1

6.0. Conclusion and Policy Recommendations

Our paper adopted a fixed effects panel model technique and annual data from 2007 to 2021 to examine the evolution of digital financial services regulatory frameworks and their effects on conventional banking and financial inclusion in East Africa. Specifically, our study sought to answer the following research questions. What are the effect of DFS and financial inclusion on regulations and conventional banking services? What is the effect of the COVID-19 pandemic on DFS and financial inclusion?

The findings indicate that digital financial services regulations and conventional banking services have a positive and significant effect on conventional banking services. Also, the COVID-19 policy responses on the digital payments space positively affected mobile money, thereby enhancing financial inclusion in the region. Henceforth, based on the study results, we conclude that digital financial services and financial inclusion are supported by regulation and conventional banking in East Africa. We hereby propose the following recommendations:

(1) Convectional banks should leverage the existing legal, and regulatory frameworks to use mobile money digital financial services from Mobile Network Operators (MNOs) to boost credit creation in the economy because mobile money facilitates financial intermediation by pooling resources from the banked and unbanked households to the conventional banks that avail them into credit for customers.

(2) East African countries should strengthen the digital financial services regulations to backstop further development and growth of mobile money platforms; this will also address the inherent risks and liabilities such as fraud, which boosts customer confidence in digital financial services.

(3) Central banks should be concerned about mobile money since it forms part of the money the banks lend customers, hence broad money. Its influence on monetary aggregates is evident thus, the macroeconomic stability of lending rates and prices is also crucial for financial inclusion in the EAC.

(4) Regulatory authorities should promote and ensure effective competition in the evolving mobile money market, especially with the emergence of new players during the pandemic. This will enable the consumers to access and utilize a range of high-quality products and services.

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Annexes

Table A1: Performance of the East African Countries across the six dimensions of the MMRI

		Authorization	Consumer Protection	KYC	Transaction Limits	Agent Network	Infrastructure and Investment environment
Kenya	2018	100	100	32	100	100	62
	2019	100	100	32	100	100	62
	2020	100	100	32	100	100	62
	2021	100	100	32	100	100	62
Tanzania	2018	100	80	92	100	100	45
	2019	100	80	92	100	100	60
	2020	100	80	92	100	100	60
	2021	100	80	92	100	100	60
Uganda	2018	84	80	32	100	94	68
	2019	84	80	32	100	94	68
	2020	84	80	32	100	94	68
	2021	100	80	52	100	100	62

Source: Author's construct based on data from Groupe Speciale Mobile Association (2022).

Figure B1: Graphical exposition of the study variables in Kenya, Tanzania and Uganda

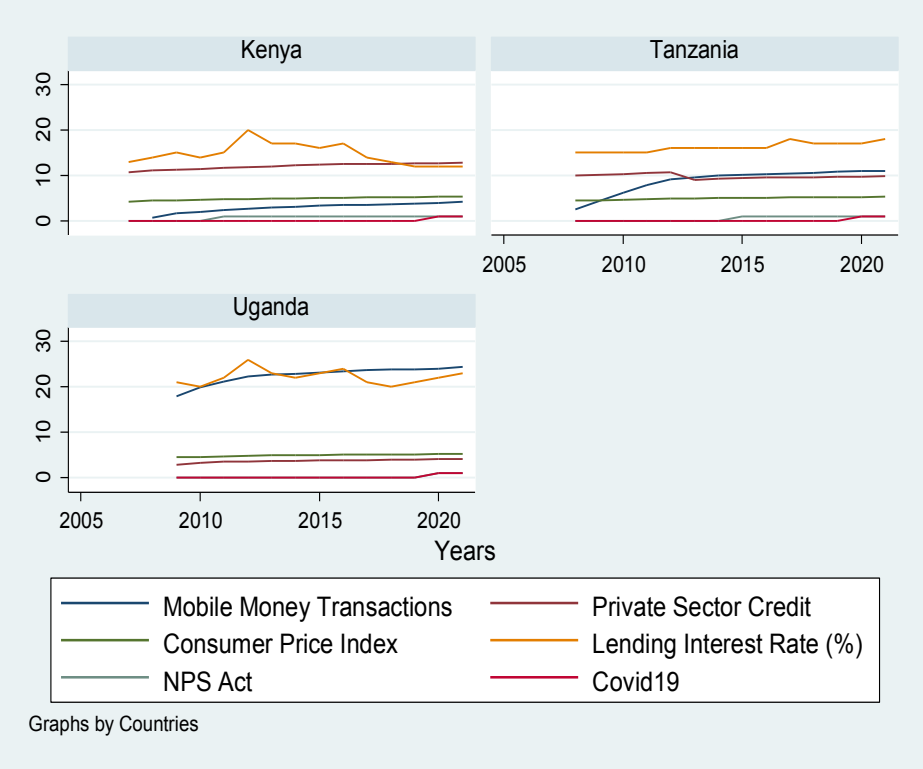

Table B1: Some of the government responses on DFS during the COVID-19 pandemic period in East African countries.

Countries	Measures Taken
Kenya	On March 2, 2020, the Central bank of Kenya encouraged the waiving or reducing charges on mobile money transactions to disincentive the use of cash. This policy was later reversed on January 1, 2021. Also, the transaction limits increased from KES 150,000 and KES 300,000, respectively with monthly limits scrapped from 16, March 2020 until 31 December 2020.
Tanzania	In 2020, the daily transactions limit for mobile money operators was raised from about US $ 1,300 to US $ 2,170, and the daily balance limit was raised from US $ 2,170 to US $ 4,340 (IMF, 2020). The daily transaction limits increased from TZS 3m to TZS 5m, and the daily balance increased from TSZ 5m to 10m.
Uganda	From February 2020, the Bank of Uganda worked with mobile money providers and commercial banks to ensure they reduced the charges on mobile money transactions and other digital payment charges. These measures, which remained in place until March 2021, were extended for another six months starting on April 1, 2021 (IMF, 2020). For example, no charges for P2P transfers of transactions of up to UGX.30,000.

Sources: International Monetary Fund (IMF) Accessible via: *https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-COVID-19* and GSMA COVID-19 Responses Tracker. Accessible via: *https://www.gsma.com/mobilefordevelopment/programme/mobile-money/gsma-mobile-money-regulatory-response-to-covid-19-tracker-and-analysis/*

Table B2: Description of study variables measurement and their sources

Variables	Description	Measurement	Source
Mobile Money	The total value of mobile money transactions (cash in and out at the mobile money agents.	Local currencies (Kshs, Tshs and Ushs)	Central Banks of Kenya, Tanzania and Uganda (2021).
Private sector credit	Total value domestic credit to the private sector from the banks	Local currencies (Kshs, Tshs and Ushs)	Central Banks of Kenya, Tanzania and Uganda (2021).
Lending Rates	The bank rate usually meets the private sector's short-term and medium-term financing needs.	Percentage (%)	World Development Indicators, World Bank (2021).
Consumer Price Index	The index reflects changes in the cost to the average consumer of acquiring a basket of goods and services.	Indexes were developed using the 2010=100 as base year.	World Development Indicators, World Bank (2021).
National Payment Systems Act	Denotes a dummy variable capturing the digital financial services regulatory frameworks	1= time when the regulatory frameworks were enacted and implemented and 0 otherwise.	Authors construction.
COVID-19	Denotes a dummy for the COVID-19 period.	1= time indicates the period of the COVID-19 pandemic era and 0 otherwise.	Authors construction

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