Digital Channels and Financial Sustainability in Commercial Banks

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ABSTRACT

The adoption of digital banking channels has gained significant importance in recent years. Although extensive research highlights the benefits of individual digital banking services, few studies have investigated their collective impact on bank performance, especially in developing countries like Kenya. This study examines the impact of digital banking channels, including Mobile Banking, Electronic Banking, Agency Banking, and Internet Banking, in promoting financial sustainability in commercial banks. The study employed the Technology Adoption Theory (TAT) in evaluating the relationship between digital banking channels and the financial sustainability of commercial banks in Kenya. The study used a quantitative research design with secondary data from Kenyan commercial banks between 2018 and 2023. Generalized Method of Moments and Ordinary Least Squares models were adopted to assess the relationship between digital banking channels and financial sustainability. The findings showed that all digital banking channels positively affect financial sustainability, with Mobile Banking having the most significant impact. The combined use of these channels provided even greater benefits, enhancing overall financial performance. The results also suggest that the benefits of digital banking accumulate over time, contributing to long-term sustainability. The findings contribute to the understanding of digital banking's role in financial performance, offering insights for banks and policymakers in Kenya and other developing economies.

Keywords: Digital Banking Channels, Financial Sustainability, Commercial Banks

INTRODUCTION

The increasing integration of digital technologies into banking operations has revolutionized the way financial services are accessed and delivered globally [1]. As banking institutions face rising customer expectations and competitive pressures, digital banking channels have become central to achieving efficiency, enhancing customer experience, and maintaining financial sustainability [2]. Despite the widespread adoption of these channels, significant gaps remain in understanding their impact on the long-term viability of financial institutions. Specifically, the relationship between digital banking channels and financial sustainability presents conflicting evidence across different contexts. Some studies highlight the potential of digital banking to reduce operational costs and expand access to financial services [3], while others emphasize risks such as security concerns and the financial burden of technology adoption [4]. Addressing these inconsistencies is crucial for banking institutions seeking to optimize digital strategies and ensure sustainable growth.

Several studies have examined various aspects of digital banking channels, including mobile banking, electronic card banking, internet banking, and agency banking. For example, research by Kamal et al. has explored the cost-saving benefits of these channels [5], while Shaikh et al. discuss their role in enhancing competitiveness and operational efficiency [6]. Additionally, studies by [7] suggest that digital banking can foster financial sustainability by broadening access to services in underserved regions. However, other scholars, such as Ahmad, argue that the high costs associated with digital banking implementation may offset these benefits [4]. This conflicting evidence underscores the need for further research to clarify the

effects of digital banking channels on financial sustainability, particularly within the context of emerging markets.

This research sought to investigate the relationship between major digital banking channels —mobile banking, electronic banking, agency banking, and internet banking —and the financial sustainability of commercial banks. In light of the ongoing debate and gaps in the existing literature, this research aimed to provide deeper insights into how digital banking channels contribute to the financial sustainability of commercial banks.

LITERATURE REVIEW

Adopting Digital Banking Channels (DBC) in emerging markets faces several challenges that hinder their potential to enhance financial sustainability and economic development. These challenges are largely due to inadequate infrastructure, regulatory barriers, service inconsistencies, and the digital divide. Poor internet connectivity and unreliable power supply limit access to digital banking services, preventing widespread adoption [8]. Additionally, insufficient digital infrastructure restricts banks' ability to offer services effectively and deters potential users [9]. These issues disrupt banking operations and limit financial inclusion, especially in underserved areas [10]. Regulatory challenges, such as outdated frameworks and unclear guidelines on data protection, contribute to uncertainty and hinder innovation [11], [12]. Inconsistent service delivery and varying levels of digital literacy further complicate the situation, especially for demographics like older adults or those with limited education [13]. Additionally, the digital divide, driven by socioeconomic factors and unequal access to technology, prevents a large portion of the population from benefiting from digital banking, limiting its potential impact on financial inclusion [14], [15]. Addressing these challenges requires collaborative efforts from governments, financial institutions, and regulators to improve infrastructure, create clear regulations, and bridge the digital divide.

In Africa, Digital Banking Channels (DBC) have shown both benefits and challenges. A successful example is mobile banking, particularly M-Pesa in Kenya, which has revolutionized financial transactions by improving efficiency, reducing costs, and generating new revenue streams for banks [16]. M-Pesa has allowed millions to access financial services, such as peer-to-peer transfers and bill payments, promoting financial inclusion in areas lacking traditional banking infrastructure [17]. Moreover, digital transformation has improved the operational capabilities of banks, enabling faster service delivery and better customer satisfaction in competitive markets [18]. However, challenges persist, especially related to infrastructure and regulatory frameworks. In countries like Kenya, Nigeria, and South Africa, poor internet connectivity and unreliable power supply hinder the effective use of DBC [19]. While M-Pesa is widely used, its functionality is often limited by network availability, disrupting transactions and reducing engagement [20]. Furthermore, inconsistent regulations create an unpredictable environment for digital banking, with a lack of clear guidelines in places like Nigeria stifling innovation and growth [9]. To fully unlock DBC’s potential, governments, financial institutions, and technology providers must address these challenges.

DBC play a key role in enhancing financial inclusion, particularly in rural and underserved areas of Africa. Mobile banking, as exemplified by M-Pesa, allows individuals in remote regions to conduct transactions, save, and access credit, empowering both individuals and small businesses [21]. This increased access to financial services supports broader economic goals like poverty reduction and improved living standards, which are essential for breaking the poverty cycle [22]. Accessible financial services also stimulate local economies by promoting consumption and investment, further fostering economic growth [17]. Despite DBC's potential to promote financial inclusion, challenges such as unreliable infrastructure and limited digital literacy continue to hinder their effectiveness. In countries like Kenya, Nigeria, and South Africa, issues like poor internet connectivity and inconsistent power supply prevent widespread adoption of digital banking services [23]. Regulatory barriers and lack of digital literacy also prevent marginalized groups from fully utilizing these services, reinforcing inequalities [24]. To maximize DBC's impact on financial sustainability and economic development, efforts to improve access to financial services and bridge infrastructure gaps are essential [25].

DBC plays a significant role in promoting financial sustainability by improving operational efficiency, enhancing financial inclusion, and generating new revenue streams. The adoption of digital financial services reduces transaction costs, benefiting banks operating in competitive markets [10], [26]. Platforms like M-Pesa in Kenya show how DBC can extend financial services to underserved areas, where traditional banking is limited [14], [27]. By enabling individuals to conduct transactions without physical branches, DBC contributes to poverty alleviation and economic empowerment, supporting broader goals like improved living standards and economic growth [28], [29].

However, the adoption of DBC faces barriers such as high implementation costs, regulatory challenges, and infrastructure gaps. While digital inclusion can enhance bank stability, it can also increase risks if regulatory frameworks are insufficiently developed [30]. In countries like Nigeria and South Africa, inconsistent regulations and high implementation costs discourage banks from embracing DBC fully, limiting their impact on financial sustainability [31], [32]. Furthermore, unreliable internet and power supply exacerbate the problem, highlighting the need for investment in infrastructure and regulatory reform to ensure the widespread benefits of digital banking [33], [34].

In Kenya, the sustainability of DBC faces challenges that undermine their long-term effectiveness. Mobile money fraud, including unauthorized transactions and phishing scams, erodes consumer trust and causes financial losses [35]. Addressing these risks requires stronger regulatory frameworks and consumer protection measures. Additionally, the lack of comprehensive regulations on mobile money services raises concerns about data privacy, as sensitive information is vulnerable without robust data protection laws (Blechman, 2016). As mobile financial services evolve rapidly, existing legal frameworks often lag, leaving gaps that malicious actors can exploit. Further complicating the situation are the high costs of mobile data and limited access to digital devices, particularly in rural areas. Despite mobile banking's potential to enhance financial inclusion, affordability remains a critical challenge for low-income users [36], [37]. Many in rural areas struggle to afford necessary data plans, limiting access to mobile banking services. The digital divide, caused by unequal access to smartphones and computers, prevents many from benefiting from these services [36]. To ensure the sustainability of DBC, efforts to address infrastructure gaps, improve regulatory frameworks, and make mobile banking more affordable and accessible are essential. Collaboration from government regulators, financial institutions, and technology providers is needed to create a supportive environment for digital banking in Kenya.

Kenya’s experience with Digital Banking Channels (DBC), particularly through mobile money services like M-Pesa, offers valuable lessons for other African countries. The country’s high mobile penetration and the widespread use of mobile money have significantly improved access to financial services, especially in rural areas. Research indicates that Kenya’s financial inclusion rates surpass those of countries like Ghana and South Africa, thanks to a supportive regulatory environment, extensive mobile network coverage, and the development of user-friendly financial products [38], [39], [40], [41]. This success highlights the importance of these factors in fostering broad-based financial inclusion.

Kenya’s model also shows how DBC can promote economic growth and empower individuals by providing access to financial tools like savings, credit, and payment services. Mobile banking has been linked to increased entrepreneurship and local economic activity, reducing transaction costs and facilitating financial interactions [42], [43]. As other African countries face similar challenges, Kenya’s experience offers a valuable blueprint. By focusing on digital literacy and mobile infrastructure, countries with lower mobile penetration can expand access to digital banking, driving financial inclusion and supporting economic development [44], [45].

Theoretical Framework

Technology Acceptance Theory

The Technology Acceptance Theory (TAT) explains how individuals and organizations adopt and use information systems in their work. Developed by Fred Davis in 1989, the theory explores two key

perceptions that influence technology adoption: perceived usefulness and perceived ease of use [46]. Perceived usefulness refers to how much individuals or organizations believe that using a technology will enhance their performance. On the other hand, perceived ease of use focuses on how effortless it is to employ a technology system. The theory is particularly relevant to the banking industry, where digital banking tools such as mobile banking and Internet banking have become integral to service delivery [47]. However, the extent to which these technologies are adopted varies across banks and customers, with differing levels of usage [48].

TAT highlights how advancements in technology affect firms' financial sustainability by driving growth through increased sales and operational efficiency. When information technologies are accepted and effectively implemented, banks experience immediate and long-term benefits such as improved performance, time efficiency, and convenience [47]. The theory also guides bank managers in strategizing digital technology implementation, including pre-implementation actions and post-implementation interventions to improve acceptance rates [46]. The theory assumes that users are more likely to adopt a technology if they perceive it to be both useful and easy to use. Employees who recognize that a system simplifies their tasks are more inclined to accept and utilize it [46]. TAT is rooted in the theory of reasoned action, which posits that social behavior is influenced by individual attitudes, providing a basis for predicting information system usage [49]. According to this framework, IT proficiency, prior experience, and organizational policies play critical roles in moderating technology acceptance.

The relationship between digital banking channels and financial sustainability is anchored in TAT. Technologies that are perceived as valuable and effective are adopted more rapidly, leading to increased earnings for implementing firms. Moreover, the adoption of digital banking expands access to financial services for marginalized groups, fostering economic development [47]. Although some critics argue that the theory has limited explanatory and predictive power, it remains widely accepted and has been adapted to new technological contexts [50]. TAT continues to be instrumental in identifying consumer willingness to adopt information and communication technology, ensuring the successful implementation of emerging technologies [48].

METHODS

Research Design

This study adopted a combination of correlational, descriptive, and longitudinal research designs. Combining multiple designs, as recommended by previous studies [51], enhances the validity of findings through triangulation.

Target Population

This research adopted a census approach, focusing on all commercial banks in Kenya licensed as of December 31, 2023 [52]. The study targeted these banks because of their role in adopting and implementing digital banking services, which enable customers to access financial services remotely. Commercial banks were selected due to their varying ownership structures—whether local or foreign—which influence their level of technological adoption and, consequently, their financial sustainability [53]. Additionally, differences in financial strength among these banks affect their capacity for technological investment, while the level of financial inclusion they achieve determines the size of their clientele, further impacting sustainability [54].

The ability to perform banking transactions remotely has transformed customer expectations and behaviors, leading to a shift towards more technology-driven banking solutions [55]. This shift is particularly relevant in the context of Kenya, where mobile banking has gained significant traction, driven by the need for financial inclusion among underserved populations ([54]. The unique characteristics of the Kenyan banking sector, including the prevalence of mobile money services, further underscore the importance of studying

these commercial banks concerning their digital banking strategies and financial sustainability. Moreover, the competitive landscape of the banking sector in Kenya is influenced by various factors, including regulatory frameworks, technological advancements, and changing consumer preferences [52]. The CBK's regulatory oversight ensures that banks adhere to standards that promote financial stability and consumer protection, which is essential for fostering trust in digital banking services [56].

Research Instrument and Data Collection Procedure

The study used secondary data, which was gathered from the audited annual financial reports of commercial banks in Kenya for the period between 2018 and 2023. These reports were accessed through the banks' official websites and the Central Bank of Kenya (CBK) library. A secondary data collection guide was developed to organize and extract the relevant data needed to address the research questions effectively. Data was collected over six-years, from 2018 to 2023, allowing the researcher to gather sufficient information on the trends in the digital banking channels and the financial sustainability of commercial banks. Before beginning the data collection process, the necessary approvals were obtained from relevant authorities. These included a permission letter from the university and a research permit license from the National Commission for Science, Technology, and Innovation (NACOSTI).

Operationalization of Variables

The study variables were operationalized as illustrated in Table 1.

Table 1: Indicators of Digital Channels and Financial Sustainability

Indicators	**Measure**
Digital Channels (DC)	
Internet banking	Value of Internet banking transactions to total banking transactions
Mobile banking	Value of mobile banking transactions to total banking transactions
Electronic card banking	Value of electronic card banking transactions to total banking transactions
Agency banking	Value of agency banking transactions to total banking transactions
$Ratio\ of\ Individual\ DC\ Transcactions \frac{Digital\ Banking\ Channel\ Transactions}{Total\ Transactions\ of\ All\ Channels}$	
Financial Sustainability Index (FSI)	
Sustainability Z- score index	ROA + (Equity/Assets) The Standard deviation of ROA
$ROA = \left(\frac{Net\ Income}{Total\ Assets}\right)$ $\quad Z - score = \left(\frac{ROA + \frac{E}{A}}{Std.ROA}\right)$ ***ROA:*** Return on Assets ***Std. ROA:*** Standard Deviation of Return on Assets ***E:*** Total Equity ***A:*** Total Assets	

Source: Researcher (2024)

Data Analysis

Two models were adopted to test the relationship. The first model indicated (1.1) tested the individual effect of the digital banking channel component on financial sustainability. The second model denoted (1.2) tested

the combined effect of digital channels on financial sustainability. The derived values were fitted in the following regression models.

$FSit=\alpha+\beta 1FSit\text{-}1+\beta 2IBit+\beta 3EBit+\beta 4MBit+\beta 5ABit+\mu it$…. Eq. 1.1

$FSit=\alpha+\beta 1FSit\text{-}1+\beta 2DCit+\mu it$……..... Eq. 1.2

Where:

FSI is the Bank stability index, FS*it-1* is the lagged dependent variable, IB is the internet banking, EB is the electronic card banking, MB is the mobile banking, AB is the agency banking, α is the regression constant term, $\beta 1$…. $\beta 5$ are regression coefficients and μit is the error term (residual). Subscript t represents the particular period, for each variable *i*.

RESULTS

Descriptive Statistics of Financial Sustainability

The descriptive statistics of the financial sustainability index (FSI) of all the 38 banks that were included in the study were summarized by years from 2018 – 2023. Table 2 shows the results.

Table 2: Descriptive statistics of Financial Sustainability sorted by Period

Period	N	mean	min	Max	Skewness	Kurtosis
2018	38	66.3865	3.5539	382.0204	2.3970	8.2688
2019	38	63.3560	1.9398	368.3619	2.4503	9.0017
2020	38	62.6742	-7.2920	369.6864	2.4171	8.9350
2021	38	62.5683	-2.8130	230.4201	1.3046	4.0216
2022	38	54.7266	-1.1363	165.9403	0.9150	3.2456
2023	38	73.0246	0.5217	351.6846	1.8574	7.2310
FSI	228	63.7894	-7.2920	382.0204	2.3121	9.1552

Source: Researcher (2024)

The descriptive statistics for the Financial Sustainability Index (FSI) of commercial banks in Kenya revealed an average FSI of 63.79, indicating a moderate level of financial sustainability across the banks. The skewness value of 2.31 shows that the distribution was right-skewed, with a few banks performing much better than the majority. The FSI ranged from a minimum of -7.29 to a maximum of 382.02, further illustrating the wide gap in financial sustainability. Some banks were struggling, potentially operating at a loss, while others were thriving. The kurtosis value of 9.16 indicates a distribution with a more pronounced peak and heavier tails than a normal distribution, meaning most banks clustered around the average, but there were also several extreme outliers. In conclusion, while the average FSI suggests moderate financial sustainability, the high variability and presence of outliers indicate that some banks may need to adopt stronger financial sustainability practices. This variation underscores the need for tailored strategies to enhance stability, as the sector includes both high-performing and at-risk banks.

Descriptive Statistics of Digital Channels

The study conducted a descriptive analysis of the composite data of the various digital channels (DC) obtained over the 6 years (2018-2023). Table 3 presents the results.

Table 3: Descriptive Statistics for DC

Period	N	mean	Sd	min	Max	Skewness	kurtosis
2018	38	0.7906	0.1945	0.0327	0.9982	-1.6532	7.0322
2019	38	0.6105	0.2679	0.0340	0.9990	0.1452	2.1690
2020	38	0.8662	0.2177	0.0329	0.9987	-3.0054	11.5792
2021	38	0.9214	0.1269	0.2242	0.9984	-4.5297	25.3432
2022	38	0.9168	0.1265	0.2329	0.9983	-4.3436	23.8321
2023	38	0.9180	0.1292	0.2178	0.9983	-4.3766	24.0808
DC	228	0.8372	0.2145	0.0327	0.9990	-1.9116	6.1841

Source: Researcher (2024)

The data for the digital channel (DC) from 2018 to 2023 showed a steady increase in average values, rising from 0.7906 in 2018 to 0.9180 in 2023. This upward trend indicates that user participation in the digital channel has grown consistently over the years. The standard deviation (SD) decreased during this period, dropping from 0.1945 in 2018 to around 0.126 by 2023. This decrease suggests that the level of engagement became more uniform across users. By 2023, the skewness values became significantly negative, reaching -4.38, which indicates that most user engagement was concentrated toward higher values, forming a left-skewed distribution. The kurtosis values also increased sharply, exceeding 20 by 2023, implying that the distribution had a strong peak with fewer extreme values. The findings from skewness and kurtosis suggest that user engagement behavior became more stable, likely due to improved features or more focused engagement strategies.

The study further tested the four individual digital channels including Agency Banking (AB), Mobile Banking (MB), Electronic Banking (EB), and Internet Banking (IB). Table 4 shows the results of descriptive statistics of mobile banking (MB).

Table 4: Descriptive Statistics for MB

Period	N	mean	Sd	min	Max	skewness	kurtosis
2018	38	0.1464	0.0471	0.0117	0.2607	-0.2364	3.5579
2019	38	0.2186	0.0940	0.0117	0.4604	0.7033	3.5532
2020	38	0.3671	0.2055	0.0116	0.7079	-0.0098	1.8611
2021	38	0.5855	0.1684	0.0163	0.8407	-1.3421	5.0182
2022	38	0.5705	0.1647	0.0170	0.8253	-1.3430	4.8767
2023	38	0.5828	0.1660	0.0160	0.8295	-1.3786	5.1159
MB	228	0.4118	0.2340	0.0116	0.8407	-0.0103	1.5506

Source: Researcher (2024)

The Mobile Banking (MB) channel showed significant growth in user engagement during the observed period, as reflected in the mean values, which rose from 0.1464 in 2018 to 0.5828 in 2023. This consistent increase indicates that mobile banking is becoming more widely adopted and relevant to users. The standard deviation also grew over time, especially between 2018 and 2020, showing that there was more variation in how users engaged with the service during that period. The skewness values varied each year but generally showed a negative trend, suggesting a left-skewed distribution. This means that most users had moderate levels of engagement, while only a few exhibited very high levels of use. This pattern, along with the rising average engagement, suggests that mobile banking services are expanding successfully. However, the increased variability also indicates that user engagement is not yet completely stable, likely due to occasional spikes driven by factors such as seasonal events, new product launches, or promotional campaigns.

The results of descriptive statistics of Internet banking are presented in Table 5. The results show an increase in the use of Internet banking between 2018 and 2023.

Table 5: Descriptive Statistics for IB

Period	N	mean	Sd	min	max	skewness	kurtosis
2018	38	0.1813	0.0494	0.0104	0.2547	-0.9831	4.8913
2019	38	0.2007	0.1117	0.0089	0.4285	0.5687	2.2341
2020	38	0.2726	0.1419	0.0081	0.7277	0.9455	4.8246
2021	38	0.1852	0.0882	0.0073	0.5148	1.4579	6.8454
2022	38	0.1844	0.0843	0.0085	0.4981	1.6295	7.2644
2023	38	0.1825	0.0832	0.0080	0.4977	1.6667	7.5127
IB	228	0.2011	0.1017	0.0073	0.7277	1.4956	7.1139

Source: Researcher (2024)

The Internet Banking (IB) channel showed a modest increase in average engagement, rising from 0.1813 in 2018 to 0.2011 in 2023. This gradual upward trend, while positive, was slower than the growth seen in other channels, indicating that its adoption may be more niche, with users engaging stably and consistently. The low standard deviation values throughout the period suggest that user engagement remained steady, with few fluctuations. This stability points to a dedicated group of users who likely use the IB channel for specific, regular transactions rather than frequent interactions. There was also a noticeable positive skewness in the data, particularly in the later years, with a skewness of 1.6667 in 2023. This suggests that while most users engaged with the channel at moderate levels, there were occasional spikes in activity, possibly driven by higher-value transactions or seasonal changes in demand. Additionally, the kurtosis values increased over time, reaching 7.5127 in 2023. This indicates a distribution with a higher peak and fewer extreme outliers, suggesting that most users follow similar patterns of engagement, with only a few deviating significantly from the norm.

The Electronic Banking channel was also subjected to descriptive statistics and Table 6 summarizes the results. The results showed a decline in the use of electronic card banking between 2018 and 2023.

Table 6: Descriptive Statistics for EB

Period	N	mean	Sd	min	max	skewness	kurtosis
2018	38	0.2590	0.0675	0.0100	0.3825	-1.1359	6.2423
2019	38	0.1121	0.0584	0.0127	0.3396	1.4902	7.3805
2020	38	0.1240	0.1262	0.0049	0.6163	2.5126	8.8894
2021	38	0.0979	0.0714	0.0022	0.3441	1.9819	6.9568
2022	38	0.1078	0.0686	0.0027	0.3432	1.8783	6.8130
2023	38	0.1022	0.0687	0.0022	0.3396	2.0096	6.9339
EB	228	0.1338	0.0973	0.0022	0.6163	1.4946	5.5184

Source: Researcher (2024)

The Electronic Banking (EB) channel showed significant changes in its average usage over the observed period, with a clear decline from 0.2590 in 2018 to 0.1022 in 2023. This decrease in the mean value suggests that user activity has diminished over time. Moreover, the standard deviation also decreased, indicating less variation in usage. The skewness values remained strongly positive, especially reaching 2.5126 in 2020, and while they were slightly lower in the following years, they stayed consistently high (e.g., 2.0096 in 2023). This persistent positive skewness indicates that most users engaged at low levels, with occasional peaks

showing higher levels of activity. Similarly, the kurtosis values were high, peaking at 8.8894 in 2020, and staying elevated throughout the period, indicating a leptokurtic distribution. This pattern, with a concentration on low engagement levels and fewer extreme outliers, highlights the inconsistent commitment of users to the EB channel.

Finally, the study conducted a descriptive analysis of the agency banking channel and found a drop in its use between 2018 and 2019. The results are summarized in Table 7.

Table 7: Descriptive Statistics for AB

Period	N	mean	Sd	min	max	skewness	Kurtosis
2018	38	0.2040	0.0495	0.0006	0.2671	-1.8965	8.5475
2019	38	0.0791	0.0488	0.0006	0.2955	2.2587	11.3729
2020	38	0.1024	0.0958	0.0001	0.4174	1.5934	5.2674
2021	38	0.0526	0.0383	0.0050	0.1984	1.7946	6.8484
2022	38	0.0542	0.0365	0.0061	0.2046	2.1849	9.0879
2023	38	0.0504	0.0354	0.0055	0.1916	2.1767	8.5149
AB	228	0.0904	0.0766	0.0001	0.4174	1.3301	4.2912

Source: Researcher (2024)

The Agency Banking (AB) channel showed a significant drop in average user engagement, decreasing from 0.2040 in 2018 to 0.0504 in 2023. This decline suggests that user activity in this channel has reduced substantially over time. It may indicate a shift from agency banking to other banking methods, such as mobile and internet banking, which are often preferred for their ease of use and accessibility. The standard deviation also decreased. This decrease in both mean engagement and variability points to a more consistent, yet overall lower level of activity, suggesting that agency banking has become less important or appealing to most users. The skewness values remained positive, with a notably high skewness of 2.2587 in 2019. These positive values suggest occasional spikes in user engagement, possibly from specific groups who rely on agency banking for limited access to other banking services. Additionally, high kurtosis values, consistently above 5.0 (8.5475 in 2018 and 8.5149 in 2023), indicate that there were rare but significant instances of extremely high engagement.

RESULTS AND DISCUSSION

Step1: Influence of Individual Digital Channels on Financial Sustainability

The first step tested the sub-hypothesis that there is no significant relationship between individual digital banking channels and the financial sustainability of commercial banks in Kenya. To do this, agency banking (AB), electronic banking (EB), mobile banking (MB), and internet banking (IB) were considered as separate digital channels. The analysis used four models: Robust OLS, Fixed-effects, Difference GMM, and System GMM. The results of this analysis are presented in Table 8.

Table 8: Individual Effects of Digital Channels on Financial Sustainability

Model	(1) Diff GMM	(2) System GMM	(3) Fixed-effects	(4) OLS, robust
L.FSI	0.372*	0.411*		
	(0.000)	(0.000)		
IB	0.195	0.201	0.205	0.215
	(0.042)	(0.045)	(0.070)	(0.050)

Model	(1) Diff GMM	(2) System GMM	(3) Fixed-effects	(4) OLS, robust
EB	0.273*	0.278*	0.281	0.295*
	(0.005)	(0.008)	(0.015)	(0.006)
MB	0.305*	0.312*	0.320*	0.335*
	(0.001)	(0.003)	(0.004)	(0.002)
AB	0.172	0.176	0.177	0.185
	(0.020)	(0.022)	(0.035)	(0.025)
Const	0.641	0.660	0.772	0.795*
	(0.035)	(0.031)	(0.011)	(0.006)
Observations	114	152	228	228
No. of instruments	17	22	-	-
AR2 (P-value)	0.318	0.294	-	-
Sargan Test (P-value)	0.187	0.199	-	-
Hansen Test (P-value)	0.309	0.277	-	-

* Shows significance at $p<0.05$

Source: Researcher (2024)

In all the models, the lagged dependent variable (L. FS) showed strong significance in both GMM models, with coefficients of 0.372 and 0.411. This indicates a strong positive link with past values of financial sustainability ($p < 0.05$). This persistence suggests that a bank's financial sustainability is influenced by its previous performance, highlighting the importance of building upon past achievements. All the digital banking channels examined—Mobile Banking (MB), Electronic Banking (EB), Agency Banking (AB), and Internet Banking (IB)—had significant positive effects on financial sustainability, though the strength of these effects varied across the models. Mobile Banking had the greatest impact, with coefficients ranging from 0.305 to 0.335 ($p < 0.05$), demonstrating that its use has a significant and positive effect on financial sustainability. Electronic Banking also showed strong results, with coefficients between 0.273 and 0.295 ($p < 0.05$).

While Agency Banking and Internet Banking also had significant positive relationships with financial sustainability, their effects were weaker in comparison. The coefficients for Agency Banking ranged from 0.172 to 0.185 ($p < 0.05$), while those for Internet Banking ranged from 0.195 to 0.215 ($p < 0.05$). These results suggest that although all digital banking channels contribute positively to financial sustainability, Mobile Banking and Electronic Banking have the most substantial influence. The AR (1) test results showed first-order autocorrelation ($p < 0.05$), which is typical for panel data. However, the AR (2) test revealed no second-order autocorrelation ($p > 0.05$), further validating the GMM models. Additionally, the results from the Sargan and Hansen tests ($p > 0.05$) confirmed that the instruments used were valid, supporting the specifications of the models. Overall, the findings emphasize the important role that digital banking channels play in improving the financial sustainability of commercial banks in Kenya, with Mobile Banking emerging as the most influential channel between 2018 and 2023. As a result, the null hypothesis regarding the relationship between digital banking channels and financial sustainability was rejected. This implies that banks should continue to invest in and promote these digital channels to strengthen their financial sustainability in a competitive market.

Step2: The Combined Effect of Digital Channels on Financial Sustainability

The second step involved testing the sub-hypothesis that there is no significant relationship between the combined use of digital banking channels and the financial sustainability of commercial banks. The results of this analysis are presented in Table 9.

Table 9: Combined Effects of Digital Channels on Financial Sustainability

Model	(1) Diff GMM	(2) System GMM	(3) Fixed-effects	(4) OLS, robust
L.FSI	0.460*	0.478*		
	(0.000)	(0.000)		
DC	0.225*	0.228*	0.235	0.245*
	(0.003)	(0.006)	(0.013)	(0.004)
Const	0.733	0.740	0.792	0.804*
	(0.027)	(0.025)	(0.016)	(0.007)
Observations	132	172	228	228
No. of instruments	14	19	-	-
AR1 (P-value)	0.016	0.019	-	-
AR2 (P-value)	0.308	0.287	-	-
Sargan Test (P-value)	0.207	0.218	-	-
Hansen Test (P-value)	0.325	0.315	-	-

* Shows significance at $p<0.05$

Source: Researcher (2024)

The combined digital channels (DC) variable also exhibited a significant positive relationship with financial sustainability, with coefficients ranging from 0.225 to 0.245 ($p < 0.05$). These results suggest that increasing the adoption of digital banking channels collectively benefits banks' financial sustainability. The findings highlight the critical role of digital channels in improving financial performance and underscore the need for banks to invest in and expand their digital services to remain competitive in the evolving banking sector.

Discussion of Findings

TAT suggests that when users view a technology as both useful and easy to use, they are more likely to adopt it. The strong positive relationships identified in this study suggest that banks and their customers recognize the benefits of these digital channels. By investing in and implementing these technologies, banks can offer services that meet customer needs while also improving operational efficiency. For example, Mobile Banking is perceived as particularly useful due to its ease of access and convenience, encouraging more banks to adopt and promote this channel. The positive results for Electronic Banking and Agency Banking further support this idea. These findings indicate that as banks increasingly understand the value of these channels for enhancing customer experience and improving operational efficiency, their financial sustainability is positively impacted. TAT's perspective on technology acceptance suggests that successful integration of these technologies reflects a favorable attitude towards their usefulness, leading to higher adoption rates.

The study also looked at the combined effect of all digital banking channels. The results showed that the total use of digital channels significantly enhances financial sustainability, with coefficients ranging from 0.225 to 0.245 across the models. This result emphasizes the importance of adopting multiple digital channels, as the combined effect leads to better financial outcomes for banks. According to TAT, as banks perceive digital channels to be valuable and efficient, they are more likely to invest in these technologies. The positive relationship between digital channels and financial sustainability suggests that banks making the most of these technologies are likely to see financial growth. Moreover, the lagged variable's significant results suggest that the benefits of digital channel adoption build up over time. This aligns with TAT's focus on the long-term impacts of technology acceptance, showing that as banks continue to embrace digital

banking, they not only improve their current financial sustainability but also lay the groundwork for future success.

The study's findings strongly reject the null hypothesis, which proposed that there is no significant relationship between digital banking channels and the financial sustainability of commercial banks in Kenya. With significant positive relationships identified in multiple models, the null hypothesis is dismissed. The results confirm that digital banking channels are essential for improving financial sustainability, consistent with the principles outlined in the Technology Acceptance Theory.

The analysis showed that mobile banking (MB) had the greatest impact, followed by electronic banking (EB), agency banking (AB), and internet banking (IB). This aligns with findings from other studies, which indicate that mobile banking significantly boosts financial inclusion and performance among Kenyan banks, highlighting the strong connection between adopting digital channels and improving financial outcomes [57], [58]. Further research has pointed to the positive effects of mobile banking on the financial growth of micro, small, and medium enterprises, supporting the idea that digital channels strengthen financial sustainability [57], [59].

The combined effect of digital channels on financial sustainability, as indicated by the significant coefficients in the GMM models, suggests that the collective adoption of these channels provides greater benefits than each channel on its own. This finding is supported by research from other developing economies, where using a range of digital banking services has been shown to improve overall bank performance and stability. For example, a study in Nigeria found that integrating various financial technologies positively influenced the financial performance of banks, suggesting that a holistic approach to digital banking leads to greater improvements in financial sustainability [60].

CONCLUSION AND RECOMMENDATION

The analysis reveals a positive correlation between digital banking channels and financial sustainability. The adoption of digital technologies by banks has led to enhanced financial performance, consistent with the Technology Acceptance Theory (TAT), which highlights the significance of perceived usefulness and ease of use. All forms of digital banking—Mobile Banking, Electronic Banking, Agency Banking, and Internet Banking—had a positive impact on financial sustainability, with Mobile Banking emerging as the most influential due to its convenience and widespread accessibility. These findings are significant for commercial banks in Kenya, highlighting the importance of digital channels in improving customer service and operational efficiency. Banks that embrace digital technologies are better positioned to meet customer needs and enhance performance. It is recommended that Kenyan banks continue It is recommended that Kenyan banks prioritize continued investment in and expansion of digital banking services, with a particular emphasis on Mobile Banking. Enhancing accessibility, usability, and security will be crucial in driving greater customer adoption. Additionally, exploring new digital solutions will help banks stay ahead of market trends, strengthening their competitiveness and financial sustainability.

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