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Effect of Financial Innovation on Intermediation Efficiency within the Banking Sector in Kenya

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Abstract

The banking sector in Kenya has rampantly undertaken a lot of financial innovation, a move seemingly emanating from the need to bridge the gap between the two economic agents and a quest to address the dynamic changes in their clientele and the financial system as a whole. However, despite the vital role played by the financial innovations, the tangible evidence related to its effect on financial intermediation efficiency has been scanty. The latter could be as a result of few empirical studies, denying the players the vital information on the effect that financial innovation has on the sector. This study sought to establish the effect of financial innovation on the financial intermediation efficiency within the banking sector in Kenya for the period beginning on 01st January 2012 and ending on 31st December 2020. Secondary data collected from the Central Bank of Kenya website was utilized. This data was grouped on quarterly averages based on the financial reporting timelines of the banking sector in Kenya. The predictor variables used include: Volumes of Mobile banking transactions; internet banking transactions; Point of Sale; RTGS; Automated Clearing House and Automated Teller Machines. The outcome variable was interest rate spread, which is the difference between the lending rates and deposit rates, as proxy for financial intermediation efficiency. The study focused on the aggregate banking sector. The study adopted a descriptive research design and the data was analyzed using a multiple regression model. The F-value had a significance of <0.001 which is less than p-value of 0.05, an indication of significant statistical relationship between the outcome and predictor variables under the study. The results from the regression analysis indicated that volume of mobile banking transactions was positively and significantly affecting the efficiency of financial intermediation. Internet banking and Agency banking were positively but insignificantly affecting financial intermediation efficiency. Automated clearing house and ATMs' volumes were adversely and insignificantly affecting the efficiency of financial intermediation. The adjusted $R^2=0.844$ indicating that 84.4% of the change in financial intermediation efficiency was influenced by the predictor variables under the study. The study also established that R=0.931, meaning that the predictor variables had a strong correlation with the outcome variable. Therefore, the study concluded that, financial innovation is a huge determinant of the financial intermediation efficiency in Kenya, highly influenced by the Mobile Banking Transactions. The recommendations thereby were: Banks to continuously research on the technology based banking; carry out rigorous mass sensitization programs and campaigns; designing of the technology based banking platforms to be done in conformance with the consumers requirements and expectations; create an integrated one stop comprehensive financial services platforms; offer rebates on savings/deposits rates done on the financial innovation platforms; continuous maintenance of the alternate banking channels ;creation of digital centers at bank branch levels; offer information and financial support to agency banking agents and install security measures to safeguard information /financial losses. The study suggests that: The same kind of study to be conducted after a significant period of time (post the interest rate capping

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period); another study that entirely focusses on individual banking institutions and same scope be extended to the other subsectors of the finance sector including insurance and microfinance institutions.

Keywords: *Financial Innovation, Financial Intermediation Efficiency, Banking Sector in Kenya*

Introduction

The growing significant roles of financial intermediation in modern economies coupled with rapid and sophisticated development of financial innovation, has not only triggered interest in the financial sector and policy making but also in the field of academic research. The financial sector has for a long time struggled with inherent market imperfections ranging from high transaction costs, inefficient service delivery, increasing agency costs to extreme information asymmetry (Chukwunulu &Ibenta 2020). These market imperfections have created a huge gap between the two major units of the financial system, that is, Surplus and Deficit units, which has been blamed for the slow economic development. It is a primary knowledge that, liquidity within an economy enhances investment which ultimately culminates into strong economic growth. Therefore, an improved financial intermediation is inevitable. In pursuit of the latter, the financial sectors must re-invent themselves, meaning that, modified and/or new products are needed, the procedures /processes ought to be enhanced, new information dissemination platforms are a must have and disintegration of the centralized mode of service delivery should be instituted (Pianalto ,2007).

This study was anchored on the following theories: Agency theory; financial asymmetry theory; circumvention innovation theory; constraint innovation theory and transaction innovation theory. Information asymmetry notes that, lack of adequate and timely information between the two economic agents hinders their direct interaction, (Akerlof, Spense & Stiglitz, 1970). Agency theory cites that, separation of owners from control could lead to the rise of conflicting interest (Jensen & Meckling, 1976). Circumvention innovation theory portrays financial innovation as a confrontational tool to the government-imposed controls and regulations. Constraint induced innovation theory presents innovation as resultant effect of a financial system's internal and external hindrances. Transaction costs theory, views financial innovation as a gateway to efficiency in the financial systems resulting to reduced transaction costs.

The Kenyan financial sector has witnessed a rampant financial intermediation shift in the last few years. The failures of the banking sector in the 1990's prompted for radical moves in the financial system, with each participant targeting to improve efficiency, cost cutting/saving and enhance convenience of the service delivery. These have paved way for innovation at all service/product and organizational fronts, resulting into significant reductions in the barriers to entry in the financial markets, emergence of new products and instruments and active growth in the banks' branch networks (Njuguna, 2011). Mobile banking uptake has been on an upward trajectory since the inception of Mkesho platform by Equity bank, followed by Mshwari,KCB Mpesa,M-Coop cash,Mkopa and many other digitally based platforms such as Branch,Timiza among others (KBA,2020).Currently,100% of the Kenyan commercial banks have employed mobile banking, operationalized either as an application or USSD.ATM services patronage has been on the rise, a platform that not only supports operations of bank accounts but also enhanced use of Prepaid cards. The uptake of agency banking and internet banking has been significant. The development and adoption of RTGS and Automation of clearing houses have notably improved payment settlement through reduction of transaction timelines and eradication of inherent risks associated with the traditional systems.

Research Problem

Financial innovation can potentially disrupt the traditional financial and enhance a more open, inclusive and highly efficient financial systems. The effects of the modern day innovation with regard to financial intermediation has widened the accessibility of financial information, products and services, thereby enhancing a speedy and highly effective interaction of the two economic agents. The result has been, better pricing of risks leading to improved interests on savings and favorable cost of credit. Additionally, ease of credit scoring and tracking of loans have enhanced efficiency in credit management. However, the risks and costs associated with the financial innovation has exposed both the financial institutions and their patrons to losses, a factor that has seen uptake of some financial innovation increasing at decreasing rates (Korir, Sang, Shisia & Matung'u, 2015).

The banking sector in Kenya has experienced high expectations from both economic agents as well as increased competition emanating from external financial systems and alternate intermediation channels (CBK,2015).The resultant response has been rigorous financial innovation and adoption, targeted at meeting and/or exceeding service delivery expectations, with CBK (2020) noting that, 79% of the

commercial banks introduced a financial innovation related products between January 1, 2020 and December 31st, 2020. According to KBA (2020), digital credit/mobile banking were the commonly utilized channels for daily/emergency needs in Kenya, accounting for 46.2% of such transactions in 2015.Further, the same study noted that, 54% of Kenyans saved their funds in the digital wallets platforms in 2019. Adoption of mobile financial services, internet banking, agency banking and other alternative channels have been on the rise in the recent past. However, financial institutions and their clients have been exposed to high level of risks, some of which have resulted into huge financial losses and data breaches (Korir, Sang, Shisia and Matung'u, 2015). Mobile banking and Internet banking have been a target of fraudsters and hackers. Agency banking has been a weak link in the consumer data protection, leading to a significantly reduced patronage. Additionally, constant outage on third party service provisions such as internet and mobile phone services can negatively impact on the reliability of such platforms.

Despite the high level of financial innovation adoption and patronage, the resulting effects has somehow been conflicting. Vargas (2009) appreciated the pace of financial innovation in Costa Rica. However, the scholar found no significant shift in financial intermediation from the traditional practices. Chukwunulu and Ibenta (2020) identified ATMS, Mobile banking, PoS and internet banking as the major financial innovations in Nigeria. The study concluded that, Internet banking, Mobile banking and ATMs had a positive but insignificant effect on financial intermediation while PoS indicated an adverse effect on the efficiency of financial intermediation. Ansong, Yiadom and Asmah (2011) found out that, financial innovation in Ghana had undesired effects on the savings short termly but its effects are expected to be positive and significant in the long-run. Most of these studies do not outline the reasons behind the failure or success of financial innovation in the financial systems under consideration. At the same time, the assumptions made is that, financial innovation is the primary factor influencing financial intermediation, which might miss out other factors at play that could undermine the gains of financial innovation. Additionally, financial innovation bears both pros and cons, an element that misses out on the conclusions, but can have a bearing on the patronage from both the economic agents. Empirical reviews show that, the studies done on financial innovation and its effects on financial intermediation in Kenya are scarce. Majority of the existing empirical work focus on financial innovation and financial performance correlation. Considering the vital role of funds mobilization and allocation in the Kenyan financial system,

it is paramount to determine, what is the effect of financial innovation on the financial intermediation among the Kenyan commercial banks?

Research Objectives

To determine the effect of financial innovation on financial intermediation efficiency within the banking sector in Kenya.

Literature Review

Theoretical Review

Financial intermediation and financial innovation base their roots on several theories on which they are anchored on. This section will cover those theories which include, theory of information asymmetry, Agency theory, Circumvention innovation theory, Constraint-induced innovation theory and transaction cost innovation theory.

Information Asymmetry Theory

Information asymmetry in the financial market can be referred to as a situation in which an economic agent is deemed to be in possession of vital market information at the expense of another economic agent, resulting into undue advantage , (Akerlof, 1970 ; Bergh,2019).Developed by Akerlof ,Spense and Stiglitz (1970),this theory can be of ex-ante nature, ending up presenting adverse selection, interim nature, resulting to moral hazard and finally ex-post nature, culminating into auditing or costly enforcement and authentication. In contrast to the Arrow-Debreu model, the general imperfections in the financial markets can be attributable to the information asymmetry.

Financial intermediation is anchored on this theory. Its existence is a resultant effect of the inherent market imperfections which include: High transaction costs; unequal, inadequate and untimely flow of information, stringent regulatory and taxation measures (Scholtens & Wensveen, 2003). The latter factors make it difficult for the direct interaction of the economic agents, a situation that explains the active participation of intermediaries in the financial markets to fill in the already existing information gap (Chukwunulu & Ibenta, 2020).

The major assumption of this theory is that, all important information is in possession of only one economic agent at the expense of the other. However, the reality is, in real markets, not everyone is in the "dark", a situation resulting from the enormous information availability from sources such as Consumer reports, Underwriters laboratory and credit bureaus. Additionally, some government actions can prevent market prices from accurately reflecting important information.

The relevance of this theory to the study is because it presents a justification point of view on the rationale for the existence of financial intermediation and intermediaries and also, extends to link the role played by the intermediaries to the transaction costs charged thereof (Chukwunulu & Ibenta,2020).

Agency Theory

Developed by Jensen and Meckling (1976), this theory explains that, the issue of conflicting interest coupled with emergence of agency costs crop up as a result of ownership separation from control and direction aspects appertaining to the nature of risks being undertaken (Panda,2017). This means that, measures have to be employed with an aim of curbing the agency conflicts expected, resulting to the rise of agency costs. Financial intermediation entails deposits from the savers, which is then converted into credit and issued to the deficit units but must be availed to the savers upon maturity or as when needed. The deposit taking and loan issuance create an agency relationship between both ends of the economy and the financial institutions, hence application of the agency theory.

The theory focus is in providing practical solutions to the inherent problems associated with the principal and the agent. This theory outlines several implementable recommendations targeted at enhancing proper organizational governance and management of the agents' actions in line with the contractual agreements. However, the theory seems to be one sided with the primary assumption being that, the problems always emanate from the agent, which is not always true. According to Parrow (1986), the agency theory is not developed to control the principals, negating the fact that some principals are exploitative.

The relevance of this theory to the study is that, it elaborates how significant a managerial action can tilt the success or failure of the financial intermediation process. The theory shows how managers in the financial institutions can shelf the goals of the owners and the economic agents in pursuit of individualized interest (Acaravci & Calim, 2013).

Circumvention Innovation Theory

Developed by Kane (1987), this theory observed that, governments are always at the center of imposing controls and regulations in the financial sector. The scholar, for instance, samples the property taxation as a form of control, which ends up curtailing profit maximization goals of most financial institutions. This theory seems to lean majorly on creation/bridging the gap between financial and political forces. However, Kane (1987) argument is against the regulative measures /policies that directs financial markets into a certain predetermined economic direction. His model has highly been instrumental in forming foundation for most of the financial evolutions in the USA for over three decades. His imposing force has been on the regulative role of the Federal deposing regulation and the dynamic external market forces which includes depositing environment, technological environment and unforeseen financial prospective advancements. The assumption in this theory is that, the regulation innovation is always geared towards reinforcing regulations. However, the reality is that, the release of such regulations is aimed towards liberal market innovation (Cherotich, Sang, Shisia & Matung'u, 2015).

Its importance to the study is that, it presents financial innovation as a means to curtail losses that emanate from regulations and prevent regulation-induced management failures. In other words, the theory builds insight into financial innovation as a strategic tool directed at profit earning and circumvention of government controls.

Constraint-Induced Innovation Theory

This theory leans towards the internal (self-imposed) and external (markets/government imposed) hindrances that undermine the efficiency of financial institutions. The urge of profit maximization by the financial institutions is the major driving force towards the growing financial innovation (Silber, 1983).

Silber (1975) outlines institutions reaction as a linear optimization model in which case, companies pursue utility maximization subject to a variety of both internal and external constraints. In his explanation, he noted that 60% of all financial innovation can be explained by the latter model. In his conclusion, he stated that, two major constraints exist which tend to increase economic benefit via cost reduction, namely: Better allocation of risks and circumvention of outdated policies.

Constraint-induced theory approaches financial innovation from a micro economic perspective. However, most scholars find it to be over emphasizing innovation in adversity. Therefore, it is deemed not to have the capability to situationally express financial innovation increment in the dynamics of liberal finance, satisfactorily.

Its significance to the study is due to its contribution towards financial innovation in that, it views innovation as a gateway towards reduction and/or removal of all financial constraints impacting on the profit maximization goals of a firm. Sibler (2004) states that institutions facing market imperfections such as entry barriers and stringent regulations can embrace innovation as an incentive towards better operations. Stavins (2011), notes that, MBT, IBT and RTGS are forms of financial innovations expected to improve intermediation. However, this theory discusses financial innovation excessively in adversity, a view that cannot comprehensively express the variable in the dynamics of liberal finance (Achieng,Karani & Tabitha,2015).

Transaction Cost Innovation Theory

The theory advocates for minimization of transactional costs as a reactive response towards technological advancement, (Hicks and Niehans, 1983). In view of this theory, the quest for cost reduction catalysis financial innovation and further improves service delivery efficiency. This theory states that the core goal for financial innovation is profit maximization. As the promoters of the transaction cost theory, Hicks & Niehans (1983) argued that, the outstanding reasons for pursuing financial innovation is in order to minimize the transaction costs. This particular goal leads to a ripple effect that ultimately improves financial services. In the development of this theory, the scholars focused on financial innovation as a function of both microscopic economic structural variations and the imposing motive of firms' goal of maximizing shareholders' wealth.

Transaction costs theory falls short of understanding that; financial institutions are not available options for structuring transactions efficiency when the financial markets fail. Instead these institutions possess certain advantages that enhances governance and execution of positive forms of financial activities through employment of logical means that are quite unique in the market.

Its relevance to the study is because it offers explanation to financial innovation as best avenue to try and reduce transaction costs, for better intermediation and goals attainment. Muia (2013) supports the latter view by stating that, invention methods are the highly positively impactful to organizations that aim at reducing transaction costs which threaten their existence and sustainability.

Empirical Review

Vargas (2007) assessed the effect of product innovation on financial intermediation output in Costa Rica. Using the User cost framework for financial assets, the results indicated that, the financial institutions considered heavily relied on the traditional products for intermediation services. This reflected the conservative nature of most state-owned banks and probably could reflect /show the weight of innovation output across the whole financial system within Costa-Rica. However, having considered state-owned banks, the study excluded the private financial intermediaries who are generally considered to be the epitome of financial innovation due to their profit maximization goals.

Mishra (2008) carried out a study on the economic effects of financial innovation that arise in highly sophisticated and complete financial markets. The study argued that, financial innovation in the context of services, technologies, instruments, markets and institutions tend to move financial resources from the surplus economic agent and channel them to the most productive sectors, hence enhancing capital accumulation leading to high rate of economic growth. Through a descriptive approach of various financial innovation forms, the study concluded that, financial innovation led to a greater savings level, capital accumulation and thus higher growth of the economy. This conclusion was in line with Chou and Tuan K (2007), who established that, efficiency of financial intermediation is raised by financial innovation through increment of financial products and services that in turn enhance matching of financial needs for both the economic agents.

Aikaeli (2008) determined the efficiency of Tanzania's commercial banks. By use of secondary data (time series) of the banking sector, the scholar examines efficiency of the banks at the technical, scale and cost fronts. Data Envelopment Analysis (DEA) model was used to establish the efficiency estimates of the banks. The results indicated that, the level of efficiency was fair but with significant improvement required. Foreign banks reflected the highest levels of technical inefficiencies. Cost inefficiencies were related to

poor labor compensation, inadequate management capacity, inadequate fixed capital and excessive liquid assets.

Okiro and Ndungu (2013) studied the effects of Internet banking and Mobile banking on the general financial intermediation in Kenya. Using both descriptive and qualitative research design approach, the study analyzed a sample of 30 financial institutions. The study indicated that, Kenya's financial institutions and markets were rampantly being revolutionized due to the effect of financial innovation. Rapid technological advancement had increased efficiency, reduced costs and improved customers' interaction with the financial system.

Turan (2015) sought to establish the effect of crowdfunding on financial intermediation. Using the exploratory approach backed by current data to comprehend the equity crowdfunding setting and stakes for major players globally, the study observed that, due to the potential associated with the ability of crowd funding to raise equity funding for startups, the platform is asserting itself as an alternative to the traditional financial intermediation platforms. However, the scholar noted that, the Crowd Funding platform are less regulated and standardized posing several risks but if well managed, they can change the financial intermediation land scape from how it is known currently.

Gibson (2015) sought to establish the effects of financial technology on financial services delivery in Ireland. In its submission, the study outlined that, the traditional financial intermediation models had widely been disrupted by the Fintechs. The study observed that, barriers to entry had highly reduced and at the same time, financial services delivery to the customers had greatly been enhanced. In the conclusion, the scholar encourages adoption of financial innovation in the financial markets purposely for efficiency and competitive advantage. This study is highly supported by Eman (2017) who observed that, a reduction in barriers to entry had encouraged new entrants who in turn have made financial intermediation better thus mobilizing more savings from the formerly unbanked population.

Observing the future of financial innovation and financial intermediation in Kenya, Otieno et al (2015) noted that, improved financial innovation accrues various advantages in the financial system in the country. These include optimization of taxes, deregulation, reduction in transaction costs, increased market liquidity, less agency costs, increased risk sharing, lesser information asymmetry and increased capital intermediation

/raising, affordably. The study suggested that, accounting processes and auditing standards should be instituted to mitigate differences that could outcrop and reduce biasness, misinterpretation and ambiguity which can lead to economic agents making unviable investment decisions.

Omanga and Dreyer (2017) delved into the effects of mobile technologies and financial innovation on financial inclusion in Kenya. Using Mpesa as the case study, the scholars explained that, clients in Kenya could bank remotely while at the same time, the cost of such services being bearable. In their conclusion, the scholars observed that Mpesa is highly disruptive form of financial innovation in the sense that, it improves growth of wealth and increases financial inclusion in the country.

Cai (2018) assessed the impact of Fintech on Financial Intermediation. In this study, the scholar considered two independent variables, namely, crowdfunding and block chain. The study concluded that, both variables significantly affect the traditional financial intermediation. The Scholar outlined that, crowd funding platforms present themselves as substitutes for traditional financial intermediation and act as the new intermediaries without necessarily eliminating the intermediation need, whereas, block chains tend to eliminate the intermediation need in some financial areas due to the trust element inherent in them.
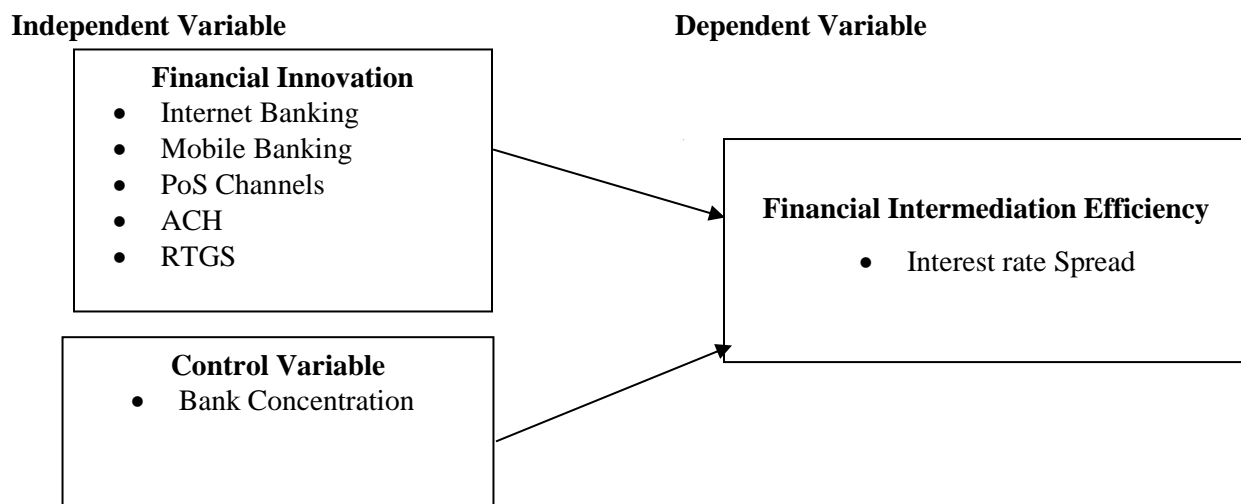
Chukwunulu and Ibenta (2020) studied the effects of financial innovation on the efficiency of financial intermediation in Nigeria. Using OLS regression technique and considering Automated Teller Machines (ATMs), Internet Banking transaction volumes (IBT), Point of Sale transactions (PoS) and Mobile Banking Transaction Volumes (MBT) as the independent variables, the observation was that, MBTs, ATMs and IBTs had a positive but insignificant effects on financial intermediation while PoS demonstrated a negative effect on the latter's efficiency. In addition, the scholars noted that, 57% of the dynamics in the financial intermediation associated with financial innovation are statistically insignificant. Therefore, in conclusion, the study stated that, financial innovation in itself does not determine financial intermediation efficiency in Nigeria. The scholars thereby suggested for a policy change instead that could facilitate improvement in interest rate savings, in order to motivate the surplus units to avail funding for the deficit units.

Studying the effect of Fintech services on the traditional financial intermediation practices in Sri-Lanka, Dharmadasa (2021) used the descriptive method to analyze the impact on the credit, capital raising and deposit savers. The study looked into the bank lending and peer to peer (P2P) lending platforms. The results

showed that, although there won't be catastrophic threat of Fintech on the general banking Industry, but there will be lenders migration from the banks to the P2P platforms, where lesser people rely on the banking system and where the costs and risks associated with regulation are high. The scholar observed that the imminent loss of customer segments in the banking industry is inevitable but it is expected more technological advancement skills will be acquired by the banks to help cope with the challenging environment.

Conceptual Framework

The below conceptual model represents the anticipated correlation between the variables. The independent variables will be the mobile banking transactions, internet banking transactions, PoS channels, and ACH and RTGS transactions. The interest rate spread will be used as a proxy of financial intermediation efficiency, which is the dependent variable.

Independent Variable   **Dependent Variable**

Financial Innovation
- Internet Banking
- Mobile Banking
- PoS Channels
- ACH
- RTGS

Financial Intermediation Efficiency
- Interest rate Spread

Control Variable
- Bank Concentration

Methodology

Research Design

The study used a descriptive approach. This design results into well formulated and important knowledge principles, hence offering significant solutions to a problem, (Mugenda, 2003). According to Gay (2009), this research design is rigid and focuses only on the objectives of the study. It explains a subject through profile development of a group of problems, people or events, via data collection and tabulation of frequencies on research variables (Saunders and Thornhill, 2000). Additionally, it aims at providing validity and accuracy in representation of the study variables thus confining the scholar to the research problem,

(Cooper and Schindler, 2008). This study is a case of aggregate Kenyan banking sector for the period ending on 31st December 2020.

Data Analysis

Descriptive statistics was used in summarizing and explaining the study variables. The findings were established through measure of central tendencies, frequencies, dispersion in the tables and percentages. Pearson correlation, ANOVA, multiple regression, coefficient of determination generated the inferential statistics.

The regression model to be applied was of the form:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_{6+}\, e$

Where,

Y = Interest rate Spread

X_1 = Mobile banking transactions

X_2 = Internet banking transactions

X_3 = Transactions in the PoS channels

X_4 = Automatic Clearing House (ACH) transactions

X_5 = KEPSS/RTGS transactions

X_6 = Bank Concentration

α is a constant

β_1- β_6 = Co-efficient of explanatory variables,

and e=Error

Operationalization of Study Variables

Variables	Indicator	Measures	Empirical Studies	Measurement Levels
Financial Intermediation Efficiency	Savings and credit interest rates	Interest rate spread	Akhisar,Tunay & Tunay (2015 and Chukwunulu & Ibenta (2020)	Ratio
Mobile Banking	MBT	No.of Mobile banking Transactions	Chukwunulu & Ibenta (2020)	Ratio

Internet banking	IBT		Number of Internet banking transactions	Akhisar,Tunay & Tunay (2015) and Chukwunulu & Ibenta (2020)	Ratio
PoS	PoS		No. of PoS Channels	Akhisar,Tunay & Tunay (2015) and Chukwunulu & Ibenta (2020)	Ratio
ACH	Number ACH	of	No. of ACH Transactions	Boot (2008)	Ratio
RTGS	Number RTGS	of	No.of RTGS Transactions	CBK (2020)	Ratio
Bank Concentration	ATMs		Number of ATMs Transactions	Tunay & Tunay (2015)	Ratio

Test of Significance

To determine the statistical significance of both the overall model and the individual variables, f -test was used to measure the significance of the overall regression model at 5% while t-test was used to measure the individual significance of the independent variables. Coefficient of Determination (R^2) was used to measure the variability of the dependent variable as explainable by the independent variables.

Results and Discussions

Descriptive Statistics

Data for interest rate spread, Mobile banking transactions, Internet banking transactions, Automate Clearing House, ATMs, RTGS and Agency banking was collected for this study. The descriptive statistics outcome is as indicated in Table 4.1.

Table 4.1 Descriptive Statistics

Variable	N	Mean	Std Dev	Min	Max
MBT	36	107.885	39.436	42.594	175.168
IBT	36	0.109	0.0327	0.050	0.168
PoS	36	1.741	0.793	0.579	3.306
ACH	36	2.530	0.163	2.085	2.817
ATMs	36	8.715	3.933	4.182	25.072

RTGS	36	0.300	0.163	0.117	0.510
IRS	36	8.122	2.623	4.980	12.170

As per the results indicated by the descriptive Statistics, the mean for IRS was 8.122, a minimum of 4.98, a maximum of 12.17and standard deviation of 2.623, meaning that the data is relatively distributed around the mean. Mobile banking transactions had a mean of 107.885, with a minimum of 42.594 a maximum of 175.168 and standard deviation of 39.436. Internet banking had a mean of 0.109 ,a minimum of 0.050,a maximum 0.168 and standard deviation of 0.0327.Agency banking had a mean of 1.741,standard deviation of 0.793,minimum of 0.579 and maximum of 3.306.Automated Clearing House had a mean of 2.53,standard deviation 0.163,minimum of 2.085 and a maximum of 2.817.RTGS had a mean of 0.300,standard deviation of 0.163,Minimum of 0.117 and a maximum of 0.510 while ATMs had a mean of 8.715 ,standard deviation of 3.933,minimum of 4.182 and maximum of 25.072.All standard deviations of the predictor variables seem to be relatively distributed around their respective mean values.

Correlation Analysis

This test was done to ascertain that the relationship between outcome variable and the predictor variables is statistically significant, in order to enhance the reliability of the model. This study conducted a correlation matrix in order to test and uphold the assumption.

Table 4.2 Correlation Statistics

		Mobile Banking	Internet Banking	Agency banking	RTGS	Clearing House	Teller Machines	IRS
Mobile Banking	Pearson Correlation	1						
	Sig. (2-tailed)							
Internet Banking	Pearson Correlation	-.006	1					
	Sig. (2-tailed)	.974						
Agency banking	Pearson Correlation	.871**	-.352*	1				
	Sig. (2-tailed)	<.001	.036					

RTGS	Pearson Correlation	.984**	-.041	.845**	1		
	Sig. (2-tailed)	<.001	.812	<.001			
Clearing House	Pearson Correlation	.553**	.442**	.393*	.529**	1	
	Sig. (2-tailed)	<.001	.007	.018	<.001	.120	
Teller Machines	Pearson Correlation	-.504**	-.003	-.368*	-.514**	-.264	1
	Sig. (2-tailed)	.002	.986	.027	0.01	.120	0.005
Interest Rate Spread	Pearson Correlation	-.928**	.003	-.822**	-.913**	-.482**	.460**	1
	Sig. (2-tailed)	<.001	.984	<.001	<.001	.003	.005	

From the above table, Mobile banking Transactions(MBT) and Internet Banking Transactions(IBT), Mobile Banking Transactions and ATMs had negative correlation at -0.060 and -0.504 respectively, whereas MBT and Agency Banking, Mobile Banking Transactions and RTGS, Mobile banking transactions and Automated Clearing House had positive correlations at 0.871,0.984 and 0.553 respectively. IBT and Agency banking, IBT and RTGS, IBT and ATMs had negative correlations at -.3520, -0.041 and -0.003 respectively, while IBT and ACH had a positive correlation at 0. 442. Agency banking and RTGS, Agency banking and ACH had a positive correlation at 0.845 and 0.393 while Agency banking and ATMs had negative correlation at -0.368. RTGS and ACH had positive correlation of 0.529 while RTGS and ATMs had negative of -0.514.ACH and ATMs had negative correlation at -0.2640.

Multiple Regression Analysis

Analysis of Variance

Table 4.3 ANOVA Statistics

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	208.817	6	34.803	31.586	<.001
	Residual	31.954	29	1.102		
	Total	240.771	35			

From table 4.3 above, the F-Value is 31.586, with a p-value of <0.001 which is way lower than p-value of 0.05. This means that there is a significant difference between the means of the various variables under this

study, thus enabling the predictor variables to statistically significantly predict the dependent variable. The regression model is a good fit for the data.

Coefficient of Determination (R^2)

R^2 elaborates how much change in the outcome variable can be attributed to the change in the predictor variable. In other words, it can be said to be the percentage variation in the outcome variable (In this case, financial intermediation efficiency), that was explained by the independent variable (ACH, MBT, IBT, Agency banking and ATMs), as shown by table 4.4 below. From the results presented in table 4.4 below, Adjusted R^2 is 0. 844. This meant that, 84.4% of efficiency in the financial intermediation (represented by interest rate spread) was attributable to the five predictor variables used in the study. Only 15.6% was explained by other factors not included herein.

Table 4.4 Coefficient of Determination (R^2)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0 .931	0.867	0.844	1.034687	0.735

Regression Coefficients

Table 4.5: Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std Error	Beta	t	sig
(Constant)	12.358	3.309		3.734	<.001
Mobile Banking	-0.055	0.013	-0 .8340	-4.249	<.001
Internet Banking	-7.723	9.133	-0.0960	- 0.846	.404

Agency banking	-0.536	0.676	-0.1620	-0.793	.434
Clearing House	1.390	1.583	0.0860	0.878	.387
Teller Machines	0.002	0.053	0.0020	0.030	.976

The study conducted a multiple regression analysis in order to establish a model that is statistically significant in explaining the relationship between outcome variable and the predictor variables herein used. The regression model ($Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_{5+}$ e) was:

$Y = 12.358 + (0.055) X_1 + (7.723) X_2 + (0.536) X_3 + 1.39 X_4 + 0.002 X_5$

Where,

Y =Interest rate Spread

X_1= Mobile banking transactions

X_2= Internet banking transactions

X_3= Transactions in the PoS channels (Agency banking)

X_4= Automatic Clearing House (ACH) transactions

X_5=Bank Concentration (ATMs)

α is a constant

β_1- β_5 = Co-efficient of explanatory variables, and e=Error

From the model above , holding constant all the predictor variables, the value of interest rate spread was at 12.358.Further analysis revealed that, holding other independent variables constant, a unit increase in Mobile Banking Transactions led to 0.055 decrease in Interest Rate Spread ;a unit increase in Internet Banking Transactions at constant level of all other predictors decreased IRS with a margin 7.723;a unit increase in Agency banking with all independent variables being constant culminated into a 0.536 decrease in IRS; a unit change in Automated Clearing House holding all predictor variables constant resulted to 1.39 increase in IRS and a unit increase in ATMs volumes ended up with a 0.002 increase in IRS.

At a 5% significance level and a 95% confidence level, MBT had a significance level of <0.01, IBT had significance level of 0.404, Agency banking 0.434, ACH 0.387 and ATMs had significant value of 0. 976. At significance level of <0.01, MBT was the only significant factor influencing the outcome of financial intermediation through interest rate spread.

From the variables 'analysis results, it was established that Adjusted R^2=0.844, meaning that 84.4 % of variations in the interest rate spread can be explained/attributed to Mobile Banking Transactions, Internet Banking Transactions, Agency banking, Automated Clearing House and ATMs' volumes. This meant that only 15.6 % of the changes are related to other factors outside the study, making the model highly reliable. This in line with Aikaeli (2008), who observed that, financial intermediation efficiency in Tanzania had fairly improved in the wake of financial innovation, although some adjustments were required at some fronts. Additionally, the findings were in contrast with Chukwunulu & Ibenta (2020), whereby, the Adjusted R^2=0.57, leading to conclusion that the efficiency dictated by financial innovation was statistically insignificant.

Mobile banking transactions were found to significantly determine the outcome of the interest rate spread. Its negative relationship with the interest rate spread, spelt a positive efficiency in terms of financial intermediation. Perhaps, this positive and significant effect of mobile banking transactions could be attributed to a robust mobile network coverage, affordability of mobile phone devices and alternative mobile banking services provision platforms such as USSD and apps. Additionally, the level of convenience enhanced by mobile banking, coupled with integrated mobile wallets could be a contributing factor towards a high patronage and improved financial intermediation. This finding was partly in agreement and partly disagreed with the findings of Chukwunulu and Ibenta (2020), in whose study, they established that Mobile banking transactions had a positive effect on the efficiency of financial intermediation in Nigeria, although the effect was insignificant.

By having a negative relationship with Interest Rate Spread, agency banking contributed to improvement of financial intermediation efficiency although insignificantly due to a high p-value. Automated Clearing House and Interest Rate Spread had a positive relationship thus reducing the efficiency of financial intermediation. The relationship between ATMs' volumes and Interest Rate Spread was positive but insignificant, meaning less impact on the financial intermediation efficiency's decline. These findings on the relationship between ATMs and Interest Rate spread are supported by the findings of Chukwunulu and Ibenta (2020) in Nigeria, who concluded that the former had a positive but insignificant effect on the latter.

The study established that, Mobile banking Transactions pose a highly significant impact in the level of financial intermediation efficiency. Any single transaction done on the platform reduces the interest rate spread, thereby enhancing positively efficiency in financial intermediation. The same effects are demonstrated by Internet banking transactions although its contribution towards improving the financial intermediation efficiency is low. Agency banking, which has enhanced liquidity in most case through financial inclusion, indicated a positive contribution as far as improving financial intermediation efficiency is concerned but it's expected to significantly impact on the same in the long run. However, automated clearing House and ATMs were found to contribute towards negatively affecting financial intermediation efficiency by positively impacting on the interest rate spread. The general study was contrary to Vargas (2009) findings, who had established that, financial innovation had totally no significance in financial intermediation.

Conclusions and Recommendations

The study concluded that, Mobile banking transactions had a significant effect on the level of financial intermediation efficiency within Kenya's banking sector. Its adverse relationship with interest rate spread is a positive contribution towards improving and enhancing a sustainable financial intermediation efficiency in the long run. Mobile banking has a wider coverage, geographically and demographically. The integration of the various banking services into the mobile platforms encourages convenience, ease and user friendly experiences which encourages patronage.

Internet banking encourages improvement in the financial intermediation efficiency. It can be viewed from the perspective of integrated banking services that presents an alternative banking channel. However, its contribution is insignificant. The reasons to the latter could emanate from low patronage which could be as a result of internet data costs, perceived difficult in usage, glaring risks from online hacking which could culminate into information/financial losses, low transactions speed and constant prompts for changes in the log-in credentials.

Agency banking had a positive effect on the financial intermediation efficiency. However, its effect was insignificant. The major role played by the agency banking is related to its capability to improve liquidity through financial inclusion. The insignificant contribution of this type of innovation could be attributed to

the inadequate number of agents, low sensitization levels by the banking institutions on the reliability of the channel, patronage being inclined towards cash withdrawals and payment settlement only.

Automated Clearing House had a negative effect on the financial intermediation efficiency, although its impact was insignificant. The underlying factor behind this could be as a result of the ACH acting purely as a payment settlement innovation platform for the already banked. Its impact on savings and lending rates is negligent since it only revolves around the already existing liquidity and for the already banked economic agents.

ATMs were negative and insignificant contributor to the level of financial intermediation efficiency. Although this level of innovation is meant to provide banking services outside the banking halls, it does not support lending and savings initiation which could render it less effective in terms of financial intermediation efficiency. Additionally, most transactions done on ATMs are of withdrawal nature with few installations of deposit machines, which could create an imbalance between the two key roles of financial mobilization.

In the wake of technological advancement and tech-savvy generation, the study recommends that, the banking sector should be actively researching and developing technology based banking services continuously. Banks should carry out rigorous mass sensitization programs and campaigns in order to demonstrate the benefits and usefulness of the various alternate banking channels such as internet banking, as a marketing and promotional drive. The design of Mobile banking platforms and internet banking platforms should be done in conformance to the consumers 'requirements and expectations. Integration of the banking services into these platforms should be made in a way that culminates into one stop comprehensive financial services.

Further, the study recommends savings/deposits initiated through the alternate banking channels to attract higher interest rate margins and lending requested and advanced through the same platforms to attract lesser interest rate margins. Continuous maintenance of the alternate banking channels should regularly be done to enhance reliability. Installation of cash deposit machines in the ATMs lobbies should be considered. Training of customers on the usability of this platforms in order to ensure self-efficacy should be done. The latter can be enhanced through creation of digital centers at branch levels and campaigns through the media.

The banking sector should enhance Agency banking capacity in order to support full credit and savings services remotely. At the same time, empowerment of agency banking vendors both financially and information-wise. This should be done through trainings and settling some overheads associated with running the agency banking at agents 'level. Installation of security measures should be carried out in order to safeguard customers against information/data and financial losses.

Limitations of the Study

The study focused on the period beginning on 01st January 2012 and ending on 31st December 2020.It is during this period that the government of Kenya imposed an interest rate capping on the lending rates, precisely September 2016 to October 2019.This move had a ripple effect on the deposit rates advanced to the savers. Mostly, the interest rate spread was influenced legislatively rather that market/institutional based measures. It is during this period that most banks abolished interest rates on the savings accounts and only focused on the fixed deposits. This probably had impacted negatively on the surplus units who preferably had other investment options to channel their funds. This has posed a challenge in determining the exact influence of the various financial innovation forms, on the outcome of the financial intermediation efficiency.

The study observed various forms of financial innovation and included one control variable, whose choice was influenced by the level of control the banking sector has over it. However, operations of any banking sector is highly influenced by macro-economic factors which could include the Gross Domestic Product, exchange rates, level of inflation and competition levels from the global banking sector. Inclusion of such factors could have a significant bearing on the outcome of the dependent variable, a situation that can alter the relationship among the variables under consideration as presented by the multiple regression model.

Suggestions for Further Studies

The study sought to establish the effect of financial innovation on financial intermediation efficiency within the banking sector in Kenya. The study determined that, only mobile banking had a positive and significant effect on the financial intermediation efficiency in Kenya. The study suggests for the same nature of study to be conducted after a significant period of time (post the interest rate capping period). The reasons for the suggestion is due to the impact of the interest rate capping in Kenya that overrode the interaction of the study variables under normal market/institutional forces.

The study further suggests that, another study that entirely focusses on individual banking institutions be conducted. This study will reveal how efficient each banking institution will be and how the variables interact with each other as a competitive edge for the banks under study. The data to be considered can be primary and/or secondary.

The study also suggests for an extension of the same scope to the other subsectors of the finance sector including insurance and microfinance institutions. This will establish how efficiency of financial intermediation in those subsectors has been affected by the various innovations therein. It will also form a basis for comparison between the various subsectors in terms of innovation patronage, which will reveal alternate channels' preferences, thereby assisting the players build their competence around them.

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